mangement makes a somewhat unrealistic assumption that we are only dealing with `economic man' and not the `whole man' - the man with flesh, blood, emotions, sentiments and deep seated psychological needs. As a result the strategies that the management has adopted in dealing with an economic man have, by and large, failed in the present day context. The result is low employee commitment and loyality.

On the whole, it may be concluded from the study that to be the 'best management' workers expect an employee oriented behaviour from management rather than production centered and technical orientation to human problem. The findings of the study have practical policy implications for the management. These are the indicators of their likes and dislikes and call for measures to be taken by the management for promoting workers job satisfaction and acquiring their cooperation and confidence which is basic to greater productivity and much needed industrial peace. Accepting these expectations would make the job of management rather easy, ignoring or floating them would be risky. The study is in agreement with the conclusion of Douglas, McGregor (1967 : 34) that "if management understands its men and develops proper environment, its employees will exercise self-direction and self control in the service of the objectives, to which they are committed".

It would be erroneous not to point out that workers too have a major responsibility to share in making of a best management. Employees are expected by the management to identify themselves with the goals of their organisation, display high level of work competence and devotion to duty. A detailed probe into the nature and extent of these expectations, by systematically selecting a large sample and different job levels, may prove to be of much help in bridging the present hiatus between the labour and management.

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Productivity of Public & Private Enterprises

D.C. Vashist & T.R. Kundu

This study examines the relative performance of public and private enterprises in the organised manufacturing sector in India from 1960-61 to 1984-85. The performance is analysed in terms of total factor productivity, partial factor productivity, and the sources of growth for the net output. Evaluation is done in terms of relative efficiency at given points of time and changes in performance over a period of time. Each piece of evidence, shifts in productivity over time, productivity at a point of time, and sources of growth analysis-supports the conclusion that the public enterprises are less efficient as compared to their private counterparts.

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A number of studies assessing the relative performance of public and private enterprises in India have appeared over the last decades. From a methodological standpoint, they can be grouped under two main headings: profitability analysis, and productivity analysis of performance. The important studies judging performance in terms of financial profitability include those by Das (1967), Sri Ram and others (1976), Dubashi and Lahiri (1967), and Bhalla and Mehta (1970). However, given the fact that financial profitability is far from perfect as an indicator of overall performance, the utility of these studies is rather limited.

The significant studies assessing performance in terms of productivity are : Paranjpe (1953), Dholakia (1978), and Gupta (1982). The study by Paranjpe relates to the economy as a whole and thus seeks comparison between units with widely different attributes. Consequently, the conclusions following from it should be received with due reservations. In contrast, Gupta's study relates to only one particular industry, namely the fertilizer industry, and is, therefore, too narrow in its scope to yield reasonable generalizations about the two types of enterprises at large.

Dholakia's study constitutes a welcome departure from these two studies. The study evaluates the productivity performance of public enterprises in the registered manufacturing sector with that of comparable private enterprises. The study covers a period of 15 years, from 1960-61 to 1975-76, and reaches an important conclusion that ..... "the overall economic efficiency of the public enterprises has been more or less continuously increasing at a very rapid rate since 1960-61, whereas the economic efficiency of the private enterprises has been more or less fluctuating rather than shown any significant upward trend in the period under consideration" (p.M-8).

The findings made in Dholakia need, however, to be reconsidered in view of various deficiencies in the methodology employed therein. To begin with, Dholakia used Kendrick's arithmetic index for measuring the total factor

productivity (TFP)[1]. The index implicitly assumes a linear and homogeneous production function of degree one. Thus, besides constant returns to scale and neutral technical progress, it assumes an infinite elasticity of substitution between labour and capital which is hard to justify. Then, in deriving the index of total factor input in public and private enterprises, the weights he uses for combining the separate indices of labour and capital are not specific to the type of enterprises in question, i.e., the weights are not given by the respective relative shares of labour and capital in the corresponding net income. Rather, he used common weights for both types of enterprises, viz., the relative shares of labour and capital in the net income originating in the (entire) registered manufacturing sector. This however amounts to presuming that the production structures in the two types of enterprises are invariably the same. Similarly, he applies a common price deflator in constructing the index of real net output in public and private enterprises. The use of a common price deflator, in place of the specific ones, is however highly objectionable on the ground that pricing in public enterprises is institutionally different from that in private enterprises.

The present study makes a fresh attempt to analyse the relative performance of public and private enterprises in the registered manufacturing sector. The study covers a period of 24 years, from 1960-61 to 1984-85 for which comparable data are available. The study analyses performance in terms of TFP, productivities of labour and capital, and the sources of growth for total net output and the net output per worker.

Evaluation is done both in terms of relative efficiency at a given point of time and changes in performance over a period of time. The study comes to an important conclusion that the productivity in public enterprises is lower than in private enterprises at every point of time under consideration, indicating that the public enterprises are inherently inefficient in comparison to their private counterparts. Over time, it finds that the performance of public enterprises has worsened while that of private enterprises has improved. In contrary to Dholakia's findings, this conclusion also holds for the first 15 years of the study. This contrast between the findings of the studies, it may be noted, is attributable to their methodological differences alone.

[1] The index measures average productivity of an arithmetic combination of labour and capital with base period factor prices or factor prices relating to any other period or an average of factor prices for several periods as the fixed weights. Dholakia attempts to sidestep this shortcoming of the index by changing the arithmetic weights often and then linking them together. This, however, makes the interpretation of the index ambiguous, see Domar (1962).

Methodology

The methodology adopted in the present study is what has come to be known in the literature as the Exact Index Number Approach to measuring TFP.[2] This approach consists in assuming a certain functional form, preferably a 'flexible' one, for the producer's production function and then deriving an index number formula that is consistent (exact) with the assumed functional form[3].

Following Robert Solow (1957), we identify changes in TFP with shifts in the production function and write the period-specific production function $Y^t = f_t(L^t, K^t)$ as :

$$Y^t = f(L^t, K^t; t) \qquad (1)$$

where Y^t, L^t, K^t denote respectively net output, labour input, and capital input, all measured in real terms, in period t; and the variable t for time appears to allow for technical change, i.e., any kind of shifts in the production function.

For reasons that will be clear from below, we suppose a translog functional form[4] for (1), that is :

$$\begin{aligned} \log Y^t = {} & A_0 + A_L \log L^t + A_K \log K^t \\ & + A_t t + \frac{1}{2} A_{LL} (\log L^t)^2 \\ & + \frac{1}{2} A_{KK} (\log K^t)^2 + \frac{1}{2} A_{tt} t^2 \\ & + A_{LT} (\log L^t) t + A_{Kt} (\log K^t) t \\ & + A_{LK} (\log L^t)(\log K^t) \end{aligned} \qquad (2)$$

where A terms are the parameters of the production function.

Now if a function g(z) is quadratic in a vector of variable z, then it can be verified that the following identity is true:

$$g(z^{t+1}) - g(z^t) = \frac{1}{2}\left[\Delta_z g(z^{t+1}) + \Delta_z (z^t)\right] \left[z^{t+1} - z^t\right] \qquad (3)$$

where $\Delta_z g(z^r)$ denotes the vector of partial derivatives of g with respect to the components of z evaluated at z^r (Diewert, 1976).

[2] For an excellent survey of recent approaches to the measurement of TFP, see Diewert (1980).

[3] Examples of this approach can be found in Pollak (1971); Afriat (1972); Samuelson and Swamy (1974); Diewert (1976, 1977, 1978, 1979); Christensen, Cumming and Jorgenson (1980); Gollop and Jorgenson (1980); and Lau (1979). A rationale for adopting this approach here is that it facilitates a comparison of the present study with earlier ones which also seek to measure TFP by means of an index number formula.

[4] The translog production function was introduced by Christensen, Jorgenson and Lau (1971).

Upon noting that log Y^t defined by (2) is quadratic in log L^t, log K^t, and time t, we may apply the identity (3). If we also assume competitive profit-maximization behaviour so that

$$\left.\frac{\partial \log Y^t}{\partial \log L^t}\right|_t = S_L^t, \text{ and } \left.\frac{\partial \log Y^t}{\partial \log K^t}\right|_t = S_K^t$$

where S_L^t and S_K^t are respectively the relative shares of labour and capital in the net income at period t, then the resulting identity can be rearranged to yield:

$$\log \frac{Y^{t+1}}{Y^t} = A_t^* + \frac{1}{2}\left[S_L^{t+1} + S_L^t\right] \log \frac{L^{t+1}}{L^t} + \frac{1}{2}\left[S_K^{t+1} + S_K^t\right] \log \frac{K^{t+1}}{K^t}$$

$$\text{where } A_t^* = \frac{1}{2}\left(\left.\frac{\partial \log Y^{t+1}}{\partial t}\right|_{t+1} + \left.\frac{\partial \log Y^t}{\partial t}\right|_t\right) \quad (4)$$

or transposing terms,

$$A_t^* = \log \frac{Y^{t+1}}{Y^t} - \frac{1}{2}\left[S_L^{t+1} + S_L^t\right] \log \frac{L^{t+1}}{L^t} - \frac{1}{2}\left[S_K^{t+1} + S_K^t\right] \log \frac{K^{t+1}}{K^t} \quad (5)$$

Thus A_t^* as a difference between growth rate of output and weighted average growth rates of labour and capital inputs provides a summary measure of shift in technology, i.e., growth in TFP.[5]

Note that the right-hand side of (5) can be calculated provided that data on output, inputs and factor shares for periods t and t+1 are available.

Moreover, if all factor inputs are classified as either L or K, then the available figures always show S_L and S_K adding upto one. Since we have already assumed that factors are paid their marginal products, this, by Euler's theorem, amounts to assuming that the underlying production function, i.e., the translog production function defined by (2), is homogeneous of degree one.[6]

So, utilizing $S_L = 1 - S_K$ in (5), and rearranging terms, we have

$$\log \frac{Y^{t+1}}{Y^t} - \log \frac{L^{t+1}}{L^t} = A_t^* + \frac{1}{2}\left[S_K^{t+1} + S_K^t\right] \left[\log \frac{K^{t+1}}{K^t} - \log \frac{L^{t+1}}{L^t}\right] \quad (6)$$

This identity can be used to segregate variations in output per head due to changes in TFP from those due to changes in the availability of capital per head, i.e., due to changes in capital deepening.

Sources and Construction of Data

It follows from the above discussion of the methodology that in order to derive partial and total factor productivity indices and estimate the sources of output growth in public as well as private enterprises in the organised manufacturing sector, we require time series of the aggregates of net output (Y), labour input (L), capital input (K), relative factor share of labour (S_L) and relative factor share of capital (S_K) separately for each of the two types of enterprises covering the period from 1960-61 to 1984-85. The time series relating to none of these aggregates is, however, readily available from the existing sources in the required form for the period under consideration. We have, therefore, constructed the required data from the information mainly contained in various issues of National Accounts Statistics (NAS) and Government of India Economic Survey (GOIES).

Estimates of Output

The data on net output at current prices originating in the public enterprises are available in NAS (1976, 1979, 1981, 1986). Since the price deflator of net output specific to public enterprises is not available, we have used the implicit price deflator derived from the gross domestic product originating in the public enterprises which is available in NAS at current and constant (1960-61 base) prices. The real net output originating in the private enterprises is then obtained as the difference of the real net output originating in the registered manufacturing sector and the real net output originating in the public enterprises.

Estimates of Factor Inputs

In the case of capital input, the real net capital stock at 1960-61 prices is taken as a measure of capital input. To estimate time series of the real net capital stock, we employ a perpetual inventory method. This requires benchmark estimates of net capital stock at 1960-61 prices and real net investments separately for the public and private

[5] Note that this measure of change in TFP though equivalent to the Tornqvist (1936) discrete approximation to the continuous Divisia index (1926) measure of TFP, has been derived without making any descrete approximation to the time derivatives.

[6] Jorgenson and Lau have shown that the homogeneous translog function can provide a second-order approximation to an arbitrary twice-continuously-differentiable linear homogeneous function, i.e., the homogeneous translog functional form is 'flexible'. Thus (5) defines a 'superlative' index indeed, i.e., an index that is exact (consistent with) for a flexible aggregator functional form. For other examples of superlative index formulas, see Diewert (1976).

manufacturing enterprises for the period under consideration. The bench-mark estimate of the net capital stock in the private enterprises for the year 1960-61 is available in a Reserve Bank of India study (1972). For public enterprises, we utilize the bench-mark estimate of net capital stock for the subsequent years in each of two types of enterprises is then worked out by means of the following identity:

$$K^t = K^{t-1} + NCF^t$$

where K^t and K^{t-1} denote the real net capital stock in period t and t–1, respectively, and NCF^t denotes the real capital formation in period t. The estimates of real net capital formation in each of the two types of enterprises are obtained by deflating the respective net domestic capital formation at current prices by the implicit price index of machinery and equipment. The net capital formation at current prices in public as well as in private enterprises, and the implicit price index of machinery and equipment are available in NAS. The number of persons employed during a year is used as a measure of labour input. The estimates of the number of persons employed in the organised manufacturing sector are available separately for the public and the private enterprises in GOIES (1977-78, 1982-83, and 1985-86).

Estimates of Factor Shares

Since the factor shares for labour and capital are not available separately for the public and private enterprises, we have worked out labour share in each type of enterprises as a product of persons employed and the annual 'wage rate', assumed to be equal in the two types of enterprises. This common wage rate is simply obtained by dividing the labour compensation in the registered manufacturing sector (available in NAS) by the total number of persons employed therein: The share of capital in each type of enterprises is then obtained as a residual by subtracting the labour share from the corresponding net output at current prices. The resulting relative shares of labour and capital in the two types of enterprises are given in Appendix Tables 1 and 2.

Empirical Results

Total Factor Productivity Over Time

To examine whether there has been an improvement in TFP in the public enterprises and how do these changes compare with those in the private enterprises, indices of TFP for the two types of enterprises are presented separately in Columns (2) and (3) in Table 1.

Table 1. Indices of TFP and Relative TFP

Year	TFP		Relative TFP $0.553 \times \frac{\text{Public}}{\text{Private}}$
	Public	Private	
1960-61	1.000	1.000	0.553
1961-62	1.202	1.027	0.647
1962-63	1.332	1.026	0.718
1963-64	1.390	1.067	0.721
1964-65	1.341	1.099	0.675
1965-66	1.346	1.042	0.714
1966-67	1.248	0.916	0.753
1967-68	1.188	0.888	0.740
1968-69	1.269	0.913	0.769
1969-70	1.303	1.030	0.700
1970-71	1.223	1.008	0.671
1971-72	1.183	0.996	0.657
1972-73	1.257	1.067	0.651
1973-74	1.198	1.055	0.628
1974-75	1.323	1.046	0.700
1975-76	1.271	1.000	0.703
1976-77	1.251	1.129	0.613
1977-78	1.214	1.157	0.580
1978-79	1.194	1.234	0.535
1979-80	1.124	1.191	0.522
1980-81	1.078	1.157	0.515
1981-82	0.938	1.120	0.463
1982-83	0.980	1.172	0.462
1983-84	1.011	1.364	0.410
1984-85	1.001	1.444	0.380
Average annual growth rate (per cent)	0.00	1.73	—

Note : Estimating equation is (5).

Source : Appendix Tables 1 and 2.

A glance at Column (2) reveals that productivity in public enterprises has been fluctuating rather than showing any consistent trend during the period from 1960-61 to 1975-76, the average upward shift in productivity being 1.5 per cent per year.[7] During the remaining period, i.e., from 1976-77 to 1984-85, it exhibits an almost downward trend with an average decline of about 2.5 per cent per year. The overall result for the 24 year period shows no average shift in productivity.

On the other hand, a look at Column (3) shows that productivity in private enterprises has shown, by and large, a mild declining trend during the period from 1960-61 to 1968-69 while it has fluctuated during the rest of the period.[8] The overall result for the 24 year period is an average upward shift of 1.73 per cent per year.

[7] Note that this conclusion is in sharp contrast with that reached in Dholakia where productivity in public enterprises is reported to have shown a significant upward trend with an average shift of 4.33 per cent per year.

[8] It can be varified that the average upward shift in productivity over the period from 1960-61 to 1975-76 is 1.05 as against 0.18 per cent per year reported in Dholakia.

An adhoc splitting-up of the 24 year period into three subperiods, each of an equal duration, indicates that the performance of private enterprises has tended to improve while that of public enterprises has tended to worsen. The average rates of change in productivity in private enterprises for the subperiods: 1960-61 to 1968-69, 1969-70 to 1976-77 and 1977-78 to 1984-85 are respectively -0.53, 2.65, and 3.07 per cent per year as against 3, -0.18, and -2.18 per cent per year in the case of public enterprises.[9]

Total Factor Productivity at a Point of Time

To compare the performance of public and private enterprises at a given point of time, the indices of productivity in public relative to the private enterprises on an year to year basis are presented in Column (4) in Table 1.[10]

It is apparent from the indices that productivity in public enterprises is lower than in private enterprises in every year under consideration. Thus the evidence supports the conclusion that the public enterprises are inherently inefficient, i.e., are unable to outperform their private counterparts.

Sources of Growth for Output

We have estimated the relative contributions of the three major sources of output growth, viz., labour input, capital input, and TFP, to the observed growth in net output originating in each of the two types of enterprises. The results are presented in Table 2.

The contrast between the sets of figures for the public and private enterprises indicates that there are basic differences between the underlying production structures of the two types of enterprises. To have an idea of the relative efficiency of these two production structures, we carry out a counter factual exercise. Suppose each of the two types of enterprises had experienced the other's (average) factor shares and the average growth of TFP over the years under consideration. Given its own rates of input flows, what output rate would it have generated?

Table 2. Sources of Growth for Output

	Public	Private
1. Growth rate of output	7.66	4.88
2. Explained by labour input	4.07	0.93
3. Explained by capital input	3.56	2.21
4. Explained by total inputs	7.63	3.14
5. Residual (TFP)	0.03	1.74
6. $\frac{2}{1} \times 100$	53.16	19.06
7. $\frac{3}{1} \times 100$	45.44	45.20
8. $\frac{4}{1} \times 100$	99.60	64.26
9. $\frac{5}{1} \times 100$	0.40	35.74

Note : Estimating equation is (4).
Source : Table 1 and Appendix Tables 1 and 2.

How does this compare with the actual output rate? In the case of public enterprises, this hypothetical output rate is 9.48 which is 124 per cent of the actual rate (7.66). In private enterprises, the hypothetical output rate is 3.08 which is 63 per cent of the actual (4.88). In each case, it is thus established that the production structure in the private enterprises is more efficient than in the public enterprises.

Partial Factor Productivity Over Time

We now turn to analyse the performance of public and private enterprises in terms of partial productivities. As in the case of TFP analysis, we evaluate performance both at a given point of time and over time. The relevant indices measuring performance over time and at a given point of time are presented in Table 3.

The indices of labour productivity for public and private enterprises are presented in Column (2) and (3), respectively. A glance at these indexes reveals that labour productivity in public as well as private enterprises has rather fluctuated. However, there is a significant difference between the average growth rates of productivity obtaining in the two types of enterprises. The average annual growth of productivity in the private enterprises is 3.30 per cent which is approximately three times of 1.13 – the corresponding rate in public enterprises.

The indices of capital productivity for public and private enterprises are presented in Columns (5) and (6), respectively. The indices show that productivity in both public and private enterprises has declined. The decline, however, is more for the public enterprises, being 1.83 per cent per year as against 0.43 per cent per year for the private enterprises, indicating a relative improvement in the performance of the private enterprises.

[9] It can be argued that these conspicuous opposite trends in the performance of the two types of enterprises should, at least partly, be the result of three policy measures, each discriminating against the public enterprises and in favour of the private enterprises, which were initiated and/or pursued with a renewed vigour during the period under consideration. These are : (i) the policy of economic liberalization which has initiated with the devaluation of rupee in 1966; (ii) the policy of balanced regional development whose origin can be traced back to the Industrial Policy Resolution, 1956; and (iii) the policy of Government take over of the sick units initiated in late 70's.

[10] The index = 0.553 for the initial year, 1960-61 represents the ratio of the Kendrick indexes of TFP for the public and private enterprises for this particular year. An attempt to obtain the same through estimation of the intercept term in the translog production function had to be rejected as the input coefficients for the two types of enterprises were not found equal. Besides, the data for public enterprises exhibited a high degree of multi-collinearity.

Table 3. Indices of Partial Factor Productivity and Relative Productivity

Year	Output Per Worker			Output Per Unit Capital		
	Public	Private	Public / Private	Public	Private	Public / Private
1	2	3	4	5	6	7
1960-61	1.000	1.000	.678	1.000	1.000	.256
1961-62	1.207	1.062	.771	1.184	0.990	.303
1962-63	1.326	1.061	.848	1.355	0.988	.350
1963-64	1.386	1.106	.850	1.408	1.027	.360
1964-65	1.360	1.146	.806	1.306	1.051	.319
1965-66	1.417	1.086	.885	1.212	0.997	.313
1966-67	1.333	1.068	.847	1.085	0.839	.332
1967-68	1.292	1.059	.828	0.986	0.788	.319
1968-69	1.408	1.086	.880	1.024	0.813	.322
1969-70	1.461	1.237	.801	1.030	0.902	.292
1970-71	1.384	1.234	.761	0.954	0.857	.286
1971-72	1.322	1.241	.723	0.942	0.822	.294
1972-73	1.393	1.323	.715	1.015	0.889	.289
1973-74	1.346	1.320	.792	0.945	0.865	.280
1974-75	1.572	1.354	.788	0.975	0.816	.305
1975-76	1.508	1.326	.772	0.938	0.750	.319
1976-77	1.482	1.497	.672	0.924	0.847	.277
1977-78	1.421	1.527	.632	0.909	0.874	.266
1978-79	1.417	1.666	.577	0.878	0.902	.250
1979-80	1.372	1.645	.569	0.795	0.845	.239
1980-81	1.342	1.607	.567	0.744	0.813	.233
1981-82	1.178	1.572	.508	0.639	0.775	.210
1982-83	1.258	1.680	.508	0.651	0.791	.209
1983-84	1.307	2.034	.436	0.668	0.876	.197
1984-85	1.318	2.205	.406	0.643	0.902	.184
Average Annual Growth Rates (per cent)	1.13	3.30	—	-1.83	-0.43	—

Source: Appendix Tables 1 and 2.

Partial Productivity at a Point of Time

The set of indices measuring labour productivity in public relative to the private enterprises on year to year basis is presented in Column 4. It is clear that labour productivity in public enterprises is lower than in private enterprises at every point of time under consideration. The set of indices indicating capital productivity in public relative to private enterprises on year to year basis is given in Column (7). Clearly, capital productivity in public enterprises is much lower than in private enterprises at all points of time under consideration.

Sources of Growth for Output Per Worker

We have reckoned the relative contributions of growth in TFP and that in the availability of capital per head to the observed growth rate of output per head in each of the two types of enterprises. The results are as in Table 4.

A counterfactual exercise parallel to the one conducted earlier then yielded the following results. In public enterprises, the hypothetical growth rate of output per worker is 2.96 per cent per year which is 262 per cent of the actual rate (1.13). In private enterprises, the hypothetical growth rate of output per worker is 1.39 per cent per year which is only 36 per cent of the actual rate (3.29). Thus the results of the partial factor productivity analysis reinforce the conclusions followed from the total factor productivity analysis.

Table 4. Sources of Growth for Output Per Worker

	Public	Private
1. Growth rate of output per worker	1.13	3.29
2. Explained by TFP	0.00	1.73
3. Explained by capital depending	1.13	1.56
4. $\frac{2}{1} \times 100$	0.00	52.58
5. $\frac{3}{1} \times 100$	100.00	47.42

Note : Estimating equation is (6).
Source : Table 1 and Appendix Tables 1 and 2.

Conclusions

We have examined the relative performance of public and private enterprises in the organised manufacturing sector in India from 1960-61 to 1984-85. The performance is analysed in terms of total factor productivity, partial factor productivities, and the sources of growth for the net output and factor productivities. The total factor productivity estimates are based on a superlative index number formula and are thus free from any prior restrictions on the underlying technology. Evaluation is done in terms of relative efficiency at a given point of time and changes in performance over a period of time, productivity at a point of time, and sources of growth analysis - supports the conclusion that public enterprises are less efficient compared to their private counterparts. Finally, it must however be added that the comparison of the relative capabilities of different systems of organising production is a complex task, involving the effects of three different sets of factors, viz., system environments, policies, and system structures (Koopmans and Montias (1971), and Montias (1976)). Therefore, our results perhaps need to be qualified since besides the effects of production structures they possibly include the influences of policies and environments as well. But to allow one to control for the effects of environments and policies on outcomes in order to isolate system effects, it requires a much more detailed and specialised kind of data than are presently available.

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Appendix 1. Estimated Time Series of Net Output, Factor Inputs and Factor Shares in Public Manufacturing Enterprises

Year	Real Net Outout*	Number of Persons Employed**	Real Net Stock of Capital*	Relative Share of Labour	Relative Share Capital
1960-61	82	3.69	1063	.7817	.2183
1961-62	113	4.21	1237	.7864	.2136
1962-63	150	5.09	1434	.7846	.2154
1963-64	179	5.81	1674	.7008	.2992
1964-65	192	6.35	1905	.6849	.3151
1965-66	211	6.70	2255	.6716	.3284
1966-67	206	6.95	2460	.7287	.2713
1967-68	210	7.31	2760	.7265	.2735
1968-69	237	7.57	2998	.6861	.3139
1969-70	254	7.82	3194	.6060	.3904
1970-71	248	8.06	3367	.5957	.4043
1971-72	260	8.85	3576	.6568	.3432
1972-73	298	9.62	3805	.6208	.3792
1973-74	305	10.19	4183	.6157	.3843
1974-75	356	10.19	4732	.4934	.5066
1975-76	373	11.13	5155	.5330	.4670
1976-77	404	12.26	5666	.5037	.4963
1977-78	428	13.55	6098	.5806	.4194
1978-79	446	14.16	6584	.5863	.4317
1979-80	441	14.46	7185	.5809	.4191
1980-81	448	15.02	7802	.5680	.4320
1981-82	417	15.92	8452	.5502	.4498
1982-83	457	16.34	9089	.5040	.4960
1983-84	499	17.17	9684	.5775	.4225
1984-85	516	17.61	10402	.5844	.4156

Note : *Figures in rupees crores at constant (1960-61) prices.
**Figures in lakhs.

Source : Various issues of National Accounts Statistics and Government of India Economic Survey. (GOIES)

Appendix 2. Estimated Time Series of Net Output, Factor Inputs and Factor Shares in Private Manufacturing Enterprises

Year	Real Net Output*	Number of Persons Employed**	Real Net Stock of Capital*	Relative Share of Labour	Relative Share Capital
1960-61	989	30.20	3282	.5273	.4727
1961-62	1061	30.50	3556	.5189	.4811
1962-63	1137	32.70	3816	.5398	.4602
1963-64	1239	34.20	4003	.5331	.4669
1964-65	1354	36.10	4275	.5540	.4460
1965-66	1373	38.60	4570	.5759	.4241
1966-67	1312	37.50	5186	.5816	.4184
1967-68	1287	37.10	5418	.6255	.3745
1968-69	1345	37.80	5487	.6353	.3647
1969-70	1581	39.00	5816	.5855	.4145
1970-71	1599	39.55	6185	.6245	.3755
1971-72	1619	39.82	6531	.6314	.3686
1972-73	1779	41.04	6636	.6383	.3617
1973-74	1807	41.79	6926	.6162	.3838
1974-75	1822	41.08	7408	.5917	.4083
1975-76	1806	41.58	7982	.6380	.3620
1976-77	2042	41.65	7995	.5804	.4196
1977-78	2161	43.21	8204	.1414	.3986
1978-79	2419	44.33	8898	.5728	.4272
1979-80	2380	44.17	9343	.5709	.4298
1980-81	2392	45.45	9759	.6365	.3635
1981-82	2401	46.61	10278	.5404	.4596
1982-83	2562	46.56	10738	.5591	.4409
1983-84	2980	44.73	11279	.5485	.4514
1984-85	3193	44.21	11743	.5426	.4574

Note : *Figures in rupees crores at constant (1960-61) prices.
**Figures in lakhs.

Source : Various issues of National Accounts Statistics (NAS) and Government of India Economic Survey (GOIES).

Do not confuse bad management with destiny.

—E. Hubbard

"Creativity in a business organization cannot be ordered like breakfast at the Waldorf; instead it must be stimulated, motivated, induced."

—Roy Ash

more capable to renew itself (Argyris, 1971, Lippit, 1969), and enhance organizational health. Those organizations which lack awareness as well as the self-designed checks, if provided useful assessment and correction from time to time, might show the tendency to be less problem solving oriented, this could dissipate energies and continue to remain incapable of handling environmental threats. Their efforts remain at the low key quite often because of their sense of dependency on an outside resource (e.g., a funding organization; government backing etc.), which has a commitment to keep the dependent organization going. As a result of this support, the dependent organization continues to remain maintenance oriented, and gradually gives way to inadequacy and accompanying degeneration.

In this process, organization experiences considerable difficulty in outgrowing short-falls of dependency and invariably fails in formulating developmental strategies. Most of the organizations which are overly susceptible to aforementioned qualities and establish certain self-justifying practices are identified as government bureaucracies, university systems and public enterprises. It can be observed that the concern of such-organizations is not to what is ahead of them and facing up to the challenge, but to only satisfy the current needs. This involves coping up with the situation passively which in short means showing reactive orientation rather than proactive orientation. This style of organizational functioning, therefore, compels the organizations to be less strategically oriented. Perhaps, in this sense Khandwalla (1988) outlined a framework for organizations, equally applicable to both government and public enterprises, to bring about a needed change in its orientation.

In view of the foregoing viewpoints, a systematic assessment of internal characteristics (behavioural mostly) and quality of management practices (system characteristics mostly) would be revealing insofar as strategy orientation of public sector undertaking is concerned. In this connection some of the benchmark qualities in strategy oriented organizations could be reckoned as internal health of the system, internal capability to renew organizational energies, managerial sensitivity to development and the quality of management practices in diverse areas of organizational functioning.

Theoretically, the suggested framework of Khandwalla (1988) does not appear to be different from organizational Development (OD), but it seems to establish a base for the development of the organizational system not only from within but at the macro level. At the moment there is a total lack of conceptual framework and the supporting empirical evidence to differentiate it from the existing approaches. Therefore, it can be adequately equated with the well known approaches of developmental administration, wherein considerable work has been carried out with the emphasis on using several yardsticks of management interventions and growth oriented practices.

In a similar vein, designing of human resources system (Pareek and Rao, 1988) and building organizational capability through OD interventions Chattopadhyay, 1973 a, 1973 b) are considered to be two approaches that strongly believed in strengthening of organization from within. Hence they do not seem to share a common ground with defined characteristics of organizations presumably having proactivity for strategy orientation (Khandwalla, 1988). However, there is a need to link up "within" organization approaches with macrolevel approaches along the line where empirical data could provide an objective and conceptual base for initiating and monitoring change orientation in organization systems.

Since the theoretical framework of developmental administration is well accepted in government bureaucracies, often without empirical evidence, there is a need to establish a base for further work that could establish linkages between several behavioural processes of organization. This could be instrumental in evolving a model of developmental administration through empirical testing.

Although it is not intended in the present research to evaluate discriminating qualities of developmental administration and maintenance-oriented administration, the basic objective is to evolve some sort of evaluative criteria enabling us to make inferences about developmental orientation. With this idea in mind, internal processes of a public enterprise, especially those processes which are concerned with management practices and behavioural orientations of the system have been culled out for detailed examination. In fact, quality of management practices quite often reflect diverse system properties such as positive or negative, constraining or facilitative. Moreover, quality of management practices also depicts ethos or outlook of the organization, whether it has evolved a developmental orientation or not. If this ethos is perceived to be present in sufficient degree inferences can be made about certain key processes such as strategy orientation, (Khandwalla, 1988), internal capability for problem solving (Lippit, 1969) and the higher degree of organizational sensitivity. In a similar way motivational climate as perceived by the internal people would also suggest, readiness of people to make interventions in an attempt to keep organizations development-oriented. In a case analysis partly supported by empirical data Brahman and Pareek (1981) speculated for such a possibility of motivational readiness and its contribution to managerial growth espe-

cially to the broad spectrum of the role development of managers. It was documented that the motivational climate of organizations reflecting higher degree of affiliation and control orientations relate significantly with role development or role efficacy of the managers. Singh (1984) in a study of quality of worklife showed that the work dimensions including growth, exciting place, creative place, concern for people and democratization of work (freedom and autonomy) were perceived to be poorest. Without using a dependent variable of what motivates managerial personnel it was concluded that work dimensions provided a motivational framework for people to be involved and committed.

In a similar view, but using a leadership framework, Habibullah and Sinha (1980) noted relationship between leadership styles and motivational climate of the organization. This relationship provided a clue between motivational climate and a variety of organizational process, which essentially included quality of management practices as well. Since the above studies are isolated, a common framework needs to be suggested which could give way to further work in this direction. Therefore, the present study makes an attempt to find out how a public enterprise is perceived in terms of a set of quality of management practices and the perceived motivational climate dimensions besides identifying linkages between the two i.e, quality of management practices and motivational climate.

Methodology

Sample: Data were collected from a large-sized, multilocation public sector undertaking. The company basically manufactures watches and machine tools and has an impressive record of expansion and growth over a period of 15 years. In all 157 junior and middle managers belonging to six geographically different locations of the company responded to the questionnaire. In view of the nature of survey senior executives were excluded from the study. Out of 157 respondents 72 (64%) belonged to junior cadre of management, while 85, (54%) came from middle management rank. In the above group 96% of managers had completed more than 5 years of service and only 4% had worked in the company for less than 5 years.

Instrument: A questionnaire battery consisted of Quality of Management Practices Inventory (QMPI) and Motivational Analysis of Organization (c) (MAO-C) scale (Pareek, Rao and Pestonjee, 1981) was used. The final form of QMPI consisted of 34 items and the less pertinent items were eliminated after a systematic analysis of item content. The above set, after taking into account the content of the items, was classified into 5 piles or clusters. With varying number of items under each cluster 5 dimensions were formed as control and centralized decision-making (6 items); traditional and conservative management (4 items); adaptable and innovative management (14 items), inadequate management (5 items) and participative-nurturant management (5 items). The items of QMPI were rated on a 3 point scale indicating that "the item closely described the management-1": "the item do not definitely describe the management-2" "not sure - 3". The MAO (C) consisted of 72 items with 12 organizational dimension containing 6 items each. Based on the underlying meaning of items, 6 psychological dimensions can be tapped. In the present analysis organizational dimensions have been ignored and the 6 motivational dimensions were used, which consisted of (1) Achievement Orientation (2) Expert Influence (3) Extension Orientation (4) Control Orientation (5) Dependency Orientation and (6) Affiliation Orientation.

Data Analysis: Frequency and percentages analysis were employed to establish typical trends of managerial perception with respect to quality of management practices. Along with identifying statistically significant differences between the responses, the analysis also emphasizes presence or absence of a given management quality. This was accomplished by using one way X^2 analysis on the data excluding "Not sure" category responses. Multiple regression was performed between the item of Quality of Management Practices and motivational climate dimension after reverse scoring the items on the pattern of Job Descriptive Index (Smith, Kendall and Hulin, 1969) in which "Not sure" response category was also scored. The statement which received low score of 1 was assigned high score, and high score was given low score. The "not sure" category was kept as mid point of score.

Results: Table 1 presents frequencies, percentages and X^2 values for items grouped under the dimension of "Control and Centralized Decision Making". Chi-squares were calculated between the categories of responses that were opted by the respondents. The two categories that were evaluated referred to the perception of employees whether item closely describes the quality of management practices or definitely does not describe it. The 3rd category of "not sure" was not included in the analysis due to the obvious reason that a small percentage of people responded to this category.

It can be observed that a predominant number of respondents felt that their organization is unlike a system which is tightly controlled, autocratic, having characteristics of tough management. Hierarchical emphasis or stress on differences of status was not perceived as statistically significant. Thus, with the exception noted above, all the

items accentuated the fact that organization lacked the negative features of the management practices.

Table-1. Frequencies and Percentages of Control and Centralized Decision Making Variables

Item	Closely describes		definitely do not describe		Not Sure		X^2
	f	%	f	%	f	%	
1. Tightly controlled	51	32.3	85	53.8	20	12.7	8.50 **
2. Autocratic Management	18	11.4	103	65.2	30	19.0	59.71 **
3. Tough Management	34	21.5	90	57.0	32	20.3	25.29 **
4. Bureaucratic	55	34.8	84	53.0	18	11.4	6.05 *
5. Hierarchical emphasis (Emphasis on status difference)	58	36.7	69	43.7	29	18.4	0.95
6. Rules of thumb	16	10.1	95	60.1	44	27.8	56.22 **

** P < .001
* P < . 05

Note: X^2 is calculated between 'closely describes' and 'definitely do not describe' categories

In a similar way Table 2 reports frequency analysis and X^2 values for each item grouped under "Traditional and Conservative Management". There were only 4 items which were evaluated for significant differences between the response categories.

Table-2. Frequencies and Percentages of traditional and Conservative Management variables

Item	Closely describes		definitely do not describe		Not Sure		X^2
	f	%	f	%	f	%	
1. Conservative in business dealings	56	35.4	60	38.0	41	25.9	0.14
2. Operates on Gandhian Principles	48	30.4	69	43.7	40	25.3	3.77
3. Strong emphasis on tradition	56	35.4	70	44.3	31	19.6	1.56
4. Reward mainly Seniority/Loyalty	81	51.3	45	28.5	29	18.4	10.29 **

* P < .001

Note : X^2 is calculated between 'closely describe' and 'do not definitely describe' categories.

A close scrutiny of findings revealed that there was a significant difference only in the responses of item "Management Rewards mainly seniority/loyalty", while the remainder did not manifest any significant differences. As compared to "Reward mainly seniority/loyalty", the other items such as conservative in business dealings, operates on Gandhian Principles, strong emphasis on tradition, showed percentage responses in both the categories modestly close to each other, ranging from 30.4% to 44.3%.

With respect to Adaptable and Innovative Management, 14 items bunched together and reported statistics included frequencies, percentages and Chi-square values calculated between "closely describe" and "definitely do not describe" categories. It can be ascertained that out of 14 items 8 showed significant Chi-square values (P <.001) positively favouring the Quality of management practices being "highly successful compared to the rest of industry", "planning oriented and systematic", "Seeks stability in operation and profitability", "Production/efficiency oriented", "Progressive, dynamic", "Growth Oriented (in size)", "Technocratic Management" and "Marketing Oriented". The other items that showed X^2 values as statistically significant but indicated lack of positive qualities in the management were "Tip top efficiency", and "meritocracy". The 4 items, which failed to show significant differences included "High Profitability Oriented", "Quick in seizing opportunities", "free form, informal" and "adventurous and risk taking".

Table-3. Frequencies and Percentages of "Adaptable and Innovative Management" items

Item	Closely describes		definitely do not describe		Not Sure		X^2
	f	%	f	%	f	%	
1. Highly successful compared to the rest of industry	95	60.1	33	20.9	29	18.4	30.03 **
2. Tip top efficiency	41	25.9	81	51.3	35	22.2	13.11 **
3. High Profitability	72	45.6	55	34.8	27	17.1	2.27
4. Quick in Seizing opportunities	58	36.7	60	38.0	37	23.4	0.03
5. Planning Oriented, Systematic	101	63.9	43	27.2	12	7.6	23.36 **
6. Adventurous, risk taking	73	46.2	52	32.9	32	20.3	3.52
7. Seeks stability in operation and profit	114	72.2	22	13.9	21	13.3	62.23 **
8. Production efficiency Oriented	126	79.7	22	13.9	9	5.7	73.08 **
9. Free Form, Informal	54	34.2	41	25.9	60	38.0	1.77
10. Progressive dynamic	99	62.7	34	21.5	24	15.2	31.77 **
11. Growth Oriented (in Size)	112	70.9	28	17.7	16	10.1	50.4 **
12. Meritocracy	39	24.7	88	55.7	29	18.4	18.91 **
13. Technocratic Management	88	55.7	46	29.1	23	14.6	13.16 **
14. Marketing Oriented	106	67.1	24	15.2	27	17.1	51.72 **

** P < .001
Note: X^2 is calculated between 'closely describes' and 'definitely do not describe' categories.

Table 4 presents frequencies and Chi-squares for 5 items grouped together under the rubric of "Inadequacy of management". All the items under this head as that of the items in Table 1 were negatively worded, such as "rampant inefficiency", "much nepotism" etc. The basic focus of this analysis was to evaluate respondent's perception of the quality of management practices whether these qualities were perceived as predominantly present or absent. It was clearly noted that significantly higher number of people felt that the organizations currently do not suffer from inadequacy, commonly germinated by the negatively perceived factors portrayed in Table 4. The percentages for the absence of negative qualities ranged from 53.8 to 74.1, while the percentages for presence of aforementioned qualities ranged from 12.7 to 24.1. These differences resulted in very high X^2 values ranging from 11.91 to 68.68 ($p < .001$).

Table-4. Frequencies and Percentages of "Inadequate Management" Variable

Item	Closely describes		definitely do not describe		Not Sure		X^2
	f	%	f	%	f	%	
1. Rampant inefficiency	28	17.7	82	51.9	46	29.1	26.51 **
2. Dominated by members of a community	22	13.9	110	69.6	24	15.2	58.66 **
3. Lot of politics and intrigues	38	24.1	85	53.8	33	20.9	17.95 **
4. A failure compared to the rest of industry	20	12.7	117	74.1	19	12.0	68.68 **
5. Much nepotism	36	22.8	91	57.6	30	19.0	11.91 **

** $P < .001$

Note: X^2 is calculated between 'closely describes' and 'definitely do not describe' categories.

Table 5 reports 4 items with frequencies and X^2 values, grouped under "Participative Nurturant management". It was found that out of 4 items 2 were significant which indicated that organization was perceived to be more "democratically managed: (item 1), "decentralized" (Item 4), and "participative" (Item 5), whereas the other 2 items (i.e. "takes good care of personnel" and "tender hearted management") failed to show significant differences.

Table-5. Frequencies and Percentages of "Participative and Nurturant Management" Items

Item	Closely describes		definitely do not describe		Not Sure		X^2
	f	%	f	%	f	%	
1. Democratically managed	102	64.6	27	17.1	28	17.7	43.60 **
2. Takes good care of Personnel, paternatistic	68	43.0	60	38.0	27	17.1	0.50
3. Tender-hearted Management	74	46.8	56	35.4	27	17.1	2.49
4. Decentralized	88	55.7	48	30.4	16	10.1	11.76 **
5. Participative management	97	61.4	35	22.2	24	15.2	29.12 **

** $P < .001$

Note: X^2 is calculated between 'closely describes' and 'definitely do not describe' categories.

Table 6 reports multiple repression results between quality of management practices variable, and composite motivational climate dimensions after normalizing the score distribution of QMPI items as described above. The findings are presented in the form of percentages of variance explained by the QMP variables.

Table-6. Percentages of variance explained by QMP variables in relation to motivational climate dimension

Motivational climate dimension	Control & Centralized Decisionmaking	Traditional/ Conservative Management	Adaptable Innovation Management	Inadequate Management	Participative Nurturant Management
	(%)	(%)	(%)	(%)	(%)
1. Dependency	40.79	5.29	6.15 *	4.91	1.81
2. Extension	38.87	17.49 **	8.75 *	30.79 **	5.77
3. Achievement	40.40	15.48 **	2.58	30.93 **	11.88 **
4. Control	36.73	8.33 *	0.86	18.19 *	14.97 **
5. Affiliation	39.25	3.46	12.29 **	5.38	3.67
6. Expert influence	39.00	15.96 **	5.18	24.94 **	8.27 *

** $P < .01$
* $P < .05$

It can be observed that control and centralized decision-making, being a dimension of QMP, explained significant percentage of variance in extension, achievement, control and expert influence. Traditional-conservative management, giving emphasis to loyalty related significantly with affiliation, extension and dependency. Adaptable Innovative Management explained significant variance in extension, achievement, expert influence and control, while affiliation and dependency failed to emerge as relevant variables. Inadequate management, characterized by rampant inefficiency and political intrigues in the system related to control, achievement and expert influence. Participative Nurturant Management had significant relationship with extension and achievement.

Discussion

The quality of management practices, reflect some degree of organizational health at the level of management system and the way organization adapted itself to the environment and its various constituents. It can also be seen that such organizations which are using functional management practices are likely to use human resources most effectively, achieving not only higher level of group satisfaction and commitment, but also maintaining productivity norms at the higher level. The aforementioned characteristics as perceived by the internal members of the organization could make a public enterprise highly viable or it may set the ground for degenerating organizational culture.

The findings of the present study, though partly descriptive and partly inferential, emphasized a point of view that management practices can be evaluated with reference to 5 main composites of management practices viz; (1) Control and centralized decision making indicating controlling strategies of the organization; (2) Traditional and conservative management, reflecting a powerful emphasis on age old traditions and conventions followed in the organisation. (3) Adaptable and Innovative Management, suggesting well accepted normative behaviour and receptivity to new ideas; (4) Inadequate management implying inefficiency, degenarative politics etc., and (5) Participative-Nurturant Management signifying practices of democratic and nurturance oriented management. What has been found noteworthy in the present research was that the public enterprise under study seemed to enjoy many good features of the management practices outlined above.

More specifically, in the area of control and centralized decision-making only one disturbing characteristic emerged that showed accent of the organization more on the status and role differentiation. If it is used without feedback channels between the levels it may result in more bureaucratization and decision making by a handful of members at the higher levels of authority, alienating supervisors and first line managers. It may also lead to increased inadequacy to use entreprenuership at the lower levels. Similarly, the strong orientation to rewarding people on the basis of seniority and loyalty may necessarily block the way for developing an efficient performance appraisal system as part of an integrated human resource development (HRD) practice. While the above was perceived to be mostly true that the organization rewards mainly seniority/loyalty the other typical features of a traditional management were more or less similarly weighted.

The adaptable-innovative management was clearly perceived as a basic characteristic of the system, with few exceptions such as the tip top efficiency and meritocracy were considered to be carrying lower values in the organization. This symbolized a condition in which management success in terms of external criteria were rated to be very high, but internal processes at the same time were rated to be very low. For example, meritocracy was considered to be present by 24.7 percent while 55.7 percent of people indicated that it does not exist, yielding a X^2 value of 18.19, significant well beyond .001 level of confidence. Akin to this measure, tip-top efficiency was perceived lacking by 51.3% respondents as against 25.9% respondents, yielding a X^2 value of 13.11 (p. 001). Comparing this with one of the items of Inadequate Management being another QMP dimension it was similarly perceived i.e. if tip top efficiency is not perceived rampant inefficiency was also not perceived to be overly lacking. This broadly suggested that the public enterprises under study seem to be operating at a moderate level of functioning. In this context, several researchers have argued that an informal system seemed to have better coping strategies and developmental orientation than the rigid bureacratic structure. What is obvious in the present analysis is the finding that many people do not see the characteristic of "free form, informal" orientation in the system yet the statistically significant differences were not demonstrated.

An inadequate management was characterised as one where inefficiency prevails, politics and nepotism tarnish the internal fabric and strength of the system. Although the items of this dimension were negatively worded, higher percentages indicated that negative features were relatively absent. All the 5 Chi-squares being significant, laid emphasis on the viability of the system, indirectly confirming the findings of Adaptable and Innovative Management as discussed above. The human resource management tradition symbolizes a culture in which sharing of resources, participativeness and collaboration are the main features apart from internal HRD

practices to devise a system to inculcate the above said qualities (Pareek and Rao, 1988). With respect to QMP dimension of participative-Nurturant Management items were identified as those which are created and/or evolved by the organizational system on the one hand, and those qualities which are developed by the interaction of people on the other. In this connection, the system dependent qualities such as decentralized, democractically managed and participative management were perceived positively but respondents at the same time failed to positively evaluate the behavioural aspects reflecting nurturance. In a general way, these findings suggested that application of professional management alone is not enough, developing a culture of nurturance, tender-heartedness and caring orientation in the management is also desirable.

The relationship of quality of management practices with motivational climate signify the extent to which above said practices create or enhance dominant motivational conditions in the organization, such as, the individual felt orientation of dependency, support, achievement, control, affiliation and expert influence. Although the mean values of motivational climate failed to emphasize one single motive, there were dimensions which were more or less equally weighted viz., dependency and achievement, affiliation and expert influence. The least important or less valued were extension (support) and control dimensions. In any case what is much more relevant for the present discussion is the overall impact of QMP items under each dimension and the motivational climate dimensions. In this sense, Adaptable-Innovative Management and decentralized approaches to decision-making and lower control in the organizational system seemed to have influenced motivational climate in 4 areas equally such as extension (support) orientation, achievement orientation, control orientation and expert influence ($p < .01$). In comparison with the above participative-nurturant management and adequate management have strongly influenced extension and achievement aspects of organizational climate. Further, participative-nurturant management and also less traditional management being two dimensions of QMP seemed to have equally strongly influenced extension or help seeking and support giving traditions of the mangement practices. Similarly traditional management influenced dependency extension and affiliation orientations explaining only 6, 9, and 12 percents of variance respectively. Participative nurturant management influenced the organizational climate to be support oriented. Similarly, in an isolated manner adequate management tended to relate to control and expert influences of organizational climate.

In view of the above relationships it can be said that adaptive innovative management, decentralized decision-making and adequate management practices are greatly instrumental in developing such qualities of motivational climate as extension, achievement, control and expert influence. These attributes are responsible for making the organizational system more development oriented. The characteristics of a developmental administration are such that the system is proactive and remains in tune with the enviornment following a strategy of ongoing development. In that sense, the aforementioned QMP dimensions are most valued for their impact on the organizational culture and making up the motivational climate most relevant for development within the organizational bounds.

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Distribution Channels for India : Options, Strengths and Relevance

Mohan L. Agrawal

Channel management or management of the flow of products and services from manufacturers to centres of consumption has for long been a strategic function of marketing. This paper seeks to explain the Indian distribution channels in terms of classical marketing theories. It is in this backdrop that the paper tries to explore the marketing strategy that the manufacturers should try to evolve in an attempt to lend it the necessary competitive edge.

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Channel management or management of the flow of products and services from manufacturers or suppliers to centres of consumption, has long been regarded as a strategic function of marketing. Channels of distribution aim at adding value to the market-offerings and strike a match between customer expectations and product offerings. Further, channels of distribution render a significant mix of customer services to the consuming world. According to many marketing strategists, optimum channels mix could yield for a firm a market-winning product differentiation and leading competitive edge.

For instance, consider the following instances indicative of the developments that are taking place today in distribution marketing in India :

- Bata retail shops have begun in right earnest to utilize better its shopping space and distribution clout. The retail giant has decided to sell cosmetic items too in addition to ready-to-wear and trendy garments to its customers.
- Considerable funds are being allocated to media advertising for attracting and recruiting new dealers and retailers for a wide assortment of products - both consumer and industrial. Even well established computer organizations like HCL and Essen have gone recently for high-profile advertisements to attract dealers for their range of products, consummables and customer care.
- Park-avenue - the retail arm of Raymonds is flexing its distribution muscles, after having tasted success in metropoliton cities, for further penetration. It has planned to expand its merchandise range and widen its outlet network in the same and other cities. Many other retailers are following the route, particularly in Delhi and Bombay, in what is known as 'reverse franchising.'
- 'Computer land' in electronic products and 'QSS' in photo processing business are now established names in business. Their name tells all. They promise a new distribution culture in India.

These developments though seemingly unrelated, respond to a common theme, i.e. making products available to target customers with value added by Distributive Marketing (DM)

This paper, therefore, makes an attempt to :

(a) argue for a systems approach to distribution channels in all marketing efforts;

(b) introduce the option of vertical marketing systems (VMS) in distribution channels;

(c) build up a case for VMS distribution channels against independent distribution channels; and

(d) conclude with an assessment of channels based on empirical findings about their effectiveness.

Systems Approach to Channels

Alderson (1957) and Ridgeway (1957) are some of the early advocates of this approach. In their view, distributive marketing is like an operating system with an identifiable and distinctive pattern of behaviour.

Ridgeway (1957) observed:

> "the economic process beginning with the acquisition of resources and running through manufacturing to ultimate consumption of products, is a continuous process. In many industries, however, the economic flow is the result of the work of many other small organisations - each with a separate identity and independent legal status. Despite these individual identities, their activities must form one extended system - a fact usually ignored in the administrative and organizational theories...
>
> In short, the individual firms and its executives are part of a system much larger and more complex than traditionally assumed in the writings."

In recognition of the existence of common interests and interdependence among channel members, Drucker (1962) urged the firms to view channels as an extension of their own internal organization and abandon the conceptual blindness that the concept of separate legal entity of channels might create. The fact that a significant amount of cost is added to the products after they leave the manufacturing premises, should bosten them to treat channels as a part of their own system.

Supporting the above concept of Drucker, Mallen (1967) treated it as a step in the realization of marketing concept. Mallen averred :

> "The essence of marketing concept is, of course, consumer-orientation at all levels of marketing. It is particularly important that this orientation motivates all relations between a firm and its customers, both immediate and potential. Equally important is that it permeates the channels as well."

According to the systems approach,

1 Channels consist of interrelated components that are so structured as to produce pre-determined results. These components may include any two or more of, say, original sellers, agent middlemen, merchant middlemen, facilitating agencies, influentials in channel network and/or even the ultimate buyers.

2 Channels strive to achieve objectives - often incompatible but made mutually acceptable through the process of negotiation and accommodation. In cohesive channels, a firm thinks of itself as highly interdependent and in some cases, may achieve what may be termed as 'organic-solidarity.'

3 Channels perform sequentially in logical flows, and are open with often voluntary participation. Ordinarily, one particular member administers, initiates, coordinates controls major activities of the channel system, and in simple words, leads the channel. Fisk (1961) describing the role of a channel captain, observed:

> "Marketing channels are usually under the control of single firm, i.e. it directs the allocation of resources without interfering in any way with the objectives of members participating in the system. These decision makers do not set goals for others, but do decide what will be combined in them."

4 Channels are regulated by a code of acceptable competitive behaviour.

Obviously, the system approach believes that a channel is a purposive and rational assemblage of firms and not a mere random collection of intermediaries. It emphasises a co-operative and competitive behaviour within the system. Furthermore, channels are perceived as unique social organisations that reflect the hopes, goals and aspirations of its participants. Finally, the systems approach is a recognition of channel members as a unit of competition that broadens the concept of economic rivalry. It treats economic resources as property of the system per se.

That Indian marketeers too have realized the importance of systems approach to distribution, should be clear

from the two representative examples. The first example concerns the Larsen & Toubro, which right from its inception, treated channels as an integral part of its marketing efforts for its Switch-gear market. The L & T follows a systematic approach to select its dealers, provides them stable support and nurtures them consciously. No wonder that in 20 years its switchgears distribution is more evident than that of its competitors in the product market.

Very recently, Titan (quartz) watches Ltd. tackled a host of problems concerning the dealers, retailers and distributors for its product in India. Sensing watch dealers to be of crucial importance, it went for non-conventional dealers, trained them and provided a novel discount structure. In addition, it created its own retail outlets and franchised many others to expand the distribution base of quartz market in India. Even leaders like HMT had to follow the distribution example.

However, the above high-point of the systems approach to channels should not obscure the possibility that channels may consist of independent or idiosyncratic intermediaries. Both Alderson (1957) and McVey (1960) cautioned against this risk as a potential source of channel dis-harmony. McVey (1960) stated in what is now a marketing classic:

> "The Middleman is not a hired link in a chain forged by the manufacturer but rather an independent market the focus of a large group of customers for whom he buys : Subsequent to market analysis of his own, he selects products and suppliers, thereby setting at least one link in the channel."

In view of the strengths and weaknesses of system approach, it will be more befitting to describe channels as a 'derivative operating system.' It means that channel members are principally concerned with their survival or growth so long as it is linked with their own interest. Further, channels are not an institution that will of necessity, inspire strong loyalties among the participating system members. In the words of McVey again :

> " integrated action up and down a channel is a rare luxury in marketing. Why ? It may be that a channel of distribution is a concept that is principally academic in usage and unfamiliar to many firms selling to and through these channels.."

Finally, it should be observed that channels, as a system may be highly unstable as the configuration of members in the system may change dramatically from one period to another.

In the following section, an attempt is made to examine how a systems approach to distribution has made the vertical channels possible.

Vertical Marketing Systems : The Meaning and the Rationale

As the search for differential advantages and competitive efficiency has intensified in recent years, the importance of distributive marketing (DM) system too has gone up manifold as a controllable element of the marketing mix strategy. The application of the systems approach as stated so far, has expanded the menu of options in distribution channels.

One such option, is the vertical marketing system, VMS for short (Burley, 1974).

McCammon (1970) described the VMS as :

> "...professionally managed and centrally programmed networks pre-engineered to achieve operating economies and marketing impact. Stated alternatively, these are rationalised and capital intensive networks designed to achieve technological, managerial and promotional economies through an integration, co-ordination and synchronisation of marketing flows from the point of production to the points of ultimate use."

In VMS channels, an organizational mode of co-ordination prevails. Allocation of functions, control and operation of these channels are achieved through co-ordination and managerial authority. The phenomenon of centralised decision making in VMS has resulted, in some cases, in vertical integration. In others, it has drastically curtailed the independence of channel members.

VMs channels differ significantly from the independent market intermediaries, collectively called here, as the conventional marketing system or conventional marketing channels.

The conventional marketing system comprises "a family of traditional market intermediaries, such as, commission agents, wholesalers and independent retailers etc. functional independence and lack of co-ordination are the major hallmarks of the system, which tend to affect its overall efficiency." Apart from efficiency, the following are other major arguments for VMS channels.

> A strategic distribution programme around VMS not only ensures effective control, co-ordination and utilization of system resources, but it also helps in maintaining the core market for the firms and its

system members. The Voltas distribution network illustrates this.

VMS is a logical extension of the power-seeking activities of system members. Here relationships are far more removed from the target-market and thus, less affected by the possible disadvantages of close proximity between marketeers and consumers.

- VMS represents a natural attempt to integrate and reduce conflicts in market intermediaries. These conflicts may be detrimental in serving the market. Commenting upon the benefits of integrated channels, Palamountain (1969) said:

  "the very essence of the newer market media is the integration of a series of marketing functions which formerly were executed from both ends of the distribution chains. Both manufacturers and retailers act on the promise that distribution is a process and has to be organised such that different phases of distribution process are more and more under integrated control."

Food Specialities Ltd. (FSL) had attempted this in marketing job brand 'Maggi ! Both points-of-purchase publicity and pull marketing were combined. VMS strengthens a firm's attempts to secure anew or fringe market segment, and thus, helps raising and exploiting newer business opportunities. The mineral water segment from Parlay's is a good example of this attempt. Almost overnight, a new segment appeared for the company.

The question is : Are these VMS more efficient too in comparison with conventional channels. If yes, for what reasons? The following section endeavours an answer.

The Decline of Conventional Channels.

An extensive literature survey would reveal that independent channels suffer from a variety of conflicts and inherent frictions. These frictions raise considerably the cost of marketing operations. Although these conflicts and frictions are common to both CMS and VMS channels, VMS being integrated suffers from a lower degree of then occurance and impact. The factor of integration reinforces the ability of VMS to arrive at a least-cost mode of marketing operations.

Conventional channels face conflicts owing to following factors.

1 Structural factors;

2 Transactional factors;

3 Behavioural factors.

1. *Structural factors:* among the major structural factors are

a) *Technological indivisibilities:* It may occur any time or more particularly when two sequential activities need the same resources. The task of monitoring, allocating resources and evaluating their respective contribution may be riddled with insurmountable difficulties. It may thus create, organizational frictions. As a result, it is possible that channel systems may not use the modes of operation that are, though efficient but indivisible (Alchian and Demestz, 1972).

b) *Treat of intrasystem negotiations or bargaining in channel:* It is another source of friction. It dissuades the system members from undertaking any activity of mutual interest. Co-operative advertising is one such area that can benefit all. However independent channel members may not agree on such tricky issues as rights of use and mutual contributions. Immense mark opportunities are lost due to lack of unanimites. Textile Industry, is the sufferer of this in India.

c) *Channel Communication* is crucial and also a potential source of frictions. As the conventional channels of innumerable independent members, communication is often long, slow and poor. If the communication relates to such vital areas as environment, product innovation, government policy etc., not having right communication at the right time may prove very expensive for the market. For instance, the removal of baby picture from baby-milk power packages created a communication gap. Many dealers were unable to explain the rationale of this change to the general public, in the absence of my formal and authentic communication from manufacturer.

2. *Transactional factors*: Among transactional factors are

a) *Instability in system relations*: It refers to "Inter-period variations in the identity of system members and/or their dealing practices." This instability is more transparent in CMS channels because these channel members may not feel bound by a long term commitment to any ideology. They work almost always, for immediate trading gains. Distributors of mass-consumer items always witness this practice in India.

b) *Ceaseless search for willing channel participants*: It refers to "the continuous efforts in identifying, seeking new and willing channel participants and, working out their eventual participation in the system." The search is needed on account of instability in the channel system. Naturally, this involves considerable economic resources (Logan, 1969). The search may also lead to an imbalance in the system (Baligh and Richartz, 1968) an avoidable dislocation, of delivery system and under-utilised marketing ca-

pacities. This phenomenon became acute at the introduction and maturity phases of a new product. Here again, efforts by Titan watches are noteworthy.

c) *Variations in the monitoring mechanisms*: Considerable channel frictions arise when channel members are evaluated for rewarding or/penalising them. The monitoring mechanism is usually multidimensional. Usually the appraisals vary and result into intrasystem frictions.

3. *Behavioural factors:*

a) *Lack of Adherence to established social norms*: It is commanded by the increasing recognition of channels as an 'economic and social system' (Stern and Brown, 1969). Conventional channel members, however, work primarily for their individual benefits. There is no motivation to work otherwise. often, therefore, their working is marked by cross-purposes. For instance, adequate quality-checks and control of mass consumer products are yet to be found in their distribution in India.

b) *Heterogeneous goals of system members*: There is a wide diversity of goals in conventional channels. While some members may follow profit maximisation, others may cling to more survival by price undercutting. Voltas faced this situation some time ago in marketing its 'Appie' fruit juice.

c) *Perceptual differences in member's roles*: This is perhaps the biggest source of channel frictions. Some of the perceptual differences may stem out of an unequal availability and processing of information (Mattson, 1969). At other times, channel members may deliberately delay an optimum mode of operation if it yields more monopolistic opportunities for them. The almost boycott of Glaxo products by its wide network of dealers sometime ago is a case in point.

Channel Evaluation

An Intra-VMS Evaluation :

Figure 1 outlines types of the VMS members. While administered channels of VMS are almost similar to conventional marketing system, franchising rests on a contractural obligation between channels for performing an agreed set of functions. Corporate channels command the highest control over other channels as they are fully owned by a channel member. Further tables 1 outlines the attributes of independent channel members, franchised and corporate channels.

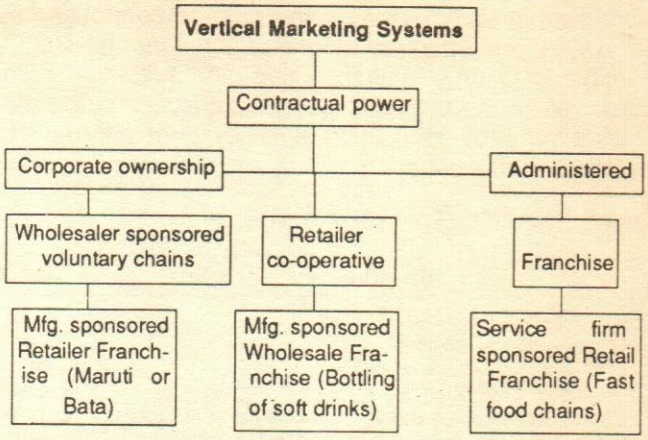

Figure 1

Table 1. Attributes of Channel System Members

Sl.	Key dimensions of Performances	Rating of Independent Channels	Franchised Channels	Corporate Channel
1.	Need of financial resources	Most	Relatively More	Least
2.	Availability of support from others	Least	Relatively More	Maximum
3.	Homogeneity in mode of operation	Least	Relatively More	Most
4.	Operational freedom	Most	Relatively More	Most
5.	Intrasystem Interaction	Least	Relatively More	Most
6.	Tendency to rely on merchandise lines	Most	Relatively Less	Least
7.	Opportunities for system negotiations	Most	Relatively Less	Not Applicable
8.	Adoption of modern skills of marketing	Least	Relatively More	Most
9.	Independent decision making	Most	Relatively Less	None at all

Inter Evaluation of Channels: Some Research Findings:

Table 2,3 and 4 summarises an empirical evaluation in regard to the independent Vs. franchised; franchised Vs. corporate; and independent Vs. corporate outlets. The purpose is to identify that channel option which is likely to fare better on the chosen indices of channel efficiency. The findings are an outcome of a research conducted in the Healthfoods in the United kingdom in 1987. The channels chosen were Independent franchise and Corporate owned dealers. The independent channel members act on their own policies and are highly individualised retailers. They have thus, no uniform distribution culture. Franchised dealer on the other hand work under a contractual obligation and perform an agreed set of functions for a franchise fee and profit. Examples are there of soft drink bottlers and apple computer services. The company-

owned channels have the highest channel control as they are owned and operated by one channel member (Mark Avenue, Bata etc.) While the independent channel members preform as individuals, the contractors corporate-channels are the application of the systems approach to distributive marketing.

Table 2. Franchised Vs. Corporate Outlets

Hypothesis or Corollary	Result
Compared with the franchised outlets, the corporate outlets will exhibit :	
I. A higher stuck turnover ratio	Rejected
II. A higher CMROI	Rejected
III. A higher perceived importance of the element success	Accepted
IV. A higher intrasystem homogeneity in the activities	Accepted
V. A higher level of introsystem contact consisting of:	
a) higher frequency of contact	Rejected
b) higher initiative in contact	Accepted
c) higher call frequency	Rejected
d) lower variability in the	
i) available contact methods	Rejected
ii) valuable do	Rejected
VI. A better quality of intrasystem communication	Rejected
VII. A lesser reliance on merchandise	
i) whole foods	Accepted
ii) supplements	Accepted
iii) herbal remedies	Accepted
iv) toiletries and cosmetics	Accepted
VIII. A greater adoption of modern marketing skills consisting of :	
i) a lower variability in the reasons for market entry	Accepted
ii) Similarity in the market competition perception	Accepted
iii) a higher provision for sales training	Rejected
iv) a higher effect of training on efficiency	Accepted

Table 3. Independent Corporate Outlets

Hypothesis or Corollary	Result
Compared with the franchised outlets, the corporate outlets will exhibit :	
I. A higher stuck turnover ratio	Rejected
II. A higher CMROI	Rejected
III. A higher perceived importance of the element success	Accepted
IV. A higher intrasystem homogeneity in the activities	Accepted
V. A higher level of introsystem contact consisting of:	
a) higher frequency of contact	Rejected
b) higher initiative in contact	Accepted
c) higher call frequency	Rejected
d) lower variability in the	
i) available contact methods	Rejected
ii) valuable do	Accepted
VI. A better quality of intrasystem communication	Rejected
VII. A lesser reliance on merchandise	
i) whole foods	Accepted
ii) supplements	Accepted
iii) herbal remedies	Accepted
iv) toiletries and cosmetics	Accepted
VIII. A greater adoption of modern marketing skills consisting of :	
i) a lower variability in the reasons for market entry	Accepted
ii) Similarity in the market competition perception	Accepted
iii) a higher provision for sales training	Rejected
iv) a higher effect of training on efficiency	Accepted

Table 4. Independent Channels Vs Franchised Outlets

Hypothesis or Corollary	Result
Compared with the franchised outlets, the corporate outlets will exhibit :	
I. A higher stuck turnover ratio	Accepted
II. A higher CMROI	Accepted
III. A higher perceived importance of the element success	Accepted
IV. A higher intrasystem homogeneity in the activities	Accepted
V. A higher level of introsystem contact consisting of:	
a) higher frequency of contact	Rejected
b) higher initiative in contact	Rejected
c) higher call frequency	Accepted
d) lower variability in the	
i) available contact methods	Rejected
ii) valuable do	Rejected
VI. A better quality of intrasystem communication	Accepted
VII. A lesser reliance on merchandise	
i) whole foods	Rejected
ii) supplements	Rejected
iii) herbal remedies	Rejected
iv) toiletries and cosmetics	Rejected
VIII. A greater adoption of modern marketing skills consisting of :	
i) a lower variability in the reasons for market entry	Rejected
ii) Similarity in the market competition perception	Accepted
iii) a higher provision for sales training	Accepted
iv) a higher effect of training on efficiency	Rejected

Conclusion

What shall a marketeer do in such a scenario of channel options? Depend upon the independent dealers and pray for the best ? Or, evolve a franchising and corporate chain of outlets and invest a vast amount of resources to develop them ? While the second alternative does appear more fascinating from the standpoint of channel control and co-ordination for serving the markets better, it is open only to few manufacturers who have got resources and willingness to do so. Besides, independent dealers can't be wished away, as they have been functioning through the changing times and culture. So, the only real alternative before marketeers is to treat channels of distribution≤whether independent or integrated, as a part of overall marketing efforts and regard them with a systems approach. The benefits of such synergy between distributors and manufacturers will be there for all to see.

The second and final question is, where do we go from here in distribution channels for India? Although the answer is very difficult to come by in certain terms, one trend is clear: It is that channels of distribution will play a major role in competitive strategies of marketeers now onwards. And in this task, VMS channels will be major performers on account of the less frictions and lower cost of marketing transactions witnessed in them.

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For Young Executives

You must be honest so that your every word is trusted. You should not be quick tempered but able to remain calm under pressure. If someone scolds you even when you have done nothing wrong, you should bear it with patience. Do not get drawn into arguments, and especially not into fights. Smile for everyone. Wherever you are, be cheerful with everyone. If someone argues with you, be patient and smile. If someone calls for you, reply; do not ignore him. If you call for someone, it should be done politely. If during the day you have too much work to do, let your colleagues do some of it for you, but always check it over yourself. If you finish all your work, go and help them who have not finished yet. Do not think in terms of "his work" or "my work". Work hard at all times.

—Tung Shu: The Chinese Almanac

District Industries Centre: The Case for Institutional Restructuring

C.S. Adhikari & Narendra Singh

The paper seeks to evaluate the role and contribution of District Industries Centre since it was created. The paper which is based on the functioning of 6 DICs of U.P. attempts to suggest remedial measures for more efficient working of these centres, after it has dwelled comprehensively over the systems and procedures of these organistions.

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District Industries Centre was created in 1978 by the Janata Government to provide an institutional base for the development of village and small industry sector. This programme sought to provide services and support to the unorganised industries under the single roof covering the urban and rural areas. After ten years of its existence it would be in order if we evaluate the facilitating role of these DICs.

Objectives, Scope and Methodology

This article attempts to document the organizational structure, functions, powers and working of DICs with a view to identifying the adequacies or otherwise of the organisational mechanisms and suggest ameliorative measures to enable DICs discharge their functions efficiently. The article is primarily based on the first hand information gathered from 5 DICs in different parts of U.P. For this the interviews were held with the General Manager and Functional Managers in each DIC. Secondary information through articles and reports etc. have also been used for the article. To be more specific the objectives of the article are :

i. To highlight various arrangements in terms of organisational structure, functions, powers of DICs and the coordination mechanism and training arrangements made at the time of DICs inception.

ii. To examine critically the working of DICs in terms of nature of schemes, systems and procedures followed in providing assistance, important schemes undertaken and linkages with financial institutions, district administration and other agencies, with a view to identifying the constraints due to which the programme suffers, and

iii. To suggest possible remedial measures.

Organisational Structure of DICs

The Directorate of Industries is the apex body headed by the Commissioner or Director of Industries, assisted by three Additional Directors of Industries at the state level. At

the regional or divisional level, it is the Joint Director who with the support of technical and financial officers looks after the working of industries department.

At the district level each DIC is headed by a General Manager (Class-I) who is supported by functional managers in different areas of which few areas may differ from district to district.

The areas are :

i. Credit
ii. Technology
iii. Khadi and Village Industries
iv. Handicrafts and Handlooms
v. Marketing and economic investigation

Two Assistant Managers and one Assistant Development Officer (ISB) look after the DICs programme at the tehsil and block level respectively. To begin with, 7 functional managers were supposed to assist the General Manager, however, later on the number of functional managers was reduced to 4-5, subject to the need of the districts.

Functions of DICs

The functions of DICs, envisaged at the time of its inception are :

a. To survey existing, traditional and new industries and raw materials and human resources; to identify schemes and undertake market forecasts for different items, to prepare sample techno-economic feasibility reports, and offer investment advice to entrepreneurs.

b. To assess the machinery and equipment requirements of small scale, tiny and village industries, to indicate the locations where machinery and equipments for different plants may be available for entrepreneurs; to liaison with research institutions and arrange for the supply of machinery on hire-purchase basis.

c. To arrange for training courses for entrepreneurs of small and tiny units and liaison with Small Industries Service Institute, the SIET Institute, and other institutions; to keep abreast of research and development in selected product lines and quality methods.

d. To ascertain the raw material requirements of various units their sources and prices, and to arrange for their bulk purchases for, and distribution to entrepreneurs.

e. To liaison with lead banks and other financial institutions, appraise applications, monitor the flow of industrial credit in the district and arrange for financial assistance to entrepreneurs.

f. To organise marketing outlets, to liasion with government procurement agencies, convey market intelligence to entrepreneurs, organise market surveys and market development programmes.

g. To give particular attention to the development of Khadi and Village Industries and other cottage industries, to liaison with the State Khadi Board and organise training programmes for rural artisans.

Looking at the above mentioned functions, it is evident that DICs are supposed to act as a guide to promote small scale and rural industries by augmenting necessary inputs, viz., technical guidance, machinery, raw material, markets, credit and training facilities through co-ordination with various institutions for the entrepreneurs.

Delegation of Powers

Responsibility and accountability, needless to say, are inherent in any office or position one holds. However, these terms bear no meaning unless they are accompanied by adequate powers. On this account, our political and administrative set-ups are plagued by lop-sided distribution of powers and DICs are no exception in this regard. General Manager, in the capacity of principal coordinator, may have three kinds of powers : administrative, financial and technical which may either be the delegated powers or the ex-officio powers. At the time of inception of DICs, it was hoped that the state governments will take immediate steps to delegate DICs most of the administrative and functional powers of the Director of Industries as well as some powers of other departments, viz., Electricity, Financial Corporation, UPSIDC and District Supply Officer etc.

Other Arrangements

Co-ordination Mechanism

For smooth coordination, a couple of inter-departmental committees have been formed. These committees will be responsible for the execution of DIC schemes. The committee headed by the District Magistrate is known as District Level Committee. This committee is represented by G.M., D.I.C. as member secretary, and people from financial institutions and banks, Joint Director (Industries) and District Development Officer/ADM (Finance) as members. This committee can sanction Integrated Margin Money Loan upto Rs.3 lakhs to entrepreneurs and can also grant capital investment subsidy.

The Chairman of this Committee (DM.) is also authorised to sanction power loads upto 25 hp. Apart from this, there is one more committee known as the Task Force Committee with General Manager (DIC) as Chairman and Manager (Credit), District Employment Officer and a nominee of the Small Industries Service Institute as members. The main function of this committee is to process the applications for self-employment schemes.

Training

In order to equip the General Manager and functional managers with up-to-date developments in their respective fields, various research training institutions conduct training programmes. The first such training course for general managers was arranged in Hyderabad and Ahmedabad. In the beginning the training programmes were related to the dissemination of the concept and policies of DIC programme, behavioural sciences and technical components of different disciplines of functional managers. Over the years, many more programmes on entrepreneurship development, decentralised planning and rural development, multiple aspects of cottage and village industries, institutional support and industrial cooperatives and effective alternatives have been taken up for training purposes.

Working of DICs

There are as many as 120 schemes pertaining to village and small scale sector as per the list issued by the Director of Industries, being implemented by the government, both under the state sector and the district sector. Of these schemes, 90 schemes are classified under the state sector and the remaining schemes under the district sector. Majority of the schemes under state sector are industry-specific and have to be implemented by the respective corporations of different industry groups, viz., leather, brassware, handlooms, handicrafts and silk and export corporations. On the other hand, the schemes under district sector could be divided into the following broad groups.

- Development of Industrial Cooperatives
- Training and development facilities to different kinds of treatment plants in Meerut, Unnao and Ghaziabad
- Glass pottery schemes (in some cities)
- Fairs and exhibitions
- DIC schemes (mainly related to loans and subsidies)
- Entrepreneurship development programmes
- Assistance to handloom cooperative societies.

Majority of these schemes do not belong to DICs in the sense that DICs have little role in the formulation and implementation of these schemes. The main focus of DICs has been to attract entrepreneurs through margin money loan schemes and subsidies, the in-built operational mechanism of which is such that banks enjoy more powers than DICs. The departmental schemes like organising fairs and exhibitions, Industrial Estates maintenance scheme and to some extent entrepreneurship development programmes have been attached relatively less importance in terms of outlays. One of the main functions of DICs is to act as a co-ordinating agency in terms of registration of entrepreneurs, recommend their project proposals to banks and other financial institutions, suppliers of raw materials, coal, cement, power, machinery and capital equipment etc.

Implementation Mechanism

In order to establish and run a small scale or tiny unit, the entrepreneur has to undergo a host of complex procedures and stages, which are :

- preparation of project report
- selection of site
- acquisition of land
- availability of credit
- procurement of machinery, equipment, raw materials, electric power and,
- marketing of the finished products.

Preparation of project report

This is a technical exercise, which the prospective entrepreneurs find bothersome to deal with. The technical back-up for the project, one wants to establish, in a theoretical framework, should primarily be given by the functional managers on their own or should get the project report prepared by the government or the private consultants. On the basis of the project report, the project can get provisional registration certificate based on which further infrastructure facilities, viz., credit, machinery, raw material, etc. can be applied for.

The execution of this whole exercise necessarily warrants a highly proficient technical cell with DICs to prepare and examine the project reports of different kinds of industries with different technologies ranging from traditional industries to hi-tech industries. But, we found in our sample districts, a good number of functional managers—fresh postgraduates, with no practical experience and specialization in their respective fields. Consequently, the project reports formulated by functional managers are invariably rejected by the banks who, in turn, get the project reports prepared by their own experts and only then finance the project. Here, on this count, the banks enjoy veto power in the sense that recovery of loan is primarily the concern of banks themselves.

Selection of Site

Two alternatives are open to the entrepreneurs to select a site for the venture one wants to start. First, the entrepreneur may establish the unit on his own land or on purchased land; second, the entrepreneur may apply for the plots and sheds developed by the UPSIDC to the General Manager on a hire-purchase basis. The acquisition of land, particularly the sold land, is again an extremely long procedural exercise and inspite of a number of officers having been appointed as Special Land Acquisition Officers, it takes many months to complete the process.

Availability of Credit

The entrepreneur having got provisional registration from DIC, routes his loan application through DIC to UPFC or commercial banks for credit requirements. The loan application form should incorporate approved project report by DIC along with information regarding land, building, plant and machinery, raw material, employment, expenditure, sales and profit and loss estimates, etc. It requires as many as 8 certificates and 14 documents to get a loan from commercial banks and UPFC respectively. UPFC sanctions loan for capital investment but the working capital has to be provided by commercial banks. There is no automatic tie-up between the UPFC and the commercial banks and each of them has its appraisal system which delays the sanction of projects.

Procurement of Other Inputs

Procurement of inputs like machinery, equipment, raw material, electricity etc. are also directly or indirectly related with DICs. In the procurement process of all these inputs, DICs recommend the requisition of different inputs to the concerned departments and agencies. The recommendations of DICs are not mandatory for the concerned departments/agencies to follow. This further erodes the authority of DICs. The DICs are authorised coal upto 100 metric tonnes from local coal dumps. They are authorised to allow Kerosene below 10 KL. In case of cement for construction of repairs of factories they make recommendations to the DSOs/DMs. The DICs are also empowered to send recommendations to the competent authorities in respect of raw materials like: molasses, cement fur, soft wood and resin, chemicals, essentiality certificate for import of machinery, equipment and raw materials, non-ferrous metals, iron and steel, paraffin wax and coal.

The authority to sanction load upto 25 hp. and 100 hp. lies with the district level and regional level committees respectively. This is subject to availability of power and material required for connecting the load. It will not be out of context to mention here, that in terms of facilitating different incentives to entrepreneurs, DIC on its own does not exercise the final authority, rather it recommends different facilities to be given to entrepreneurs to various departments and agencies.

Marketing of Finished Products

Marketing of finished products, is the most vital but most neglected aspect insofar as village and small industry development is concerned. The domain of DICs comprise both the small scale industries with investment in plant and machinery worth Rs. 35 lakh and the village industries (if we call it industry at all) with little investment covered under IRD programme. Keeping in view the coverage of DICs in terms of promotion and development of all sorts of industries, the marketing facilities thereof seem to be highly inadequate.

At present, we have three schemes, namely, store-purchase schemes, export promotion schemes, and exhibition and trade fair schemes which are directly related with marketing of finished products. Of these schemes, the first two schemes are implemented by the store-purchase section of Directorate of Industries and U.P. Export Corporation respectively. These two institutions mainly take care of the products produced in the urban centres. For industrial products produced by the rural artisans and entrepreneurs, the exhibitions and trade fairs are held which have not brought about desired incentives, mainly, because of inadequate annual budgets and institutional support at lower levels.

Constraints Identified

Looking into the working of DICs, it seems that the main focus of DICs has been on the loan and subsidy schemes to attract entrepreneurs. In this respect, as already pointed out, DICs have been made to assume the back seat behind the banks. This erosion in the status of DICs can be attributed to a number of factors, of which the lack of technical back-up and institutional framework with DICs is most important. There may be no two opinions that the banks will enjoy the ascendancy as long as the financing of project is their concern, notwithstanding the areas/sectors of the economy. However, the monopolisation of banks can be reduced to the extent that DICs also become a party in the recovery of loans and bring forward diverse, feasible, innovative and technically sound projects from entrepreneurs and get them financed through the banks. It is our firm belief that banks will not turn down foolproof sound projects particularly keeping in view the RBIs guidelines and increasing concern of the government to promote village and small scale industries.

In the implementation of other schemes referred to earlier institutions like banks, UPFC, UPSIDC, Co-operatives, Institute for Entrepreneurship Development, KVIBs, DRDA and various industry specific corporations are directly involved. In the implementation of these schemes DIC acts as a co-ordinating agency and in this capacity DICs have miserably failed primarily because DICs were never given the administrative powers and technical capabilities to uplift the stature and become effective co-ordinators. For the post-office like function of recommending various projects to various banks, departments and agencies and dissemination of some basic informations to potential entrepreneurs to help establish their projects, the present set up of DICs is more than enough, rather it could be drastically reduced to 2-3 persons affair. But then, do we have the courage to wind up the present set up of DICs? If not, why can't we re-examine the whole issue once again and / or implement the recommendations given by expert groups set up from time to time? Many evaluation studies, on the working of DICs, conducted by various institutions, viz., Comptroller and Auditor General of India, Development Commissioner, (SSI) Management Development Institute, (Gurgaon), IIM (Ahmedabad and Bangalore), PEO, (Planning Commission), Ministry of Industry, (New Delhi), Working Group on Small Scale Industries for the VIIIth Plan etc. have identified some pitfalls and extended valuable recommendations. All these studies revealed certain grey areas which could be summed as :

- Delegation of inadequate powers to G.M. of DICs
- Lack of coordination between DICs and other offices/corporations, etc. in general and banks in particular
- Lack of technical backup available with DICs
- Complex procedures in procurement of credit, machines and raw materials, etc.

The studies, undertaken till now, highlighted a host of issues concerning DICs but failed to emphasize the adequacy of institutional framework of DICs in relation to its important function to develop small scale industries. The contribution of SSI sector accounts for almost half the total industrial production and almost a quarter of the country's total exports. During the Seventh Plan it was envisaged that the production by 1990 will increase to Rs. 80,220 crores, employment to 119 lakhs and exports to Rs. 4,140 crore. Obviously, such a rapid increase in the magnitude of the sector is possible only if the institutional framework is well geared to this purpose. The institutional arrangements, at present, at the district and down below are very poor. The two Assistant Managers at the tehsil and one ADO (ISB) at the block headquarters can not be expected to cover the entire area under their jurisidiction especially when DICs are supposed to take up the task of rural industrialisation also. No need to mention that the idea to set up DICs was to provide all services and support for the development of small, tiny, village and cottage industries/ entrepreneurs right through pre-investment, investment and post-investment stages under a single-roof. Accordingly, DICs, it was envisaged, will have separate wings for looking after the special industries. But DICs, at present, have been nothing but mere extensions of Directorate of Industries and have lost their focus and become less relevant to the needs of entrepreneurs. In fact, it seems that entrepreneurs contact DICs only for registration purposes and those who do not want to avail any concession never consult DICs. Further, lack of clarity in terms of the kind of industrial activities, something the DICs should focus upon, erodes the perspective and direction, of the DICs. As a result, DICs have failed to exploit the local resources and skills through development of traditional village and cottage industries by introducing modern technology on the one hand, and help set up modern small scale industry based on inter-industry linkages and agglomeration economies in the urban or semi-urban areas on the other.

Remedial Measures

The suggestions about the working of DICs, offered by studies undertaken by various organisations mainly relate to administrative measures ranging from delegation of adequate powers to effective coordination. To be more comprehensive, the main suggestions relate to the need for :

- Ministry level steps to ensure the delegation of adequate powers
- Incentives in terms of promotions for DIC functional managers
- Systems of joint appraisal by DIC and financial institutions
- Show-rooms at zonal level for display of SSI products
- Integrated approach to plan industrial estates/areas
- Identification of industries which require no objection certificate from Pollution Control Board
- Proper offices for assistant managers at tehsil level
- Conveyance loan for field staff.

Apart from these suggestions, the first and foremost need at present is to define the jurisdiction of DICs, whether DICs are supposed to concentrate on the development of small scale industries only or they have to take up the responsibility (as it exists at present) of development of village industries and artisan based economic activities also.

Looking into the importance of rural industries vis-a-vis small scale industries it will be advisable to institute two different institutions for the development of these two sectors. At present, the Khadi and Village Industries Commission, with its boards spread over different states, is looking after the interest of rural industries more than any other institution. Recently, the scope of KVIC has been widened to include all village industries (apart from the 26 specified earlier) which involve capital investment of Rs. 15,000 per worker employed and located in villages of less than 10,000 persons. Therefore, KVIC is better suited than DICs to cater to the village and artisan based industries. The functioning of KVIBs is also far from satisfactory and needs immediate attention. Hence, the alternatives could be either to revitalise/restructure these boards or to set up an Institute for Rural Industrialisation with its wide network in the state. For small industry development, the present orgnisational set up needs complete restructuring in general and at district level and below in particular. The institution of DIC could firstly be equipped by trained and qualified technocrats and computer facilities. At the same time, one official from each department/corporation viz, UPFC, UPSIC, UPSIDC etc. which are closely associated with the development of SSIs should be located at DICs under the administrative control of the GM. Further, the GM could be delegated powers for sanctioning loans, raw material, coal and power etc. to a certain extent. For this, there should be automatic tie- up between DIC and different departments. For the sake of better management DIC could be separated into two cells, viz., District Coordination Cell and Entrepreneur Development Cell. The EDC will be manned by DIC technocrats whereas DCC will consist of responsible persons from all the departments/institutions viz., banks, district supply officer, engineer (electric), revenue officer, etc., with District Magistrate as its Chairman.

The EDC will not only extend consultancy to entrepreneurs but also conduct training programmes and complete all kinds of formalities which the entrepreneur at present is asked to do. The tehsil level functionaries main function will be to propagate the nature and scope of different schemes and to give feed back to the EDC at the district regarding the resource endowment, skills and economies of scale that are available in the area and to motivate the prospective entrepreneur to avail the opportunities offered by DICs and local environment. The TRYSEM and ISB schemes under IRDP should be taken back from DICs, so that DICs may concentrate solely on the development of small scale industries only. The GM, DICs status could be elevated to the level of an IAS officer and the functional managers under him should be technocrats drawn from different disciplines. At the same time, DICs could be given quotas of different inputs which could be assessed on the basis of the industrial needs of the district in advance on a year to year basis by different departments involved in the task of industrial development. All these measures will give DIC a new set-up which will certainly be more conducive to achieve the single window concept in a better way.

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"Anybody can cut the prices, but it takes brains to make a better article".

—Phillip D. Armous

"Scientific and humanist approaches are not competitive but supportive, and both are ultimately necessary".

—Robert C. Wood

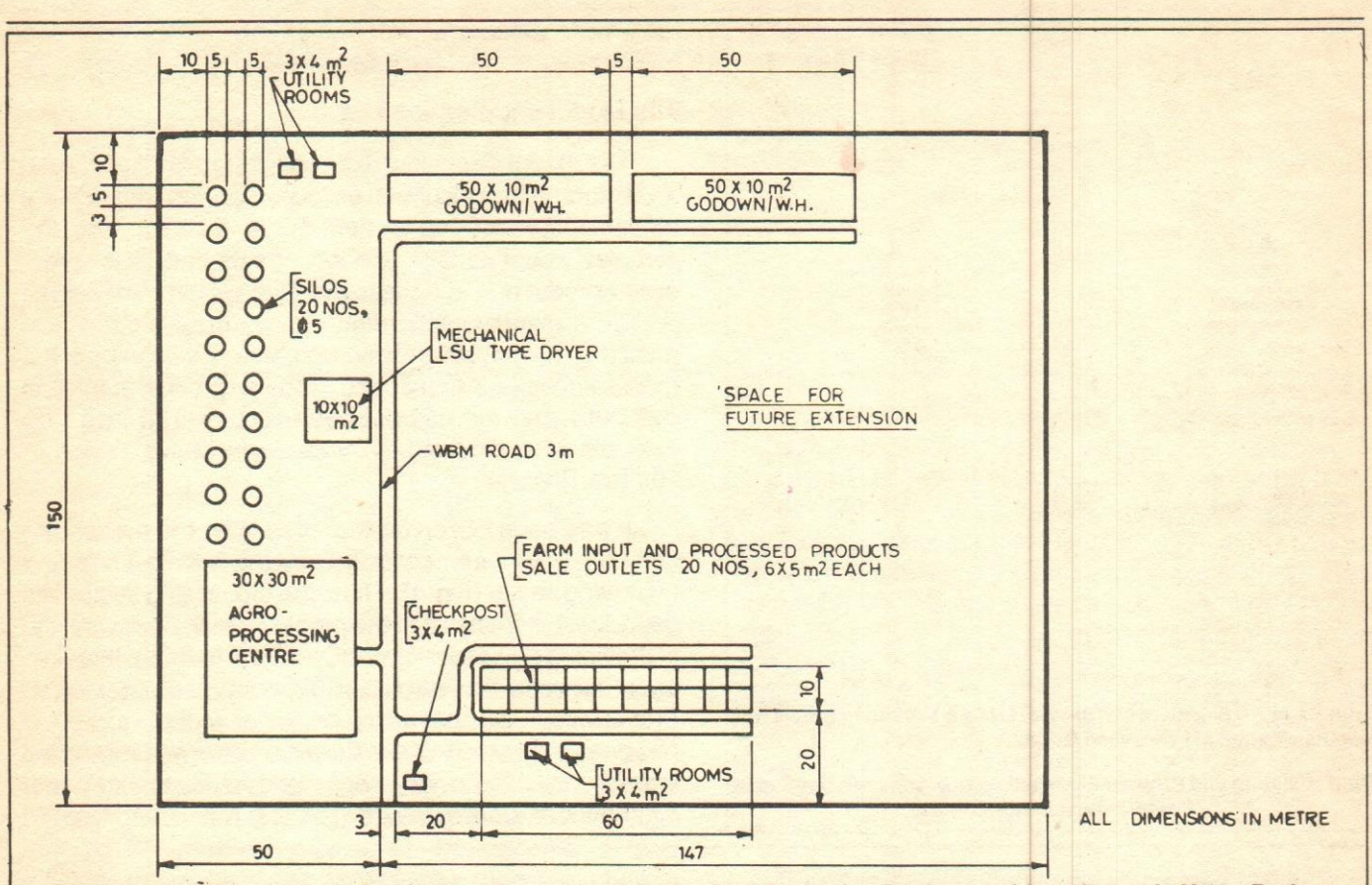

Fig. 3: Layout Plan of a Grain Storage-cum-Processing Complex for a Production Catchment of four villages in Malwa Region

model would strengthen interlinkages between R&D and growers, R&D and processing, as well as growers and processing.

Production Catchment

Storage and Processing Complex Models as suggested would be area specific. The design and service mix would vary depending upon the crops grown and demographic conditions prevailing in the specific area. For the production catchment considered here, the figures have been as under:

Population	: 8,000
No. of farming families	: 1,000
Total cultivated area	: 4,000 ha
Irrigated area	: 1,000

Agricultural production (per year); wheat (3,000 t), Bengal-gram (1,200 t), rice (200 t), sorghum (20 t), maize (20 t), soyabean (200 t), pulses other than the Bengal-gram (40 t), oilseeds (50 t), and sugarcane, coriander etc. in small quantities.

Available Storage and Processing Facilities

Most of the growers use mud bins (Kothi), gunny bags (kept in straw in a room), or underground storage structures (mostly made of cement plastered brick masonry) situated below one of the rooms of the house. There has not been any organised storage facility like a rural godown.

Processing facilities in the 4 villages have been as under:

No. of flour mills (Atta Chakki)	= 6
No. of rice hullers	= 3
No. of oil ghanis	= 1

Besides the above, there have been sugarcane crushing unit for making jaggery (2 nos.). Hence, the catchment population has been well exposed to some of the processing technologies.

Inflow-Outflow of Agri-Materials

The selected production catchment has a net surplus of wheat, Bengal-gram, Pigeonpea and soyabean. These crops are being sold to village level traders, grain markets located at Bhopal, and Urban consumers using a number of marketing channels. Among processed items, jaggery and milled rice have been the major products.

The catchment, however, buys milled pulses, edible oil, rice of different varieties, coriander (raw and processed) and spices from the nearby urban market.

Grain Storage Centre

The said complex has been designed primarily to provide facility for safe storage of food grains to the growers on custom service basis (Fig. 3). This is to prevent losses in food grains which have been occurring in traditional type of storage structure (6-7% of stored mass). Also, it would help checking distress sale of farm produce from the catchment hence, benefit farmers to earn more by releasing the stocks on price stabilization in the market. Another major function of the storage centre is to provide adequate raw materials to the processing centre of the complex for its smooth functioning all round the year.

The centre has been designed for a capacity of 3,500 tonnes (t). It is on the assumption that 50% of the winter crops of the catchment and nearly all the summer crops could be stored safely. Further, it is assumed that 2,500 t would need to be stored for smaller durations, with differences in grain type variety, lot size, quality etc. Hence, warehouse/godown type structure would be preferred here. Where as 1,000 t could be stored in hopper bottom type silo structures of 50 t capacity each (Fig. 3) metallic hopper bottom silos have been provided for grain storage in view of the following:

- meeting the requirements of larger quantities to be stored for 6-9 months of period.
- storage of raw materials for meeting the requirements of processing centre.

Provisions have been made to have 20 silos of 50 t storage capacity each. These would be prefabricated in parts and then assembled to a silo by fixing through nuts and bolts and moisture proofing material at the joints. The silos would be supported on steel columns with suitable foundation. These would be hopper bottom type in order to ensure freeflow of stored grain and allow aeration as well as easy fumigation. For loading of the silos, portable type inlined grain elevator would be used.

The godown type storage structures would ensure easy identification of lots hence, even smaller lots of gunny bags coming from small farmers could be stored for the desired period. Also unloading of smaller stocks without disturbing others would be facilitated. Two sheds of 1,250 t storage capacity each have ben provided for meeting the requirements. The design has been based on the FCI and CWC standard specifications.

The Processing Centre

For enhancing income of the farmers through value-addition in farm produce and selling value added products by them, the Processing Centre would play an important role. This would include facilities like; 1) cleaning and grading, 2) drying, 3) production of flour from cereals, 4) making 'Dalia' (wheat grits) and 'Besan' (Bengal-gram flour), 5) milling of rice, 6) production of dhal from pulse crops, 7) expelling oil from oilseeds, 8) making powders from coriander, turmeric etc., 9) chemical treatment of seeds, and 10) sealing and bagging of processed items (Figs. 2 & 3).

The Centre would provide these facilities on custom service basis. However, the centre would also take up procurement of raw materials and sale of processed items as a business enterprise of its own (Fig. 2).

Ownership

Ownership of the storage-cum-processing complex on cooperative basis could be advantageous for various aspects namely; a) maximising advantages to growers and consumers/end users, b) collective responsibility, c) diversification scope in future, and d) collective profit sharing. Though this kind of a system has vulnerability to political interferences etc. still cooperative system would be preferred because of above stated advantages (Fig. 2).

Manpower Requirement and Employment Potential

For generating the storage system, a selection staff of 1) Manager, 2) Supervisors (2 Nos.), 3) Godown Keepers (2 full time), 4) Accountant/Cashier (one), 5) Watchmen (3 nos.) and 6) material handlers (daily wage basis) would be required. The processing unit of the complex would require 1) Supervisor-cum-Foreman (one), 2) Machine operator (one), 3) Material handlers (4 nos.).

Control and Information Systems

Executive of the cooperative society would be the policy formulating body. Reports such as; 1) daily stock position, opening and closing, 2) daily cash position, opening and closing, 3) monthly reports, and 4) annual reports such as the balance sheet, profit and loss account, and cash flow statements would provide the necessary information to the concerned Govt. departments and control agencies. Controls shall also be executed through annual appraisal of employees, increments and incentives. Advance exercises on preparation of annual targets, and budgets shall also help towards exercising necessary controls.

Procurement of Raw Materials

For the Rural Grain Storage Centre of the catchment, agricultural grains would be brought by the farmers for safe storage. On weighment and quality assessment for moisture content and dockage, these would be stored in appropriate classified lots for the specified period of time (Fig. 2). However, for the agro-processing centre, adequate materials would be procured at the time of harvest and stored in silos/in lots for processing and sale. These

could be either on cash or credit terms depending upon the situations prevailing. Also grains would be procured through Grain Mandis/Markets, if the need arises for the Processing Centre. Rural Traders could also bring their stocks for the purpose of storage and processing but would need to pay more than the Growers Cooperative Members.

Marketing of the Stores Produce and the Processed Items

For marketing of the stores produce, sale could be organised at the site during peak price seasons (Fig. 2). For this, adequate information should be available with the cooperative management on prevailing prices, trends, trading area etc. in order to maximise the revenues.

For processed items, sale could be undertaken through consumer cooperative stores in urban and semi urban areas, rural shops, as well as through urban traders of processed items (Fig. 2). The cooperative management could also enter into contracts with Institutional markets like hotels, hospitals, military canteens and so on. Exercising due care to avoid losses and making adequate arrangement for quality control would be essential.

Financial Viability

The storage-cum-processing complex in the Production Catchment should be self sustaining from financial aspects. A 10% return-on-investment (ROI) could be fixed as the lower limit of performance. Calculations shown below exemplify the case for a cluster of 4 villages as a specific production catchment in Malwa region of Madhya Pradesh.

A. Land and Building	Rs.
A.1 Investment on land (200mx150m) @ Rs. 11.00 per sq. m.	3,30,000
A.2 Investment on warehouse or godown type building for 2,500 t constructed area : 1,000 m² @ Rs. 1,000 per sq. m.	10,00,000
A.3 Investment on hopper bottom silos, 50 t cap. each for 1,000 t (20 nos.) @ Rs. 350/t	3,50,000
A.4 Investment on 20 agri. inputs retail shops 6 m x 5 m each with additional 30% area as varandah @ Rs. 1,000 per sq. m.	3,90,000
A.5 Housing for agro-processing centre 200m2 @ Rs. 1,000 per sq. m. (it would also need 700 m² open area)	2,00,000
Total on buildings	19,40,000
A.6 Elect. fittings, water connections road construction, utility rooms, fencing @ 20% of building cost	3,88,000
Total (A.5) + (A.6).	23,28,000

B.Equipment and Machinery	Rs.
i. Cleaner-cum-grader 1.5 tph capacity	60,000
ii. Grain dryer-Mechanical, LSU type	2,00,000
iii. Wheat flour mill (2 nos.), capacity 1.5 g/h each driven by 7.5 KW electric motor	25,000
iv. Dhal mills (2 nos.) with polisher, CIAE design	20,000
v. Oil expeller - 6 bolt, 100 kg/h capacity, 7.5 KW electric motor operated with filter press.	60,000
vi Rice sheller, capacity 400-500 kg/h 5 KW electric motor operated	30,000
vii. Heat sealer (2 nos.)	4,000
viii. Bag sewing machine (two)	20,000
ix. Weighing balances (300 kg capacity - one, 100 kg. - one 5 kg. - one)	10,000
x. Moisture meter (portable multicrop, capacitance type)	10,000
xi. Sprayers and other insect disinfestation equipment.	30,000
xii. Seed treating machine (for chemicals)	25,000
xiii. Elevator for silos	25,000
xiv. Misc. equipment, tools and instruments	30,000
Total on equipment	5,49,000
Cost of installation @ 10% of the the equipment cost.	54,900
Grand Total on Equipment	6,03,900

C. Staff and Labour	Rs./Year
1. Manager @ Rs. 2,500/m	30,000
2. Supervisors (2nos.) @ Rs. 2,000/m	48,000
3. Accountant/Cashier @ Rs. 2,000/m	24,000
4. Supervisor-cum-Foreman @ Rs. 1,500/m	18,000
5. Machine operators - one @ Rs. 1,000/m	12,000
6. Watchmen - 3 nos. @ Rs. 750/m	27,000
7. Material handlers - 8 nos. @ Rs. 750/m	72,000
Total	2,31,000

D.Utilities	Rs.
1. Electricity (total load 40 KVA for 8 h/day and 5 KVA for 16 h/day) @ Re. 1.00 per KVA for 300 days (average weighted).	1,20,000
2. Water charges @ Rs. 200/m average	2,400
3. Fumigants (Rs/year)	4,000
4. Miscellaneous	1,000
Total	1,27,400

E. Miscellaneous office expenditure for assets	Rs.
like office furniture, almirah etc.	25,000

F. Administrative and Selling Expenses	
Stationary charges	2,000
Travelling expenses	5,000
Selling expenses	18,000
Total	23,000

G. Profitability Assessment	
1. Revenues	
i. Custom service charges for storage (weighted 2,000 t/y @ Rs. 60/t-y)	1,20,000
ii. Drying of food grains (weighted 1000 t/y for 10% moisture reduction @ Rs. 50/t) also used for dhal processing	50,000

iii. Cleaning and grading, custom service charges (for 3,000 t/y @ Rs. 70/t)	2,10,000
iv. Milling of cereals (wheat, sorghum, maize etc.) custom based (for 600 t/y @ Rs. 250/t)	1,50,000
v. Milling of Bengal-gram and pigeonpea to dhal, custom based 100 t/y. @ Rs. 1,000/t)	2,00,000
vi. Milling of paddy to rice, custom based (100 t/y, @ Rs. 250/t)	25,000
vii. Oil expelling, custom service charges (60 t/y, Rs. 1,000/t)	60,000
viii. BESAN making and packaging custom based (50 t/y. @ Rs. 500/t)	25,000
ix. Charges for seed treatment, custom based (100 t/y, @ Rs. 100/t)	10,000
x. Rentals from 20 retail shops @ Rs. 400/m per shop	96,000
xi. Sale of processed dhal, Bengalgram and pigeonpea (100 t/y @ Rs. 9,000/t)	9,00,000
xii. Sale of milled rice (50 t/y Rs. 18,000/t	3,00,000
xiv. Sale of by-products, e.g. 20 t of dhal husk, 6 t of less oil cake @ Rs. 2,000 Rs. 4,000/t, respectively	64,000
xv. Brokerage/service charges for arranging sale of food grains for 2,000 t @ Rs. 10/t	20,000
Total	23,20,000

H. Working Capital

1. Salary of staff and labour for 3 months	59,250
2. Spares and supplies	5,000
3. Electric and water charges for 3 months	30,600
4. Fumigants for 3 months	1,000
5. Stock of agri. materials for processing centre	2,00,000
6. Miscellaneous	5,000
Total	3,08,850
Say	3,10,000

I. Capital Investment

	Rs.
(Land + building + machinery+office assets+ working capital)	35,96,900
Say	35,97,000

J. Source of Finances

For cooperative ownership/operations	
1. Coop. Members	9,00,000
2. Government	9,00,000
3. Financial Institutions	17,97,000
Total	35,97,000

2. Fixed Costs (Rs/year)	Rs.
i. Depreciation on building @ 2% on Rs. 23,28,000	46,560
ii. Depreciation on machinery @ 10% per year on Rs. 6,03,900	60,390
iii. Repairs & maintenance @ 2% on building etc. and 5% on equipment	76,755
iv. Interest on loan amount @ 10% of the components of Fin. Institutions, i.e., Rs. 17,97,000	1,79,700
v. Salary of staff (fixed part)	1,38,000
vi. Interest on working capital @ 15%	46,500
vii. Administrative expenses	23,000
viii. Insurance @ 1% on Buildings, machinery and stocks	40,000
Total	6,10,905
Say	6,11,000

3. Variable Costs	
i. Wages	99,000
ii. Electric, water and other utilities	1,27,400
iii. Cost of raw material Bengalk-gram & pigeonpea 133 t/y @ Rs. 5,000/t, rice 71.5 t @ 2,750/t and oilseeds (weighted) 12 t @ Rs. 4,500/t weighted.	9,15,625
Total variable costs	11,42,025
Total fixed + Variable costs	17,53,025
Hence, profits before dividends	5,67,000

(Rs. 23,20,000 - Rs. 17,53,000)

Hence, net profits to capital investment ratio:

$$\text{ROI undiscounted} = \frac{5,67,000}{35,97,000} = 15.76\%$$

$$\text{Pay back period} = \frac{\text{Invested capital}}{\text{Profits/Year} + \text{Depreciation}}$$

$$= \frac{35,97,000}{5,67,000 + 46,560 + 60,390}$$

$$= 5.33 \text{ years}$$

Use of Surplus and Reserves

Cumulative surplus (funds) generated by the Processing complex during its course of operation could be utilised in diversification as well as vertical integration of activities. Facilities for drying and dehydration, and packaging of vegetables, production of baked products, and number of other post harvest operations could be added depending upon the funds available and confidence and expertise gained.

Creation of Rural Nucleus Industrial Base

The operation of Agro-Storage-cum-Processing Complex would open scope for activities, like repairs, maintenance, and manufacturing of different equipment/ items at rural threshold. Hence, it would encourage the local people to take up diversified activities of industrial nature. This would help in creation of strong industrial base and manpower at the rural level. It would also have long term impact for checking migration of rural people to urban areas in search of jobs.

Design For Different Regions

Under the All India Coordinated Research Project or Post Harvest Technology ICAR, work has been in progress at 10 different centres all over the country towards evolving area/catchment specific model agro-processing centres all over the country. Initially the model would have only processing component. At Central Institute of Agricultural Engineering, Bhopal and Indian Institute of Technology, Kharagpur the model Agro-Processing Centres have been successfully developed and have started functioning. These models would provide a lead for installing such centres in similar locations.

Quality Control

Quality of the finished products becomes a crucial factor for success of the enterprise and its long run profitability. Quality of the raw material and the finished products in terms of moisture content, insect infestation, adulterants etc. need to be controlled. Hence, adequate system for quality control would need to be evolved. Periodic observations, evaluation by the management would help in maintaining the quality. Proper arrangements need to be made to check insect infestation through preventive drying of crops and fumigation. Control of losses on account of attack by rodents and birds also need to be properly managed through proper arrangements.

Risk Factors and Contingencies

Agricultural products are susceptible to loss in quality and quantity through attack by insects, moulds, fungi, rodents, and birds etc., the complex may incur losses if damage due to these agencies is not prevented.

Agricultural products are high value items. Even one per cent loss of stocks because of improper weighment or pilferage would result in uneconomical operations. Hence, adequate measures need to be taken to prevent losses on these accounts. Also insurance of buildings, equipment and stocks would be essential to avoid risk of loss to property and stocks from fire hazards, floods, heavy winds, and other natural calamities. Proper functioning of equipment, machines is a key to success. Hence, the staff would need training on operation and maintenance of the machine and systems. Prices of agricultural products and finished products vary from time to time. Profitability of the centre would therefore, largely depend on the gap between these two. Hence, care needs to be taken in taking the decisions for procurement and sale at appropriate times.

Providing Vertical Linkages with 'Mandi' Operations:

Grain markets (Mandis) located in different parts of the country have been usually in operation for 4-5 months in a year. For the remaining period, they remain more or less idle. Thus, the generated income during 4-5 months of operations does not commensurate with the expenses that are to be incurred for whole of the year. To enhance the span of Mandi operations, the proposed model provides a solution through vertical integration of Mandi functioning by adding processing facilities and agricultural input retail centres.

Besides, the proposed model would help the farmers in the following ways ;

1) Provide near farm market for their produce. Hence, this would avoid their travelling to distant places for sale of farm produce, standing in queues and loss of time.

2) The proposed facility would check distress sale of farm produce since farmers could meet their immediate cash needs through loans on producing the documents of their crop stored at the storage-cum-processing complex.

Conclusions

Development and operation of area catchment production specific agro-storage-cum-processing complex appeared financially viable an enterprise for preventing losses and for value-addition to the agricultural produce at rural threshold.

The operations which could be undertaken include safe storage of food grains, cleaning and grading, milling of cereals, making dhal from grain legumes, grinding spices, rice milling, expelling oil from oil seeds, making grits, chemical treatment of seeds etc. Besides, as a service to the members of the cooperative society, sale outlets/shops would also be included at the complex. This would also give additional income to the complex as an enterprise.

The agro-storage-cum-processing complex would provide additional 15-20% income to the farmers, generated through the sale of value-added products instead of raw materials at the time of harvest, i.e., a glut situation. Also employment for skilled, semiskilled and unskilled man-power would be created for operation of the complex as well as procurement and sale.

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Punjab Agriculture: Investment in Tractors

Joginder Singh & P.S. Sidhu

A review of literature on the economic rationale of investment in farm machinery has revealed that till mid seventies the increase in productivity was attributed, to a large extent, to the use of tractor. However recent studies have pointed out that the use of tractor is becoming irrational in Punjab agriculture due to over investment in farm machinery in relation to farm size. This paper attempts to work out the cost of tractor to the farm business and spell out the activities for which it is normally used.

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The technological change which came in Punjab agriculture after the mid sixties was primarily in terms of evolution of new varieties, fertilizer use and tapping of irrigation facilities. The use of weedicides, insecticides, fungicides, micro-nutrients etc. also picked up. Not only was the use of all these inputs enough, but also the accuracy and timeliness of their application was important. Therefore, farm mechanisation was, a *sine-qua-non* for further development of agriculture.

The tractor is the basis of farm mechanisation. In Punjab, the number of tractors on farms have increased rapidly during the last 20 years. The number of tractors which was 39,798[1] during 1970-71 increased to 2,05,000 during 1987-88 in the Punjab State. On the other hand, the number of operational holdings above 10 hectares was only 73,941 (7.20%) in 1980-81. On the basis of such data, it is generally believed that the investment in tractor is uneconomical on most of the farms.

A review of literature on the economic rationale of investment in farm machinery has shown that till mid seventies the increased farm productivity was highly associated with the use of tractor. It was supported by a number of studies such as Singh & Kahlon (1973), Singh & Miglani (1976), Lal et. al. (1976) and Kahlon (1976). On the other hand, the recent studies have pointed out that use of tractor is becoming irrational in Punjab agriculture due to over investment in farm machinery in relation to farm size. Mander (1977) pointed out that investment in tractor was economically justified only on farms of 20 acres and above. The availability of excess tractor power in certain pockets of Punjab is resulting in higher cost of production. Therefore Singh et. al. (1989) stressed the need to design low horse power tractor. Therefore, this paper was attempted to work out the cost of tractor to the farm business and to spell out the activities for which it is normally used.

[1] Statistical Abstracts of Punjab

Methodology

The study was carried out in the Gurdaspur district of Punjab due to facility of data collection. Therefore, the results based on the sample cannot be generalised for the entire state, but certainly show a trend in pockets with similar agro-resource conditions elsewhere. From paddy wheat tracts of the district, 5 villages were randomly selected. The tractor population of these villages was categorized on the basis of horse power (HP). A majority of tractors were of 25 HP, 35 HP, 37 HP and 40 HP. Therefore 10 holdings operated with 25 HP tractor and an equal number of holdings with 35 HP to 40 HP were selected at random from the sample villages. The models of the tractor in both the cases were between 1976 to 1987. The results of the study would differ from farm to farm depending upon the farm size, crop pattern, model, make & HP of the tractor, type of use and maintenance of the machine. However, the synthetic situations of 25 HP tractors and of 35-40 HP tractors were developed and are discussed below.

A Profile of Respondents

The respondents selected from the Gurdaspur district belonged to the Kaler Kalan, Malikpur, Shampura, Pindori and Dhanda villages of Dhariwal, Batala, Dera Baba Nanak, Srihargobindpur and Fatehgarh Churian blocks respectively. The farm size distribution of the respondents is shown in Table 1.

Table 1 : Size distribution of operational holdings of sample respondents

25 HP tractor		35-40 HP tractor	
Farm size (ha)	No. of respondents	Farm size (ha)	No. of respondents
3-5	4	5-10	3
5-7	5	10-15	5
7-9	1	15-20	2

The farms having 25 HP tractor had operational holdings ranging from 3.2 to 7.6 hectares with an average of 5.44 hectares. On the other hand the farm operated by 35-40 HP tractor had an operational holding ranging from 6.0 to 18.8 hectares, the average for the sample being 11.64 hectares.

The entire operated area was irrigated. The cropping pattern of the sample respondents is presented in Table 2.

Paddy crop in kharif season and wheat crop in rabi season covered the major portion of the total cultivated area. The cropping intensity on farms operated with 25 HP tractor worked out to be 187.87 per cent and on farms operated with 35-40 HP tractor it was 194.33 per cent.

Table 2 : Cropping pattern of the respondents

Crop	Average area (ha) per farm 25HP tractor	35-40 HP tractor
Paddy	3.10	6.41
Kharif fodder	1.07	1.95
Sugarcane	0.25	0.76
Wheat	4.02	9.70
Berseem	0.94	2.12
Other crop	1.43	1.68
Total area	10.81	22.62

Use of Tractor

The use of tractor for different activities is presented in Table 3. On an average a 25 HP tractor worked for 301 hours per year and 35-40 HP tractor worked for 451 hours during the year. As it is clear from the table, its use is for work on the own farm, on other farms on custom hiring basis, and for performing social activities. In spite of all this, against the recommended use of 1000 hours per year, the work available for the machine is much less.

Activity-wise break-up shows that it is used mainly for ploughing i.e. more than 30% of its use is made for this purpose. For puddling its use is made to the extent of 5.98% in case of 25 HP tractor and 6.87% in case of 35-40 HP tractor. Planking operation made use of 7.69% of the total time of 25 HP tractor and 8.73% of 35-40 HP tractor. Threshing and transportation of farm inputs and products together accounted for 26.67 per cent of the time of 25 HP tractor and 40.66% of time of 35-40 HP tractor.

Table 3. The use of tractor in hours for different activities in the Gurdaspur District of Punjab, 1988-89

Activity	25 H.P. Time	% of total time spent	30-40 H.P. Time	% of total time spent
Ploughing	96 h20m	31.97	138 h56m	30.80
Puddling	18 h00m	5.98	31 h00m	6.87
Planking	23 h10m	7.69	39 h24m	8.73
Transportation of farm inputs & outputs	37 h51m	12.56	89 h13m	19.78
Threshing	39 h29m	13.11	94 h11m	20.88
Custom hiring	49 h50m	16.54	33 h50m	7.50
Other farm operations	9 h37m	3.19	7 h12m	1.60
Social work	27 h00m	8.96	17 h18m	3.84
Total	301 h17m	100.00	451 h04m	100.00

h=hours, m=minutes

The owners preferred to hire out the tractor for more time but the possibility of custom hiring was limited because of :

1. Seasonal nature of farm operations; and
2. High degree of competition between tractor owners in custom hiring market.

In spite of this, as much as 16.54 per cent of the time of 25 HP tractor and 7.50 per cent of the time of 35-40 HP tractor was utilized for working on others' farms on custom hiring basis. The other farm operations for which 3.19 per cent of time of 25 HP tractor and 1.60% of the time of 35-40 HP tractor were spent were the lifting of underground water and harrowing. Apart from the productive activities, the machine is also utilized for a number of social and religious purposes. It was worked out that during the year, 27 hours of 25 HP tractor and 17 hours 18 minutes of 35-40 HP tractor, were the time taken for performing such activities. Although, the use of tractor for social activities is made generally during the lean work load period of the machine, the depreciation cost may be higher due to its movement on the metalled roads.

Cost of Operation

In general, the farmers are ignorant of the costs of operating with an owned tractor. It includes a number of fixed costs like insurance and taxes, wages of the driver, rental value of the shed, depreciation & interest on capital. Similarly the variable costs like the cost of diesel and oil and the repair and replacement have to be considered. The average annual costs of operating with 25 HP and 35-40 HP tractors are presented in Table 4.

Table 4. Annual cost of tractor operations in the Gurdaspu District of Punjab, 1988-89

Cost item	25 H.P. (cost Rs)	% of total cost	30-40 H.P (cost Rs)	% of total cost
Cost of diesel & oil	3480.80	17.67	5293.92	19.65
Insurance & taxes	630.00	3.20	680.80	2.53
Repair & replacement	1269.50	6.45	2978.80	11.06
Imputed cost of driver	3600.00	18.28	3600.00	13.36
Rental value of shed	1656.00	8.41	1284.00	4.77
Depreciation	3045.50	15.46	4454.00	16.54
Interest on capital	6013.64	30.53	8644.44	32.09
Total annual cost	19695.44	100.00	26935.96	100.00
Cost-hour	65.37	59.72		
Expected appreciation in the value	5111.59	7347.77		
Cost/hour considering the appreciation in value	48.41	43.42		

It is interesting to note that the cost of diesel and oil which is normally considered to be the major cost accounted for only 17.67 and 19.65 per cent of the total annual cost in the case of 25 HP and 35-40 HP tractor respectively and the cost of insurance and taxes came out to 3.20 and 2.53 per cent. The repair and replacement were lower on smaller size of the tractor partly because of lesser work load and partly due to better parking sheds as compared to those of larger tractors.

The most important item of cost was the interest on the value of tractor, trolley and cultivator. The average worth of the investment in the beginning of the year worked out to be Rs. 60136.40 and Rs. 86444.40 for 25 HP and 35-40 HP tractor respectively. Considering the interest at the rate of 10% equal to the opportunity cost of investment in the bank, the cost of interest came out to be Rs. 6013.64 and Rs. 8644.44 respectively which formed more than 30 per cent of the total annual cost of tractor.

The normal working life of the tractor was taken to be 15 years. Though it seems to be on the higher side, yet by proper care and maintenance, and lesser work load, the life of 15 years is justified. After deducting the salvage value, the depreciation by straight line method was worked out. It came out to be Rs. 3045.50 (15.46% of the total cost) in case of 25 HP tractor and Rs. 4454.00 (16.43% of the total cost) in case of 35-40 HP tractor. Of course, in the real situation, the inflationary trend in prices result in rise in the value of tractor itself which has not been taken into account here. The normal rate of 8.5% hike in price of tractor can very favourably offset the expected decline in its value due to depreciation.

The tractor is mostly driven by the owner, his family member or permanent labour. Therefore, the cost of driving is generally lost sight of. But the wage of tractor driver was worked out at the market rate. Thus, it came out to be an important item of cost accounting for 18.26% of the total cost in the case of 25 HP tractor and 13.36% in the case of 35-40 HP tractor. Similarly the rental value of the shed formed higher percentage of the total cost in the case of smaller tractor, because in the real situation, the sheds constructed for this purpose were better in case of lower HP tractors as compared to those of higher HP tractors.

The total annual direct and indirect costs thus amounted to Rs. 19695.44 and Rs. 26935.96 for 25 HP and 35-40 HP tractors respectively. Dividing the annual cost by the number of hours it is put to work, the per hour cost worked out to be Rs. 65.37 in case of a 25 HP tractor and Rs. 59.72 in case of a 35-40 HP tractor. Therefore, it is clear that the former was operating at the break-even point i.e. equal to the market rate of custom hiring mainly, because of small

farms and low custom hiring possibilities in the area. The latter is, however, making profitable use of the machinery. Further if the unproductive work hours are not accounted for, the cost per hour would be still higher making the former uneconomical. But if the increase in the value of tractor as a result of increase in price at the rate of 8.5% is taken into account, the cost per hour declines to Rs. 48.41 in case of 25 HP tractor and Rs. 43.42 per hour in case of 35-40 HP tractor.

Taking in view all these considerations, it becomes justified to purchase the tractor for cultivation if the farm size is about 6 hectares, following paddy-wheat rotation and having custom hiring possibilities of 15-20% of the total work load available. Without custom hiring, a minimum of 8 hectares is essential to justify a 25 HP tractor. Under similar situations, a 35-40 HP tractor is economically justified on operational holdings' of atleast 12 hectares.

Further, the analysis was made in the average situation where the purchase of tractor was marginally justified. In the real world, the farmers having holding size less than this average and owning tractors of uneconomical power may be quite sizeable in number in the State.

Policy Implications

The study brings out that the purchase of tractor by the small farmers was economically not justified because of their use at less than optimum level. Therefore, the farmers need to be educated about the rationale of purchasing a tractor on the basis of such analysis. The institutional agencies should not encourage tractor loans to the small farmers and in the areas where the intensity of tractors is already very high. Rather, custom hiring should be encouraged in such areas. Further there is need to stress upon the farm engineers to devise small horse power tractors suitable for the small farms.

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"The Surest foundation of a manufacturing concern is quality. After that, and a long way after, comes cost".

—Andrew Carnegie

"With regard to excellence, it is not enough to know but we must try to have and use it".

—Aristotle

"If an enterprise fails to perform, we rightly hire not different workers but a new president".

—Perter F. Drucker

"Earlier, increases to productivity used to be a ritual, now they are history".

—Leeiacocca

"Wars may be fought with weapons, but they are won by men. It is the spirit of the men who follow and of the man who leads that gains the victory".

—General George S. Patton

Economics of Rice Cultivation in Assam

D.R. Kalita & R.K. Sarmah

This paper attempts to find out the economics of rice cultivation in Assam, a predominantly agricultural economy. The study conducted in Bajali Development Block tries to explore the link between rice cultivation on different sizes of farms. The paper also studies the comparative economics of different types of rice crops.

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Assam is predominantly an agricultural state with almost 80 percent of its population dependent on agriculture with rice as the major crop. To increase the standard of living of the farming community of Assam the income from rice cultivation must be increased. This study was therefore, conducted to examine the comparative economics of rice cultivation with the following specific objectives-

1) to find out the cost of rice cultivation,
2) to calculate the gross return, return to fixed farm resources and net return from rice cultivation on different sizes of farms and
3) to study the comparative economics of different types of rice crops.

Methodology

The study was conducted in Bajali Development Block during the year 1987-88. The sample for the present investigation was selected using two-stage random sampling technique. The villages formed the first stage unit and the operational holdings constituted the second and ultimate unit of sampling.

A random sample of 5 percent villages of the block resulting in a sample of 6 villages was selected. The operational holdings of each selected village, arranged in order of their sizes and distribution, transformed to obtain small (below 2.00ha), medium (2.00 to 3.3ha) and large (3.33ha and above) holdings with the help of 'Cube Root' method of optimal classification. A sample of 20 percent of the house holds was selected randomly without replacement from each of the size groups under each of the selected villages. This formed a random sample of 97 holdings comprising 40 small, 32 medium and 25 large operational holdings for this investigation.

Relevant primary data was collected from the selected households through personal interview method. An average situation representing the farming characteristics of each category of holdings was developed from the data.

The difference between the size, classes of holdings in respect of net return was examined with the help of the 't' test.

Results

Among different crop enterprises, rice occupied major portion of cultivated land in the study areas. A negligible area in comparison to the area under rice was found under other crops. The percentage of area under rice cultivation to the gross cropped area for different size groups of farm organisations is given in Table-1.

It is clear from the table that rice occupied 90.55, 88.41 and 86.32 percent of cropped area in the small, medium and large size farms, respectively. During *sali* season, local *sali* rice occupied the highest area in each of small, medium and large holdings covering 35.19, 29.22 and 30.47 percent cropped area, respectively. HYV *sali* rice occupied 18.92, 23.43 and 22.85 percent cropped area in small, medium and large holdings, respectively. In *ahu* season, local *ahu* rice was the dominant crop in all the holdings occupying 30.18, 25.44 and 22.00 percent cropped area in small, medium and large farms, respectively. HYV *ahu* rice occupied 6.31 percent cropped area in small, 10.32 percent in medium and 11.00 percent in large size holdings.

The cropping intensity decreased with the increase in farm sizes. The highest intensity was 184.18 percent in small and the lowest was 179.03 percent in large holdings.

Local Sali Rice

The expenditure incurred and returns derived from local *sali* rice in different sizes of farms are presented in Table 2. It is clear from the table that in small size farms 59.57 percent of total cost was incurred for variable inputs. The share of variable cost was 58.85 percent in medium farms and 56.82 percent in large farms. Fixed cost accounted 40.43, 41.15, 43.18 percent of total cost in small, medium and large size farms, respectively.

Table 1. Percentage of Area Under Rice Cultivation to the Gross Area

Crops	Small	Medium	Large
(a) *Sali* season			
Local *sali* rice	35.14	29.22	30.47
HYV *sali* rice	18.92	23.43	22.85
(b) *Ahu* season			
Local *ahu* rice	30.18	25.44	22.00
HYV *ahu* rice	6.31	10.32	11.00
Total area under rice	90.55	88.41	86.32
Gross cropped area	100.00	100.00	100.00
	(2.22)	(3.97)	(7.09)
Net cropped area in hectare	1.21	2.21	3.95
Cropping intensity	184.18	179.09	179.03

Figures in parentheses indicate gross cropped area in hectare

1. *Sali* season : From June/July to November/December
2. *Ahu* season : From February/March to June/July
3. *Sali* rice : Rice crops grown during the *sali* season
4. *Ahu* rice : Rice crops grown during the *ahu* season

Table 2. Cost of Cultivation of Local Sali Rice

Rs/hectare

Items	Farm Size					
	Small		Medium		Large	
	Q	V	Q	V	Q	V
A. **Variable Cost**						
1. Human Labour (Manday)						
i) Own	100.20	1503.00	80.45	1206.75	60.75	911.25
ii) Hired	17.20	264.00	35.54	533.10	52.94	794.10
2. Bullock Labour (Bullock pairdays)						
i) Own	55.33	829.95	51.34	770.10	46.13	691.95
ii) Hired	—	—	1.20	18.00	1.50	22.50
3. Machinery (Hours)	0.32	8.00	2.10	52.50	5.94	148.50
4. Seed (Kg)	47.25	141.75	45.23	135.70	44.90	134.69
5. FYM (Ton)	1.78	53.30	1.62	48.65	1.47	44.17
6. Fertilizer (Kg)		25.23		35.40		55.96
i) Nitrogen	3.25	17.65	4.64	25.20	7.35	39.91
ii) Phosphorus	0.83	6.23	1.10	8.25	1.74	13.05
iii) Potash	0.54	1.35	0.78	1.95	1.20	3.00
7. Weedicides/Pesticides		8.12		20.13		25.87
8. Interest on working capital		39.99		47.28		55.59
Total variable cost		2873.34		2867.61		2884.58
		(59.57)		(58.85)		(56.82)
B. **Fixed cost**						
1. Rental value of land, revenue & cess		1805.50		1776.20		1783.35
2. Depreciation on impliments		23.85		48.65		112.55
3. Interest on fixed capital		120.45		180.68		295.85
Total fixed cost		1949.80		2005.53		2191.75
		(40.43)		(41.15)		(43.18)
Total cost of cultivation (A+B)		4823.14		4873.14		5076.33
		(100.00)		(100.00)		(100.00)
Gross returns		4725.70		4982.50		5525.45
Returns to fixed farm resources		1852.36		2114.89		2640.87
Net returns		-97.44		109.36		449.12
Benefit-cost ratio		1:1.02		1:0.98		1:0.92

Figures in parentheses indicate percentage. Q: Quantity V: Value in Rs.

The total cost of cultivation per hectare was Rs. 4823.14 in small, Rs. 4873.14 in medium and Rs. 5076.33 in large farms. Thus as the farm size increased the total costs also increased.

The returns from the crops indicated that both the gross returns and returns to fixed farm resources increased with the increase in farm size. The net return per hectare was negative for small farms and positive for medium and large size farms. The benefit-cost ratio increased with the increase in farm size.

The differences in net return per hectare within the various size groups were tested by computing 't' values. The 't' value for the difference between small and medium holdings was 3.4258, between medium and large 4.8245 and between small and large 12.2368. These values indicated that farm groups were significantly different from each other in respect of net returns.

The 't' values for the difference between small and medium farms in respect of net return was 3.1075, between medium and large 5.7642 and between small and large was 14.3755. These indicated that the different sizes of holdings were significantly different from each other in respect of net returns.

Local Ahu Rice

Table 4 shows the expenditures and returns from local *ahu* rice cultivation in different categories of farms. It is observed from the table that the variable cost accounted 65.21, 64.43 and 62.92 percent and fixed cost accounted 34.79, 35.57 and 37.08 percent of total costs of cultivation in small, medium and large farms, respectively. The total cost per hectare increased with the increase in holding sizes with Rs. 3810.78 in small, Rs. 3899.53 in medium and Rs. 41110.50 in large farms.

HYV Sali Rice

Costs and returns from HYV *sali* rice for different size groups are shown in Table 3.

It is clear from the table that in the case of HYV *sali* rice the percentage of variable cost to the total cost of production was higher than that of local *sali* rice in all the farms. It was 60.51, 59.49 and 57.42 percent in small, medium and large farms, respectively. The percentage of fixed cost was found to be 39.49, 40.51 and 42.58 of total costs in small, medium and large farms, respectively. The total cost of cultivation per hectare was Rs. 5144.85 in small, Rs. 5157.51 in medium and Rs. 5325.31 in large size farms. Both the fixed cost and total cost of cultivation per hectare were positively related to farm sizes while the variable cost was negatively related to the holding sizes.

The gross returns and returns to fixed farm resources were positive and increased with the increase in farm sizes. Benefit-cost ratio increased with the increase in the size of holdings.

Table 3. Cost of Cultivation of HYV Sali Rice

Rs/hectare

Items	Farm Size					
	Small		Medium		Large	
	Q	V	Q	V	Q	V
A. **Variable Cost**						
1. Human Labour (Manday)						
i) Own	108.52	1627.80	87.44	1311.60	64.78	971.70
ii) Hired	19.57	293.55	38.59	578.85	55.53	832.95
2. Bullock Labour (Bullock pairdays)						
i) Own	59.29	889.35	53.97	809.55	49.11	736.65
ii) Hired	-	-	-	-	1.2	18.00
3. Machinery (Hours)	0.37	9.25	2.34	58.50	6.10	152.50
4. Seed (Kg)	47.17	141.51	44.08	132.29	43.49	130.46
5. FYM (Ton)	1.96	58.76	1.81	54.20	1.77	52.95
6. Fertilizer (Kg)		34.82		45.66		72.77
i) Nitrogen	4.32	23.46	5.48	29.76	8.92	48.44
ii) Phosphorus	1.25	9.36	1.75	13.13	2.85	21.38
iii) Potash	0.80	2.00	1.11	2.77	1.18	2.95
7. Weedicides/Pesticides		14.70		26.62		30.42
8. Interest on working capital		43.57		50.83		59.43
Total variable cost		3113.31 (60.51)		3068.05 (59.49)		3057.83 (57.42)
B. **Fixed cost**						
1. Rental value of land, revenue & cess		1882.45		1851.60		1843.78
2. Depreciation on impliments		26.35		51.52		124.80
3. Interest on fixed capital		122.74		186.34		298.90
Total fixed cost		2031.54 (39.49)		2089.46 (40.51)		2267.48 (42.58)
Total cost of cultivation (A+B)		5144.85 (100.00)		5157.51 (100.00)		5325.31 (100.00)
Gross returns		5264.85		5490.65		6050.50
Returns to fixed farm resources		2151.54		2422.60		2992.57
Net returns		120.00		333.14		725.19
Benefit-cost ratio		1:0.98		1:0.94		1:0.88

Figures in parentheses indicate percentage. Q: Quantity, V: Value in Rs.

The gross return per hectare was directly related to farm sizes. Though the returns to fixed farm resources was positive and increased with the increase in farm sizes, the net return per hectare was negative in all the size groups of farms. Benefit-cost ratio increased with the increase in farm sizes.

The 't' value for the difference between small and medium farms in respect of net returns was 1.0275, between medium and large 1.0242 and between small and large was 1.4876. These indicated that the categories of holdings were not different in respect of net return.

HYV Ahu Rice

The figures presented in Table 5 reveal that the share of variable cost to the total cost of cultivation of HYV *ahu* rice per hectare was 66.43 percent in small, 65.12 percent in medium and 62.91 percent in large sized farms. Fixed cost accounted 33.57, 34.88 and 37.09 percent of total cost of cultivation in small, medium and large farms, respectively. The total cost per hectare was Rs. 4062.49 in small farms, Rs. 4122.00 in medium farms and Rs. 4251.23 in large size farms. This showed an increase in total cost with the increase in farm sizes.

Table 4. Cost of Cultivation of Local Ahu Rice

Rs/hectare

Items	Farm Size					
	Small		Medium		Large	
	Q	V	Q	V	Q	V
A. **Variable Cost**						
1. Human Labour (Manday)						
i) Own	90.35	1355.25	80.84	1212.60	70.58	1058.70
ii) Hired	7.04	105.60	16.10	241.50	24.31	364.65
2. Bullock Labour (Bullock pairdays)						
i) Own	48.00	720.00	46.38	695.70	43.67	655.05
ii) Hired	-	-	-	-	-	-
3. Machinery (Hours)	-	-	2.16	54.00	7.49	187.25
4. Seed (Kg)	77.13	231.40	76.75	230.24	74.89	224.68
5. FYM (Ton)	1.02	30.46	0.95	28.63	0.93	27.83
6. Fertilizer (Kg)		6.38		7.40		17.46
i) Nitrogen	0.85	4.62	0.94	5.10	2.34	12.71
ii) Phosphorus	0.21	1.58	0.28	2.10	0.58	4.35
iii) Potash	0.07	0.18	0.08	0.20	0.16	0.40
7. Weedicides/Pesticides		3.04		5.27		8.18
8. Interest on working capital		32.91		37.14		42.50
Total variable cost		2485.04		2512.48		2586.30
		(65.21)		(64.43)		(62.92)
B. **Fixed cost**						
1. Rental value of land, revenue & cess		1201.35		1188.45		1182.60
2. Depreciation on impliments		12.85		32.75		68.85
3. Interest on fixed capital		111.54		165.45		272.75
Total fixed cost		1325.74		1386.65		1524.20
		(34.79)		(35.57)		(37.08)
Total cost of cultivation (A+B)		3810.78		3899.53		4110.50
		(100.00)		(100.00)		(100.00)
Gross returns		3040.75		3162.60		3395.55
Returns to fixed farm resources		555.71		650.12		809.25
Net returns	-	770.03	-	736.93	-	714.95
Benefit-cost ratio		1:1.25		1:1.23		1:1.21

Figures in parentheses indicate percentage. Q: Quantity, V: Value in Rs.

The gross return was Rs. 3152.45 in small farms, Rs. 3305.80 in medium farms and Rs. 3810.65 in large farms. Though the returns to fixed farm resources was positive and increased with the increase in farm sizes, the net return per hectare was negative in all the farms. Benefit-cost ratio increased with the increase in farm sizes.

The 't' value for the difference between small and medium farm in respect of net return per hectare was found to be 1.3675, between medium and large 3.4927 and between small and large was 5.4726. These values indicated that small and medium farms were significantly different from large size farms in respect of net returns per hectare.

From the figures presented in Table 2 through Table 5, it is observed that among the different groups of rice, HYV *sali* rice recorded the highest cost of cultivation per hectare in all the holdings followed by local *sali* rice and HYV *ahu* rice, respectively. Local *ahu* rice accounted the lowest cost of cultivation among the different rice crops. Gross returns, return to fixed farm resources and net returns were also maximum in case of HYV *sali* rice in all farms followed by local *sali* rice. Local *ahu* rice and HYV

Table 5. Cost of Cultivation of HYV Ahu Rice

Rs/hectare

Items	Farm Size					
	Small		Medium		Large	
	Q	V	Q	V	Q	V
A. Variable Costs						
1. Human Labour (Manday)						
i) Own	100.25	1503.75	90.32	1354.80	70.60	1059.00
ii) Hired	9.5	142.50	17.95	269.70	32.41	486.15
2. Bullock Labour (Bullock pairdays)						
i) Own	50.00	750.00	47.02	705.30	45.74	686.10
ii) Hired	-	-	-	-	-	-
3. Machinery (Hours)	0.37	9.25	2.42	60.50	5.05	126.25
4. Seed (Kg)	68.53	205.59	64.26	192.78	59.41	178.23
5. FYM (Ton)	1.14	34.20	1.13	33.90	1.34	40.20
6. Fertilizer (Kg)		11.41		12.29		27.96
i) Nitrogen	1.54	8.36	1.70	9.23	3.45	18.73
ii) Phosphorus	0.38	2.85	0.35	2.63	1.17	8.78
iii) Potash	0.68	0.20	0.17	0.43	0.16	0.45
7. Weedicides/Pesticides		7.37		16.42		23.60
8. Interest on working capital		34.81		38.74		47.06
Total variable cost		2698.88 (66.43)		2684.43 (65.12)		2674.55 (62.91)
B. Fixed costs						
1. Rental value of land, revenue & cess		1232.96		1228.26		1214.35
2. Depreciation on impliments		14.25		36.86		77.55
3. Interest on fixed capital		116.40		172.45		284.78
Total fixed cost		1363.61 (33.57)		1437.57 (34.88)		1576.68 (37.09)
Total cost of cultivation (A+B)		4062.49 (100.00)		4122.00 (100.00)		4251.23 (100.00)
Gross returns		3152.45		3305.80		3810.65
Returns to fixed farm resources		453.57		621.37		1136.10
Net returns		-910.04		-816.20		-440.58
Benefit-cost ratio		1:1.29		1:1.25		1:1.12

Figures in parentheses indicate percentage. Q: Quantity, V: Value in Rs.

ahu rice showed negative net returns in all the holdings. The net return was however, negative for local *sali* rice in small farms.

Conclusion

From the study it can be concluded that among the different groups of rice local *sali* rice occupied the highest area under cultivation.

Though the cost of cultivation was higher in large farms, the net return per hectare was also higher due to the higher gross returns. The gross return was higher mainly due to higher productivity of crops in large holdings than that in small and medium holdings.

Among the different groups of rice crops, HYV *sali* rice generated the highest net return per hectare in all farms due to the higher productivity of this crop. *Ahu* rice generated negative net returns in all farms. It may be due to its low productivity and risks in cultivation.

"The message of change is perfectly plain; companies will ruthlessly review their premises-and stand ready to jettison them or they will become exhibits in the Museum of Corporate Dinosaurs."

—Anvin Toffler

A New Approach to Raw-Mix Decision Making in Cement Industry

Sanjay Agarwala & S.M. Sinha

Sometimes it may become difficult for the production manager of a cement industry to use the optimal mix suggested by his consultants due to unavoidable circumstances. It then becomes necessary for him to adopt an alternate raw-mix to run the plant smoothly. In this paper, a new approach has been discussed, which enables the production manager to decide on an alternative mix without delay, which will serve his purpose.

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Usually a production manager at a cement plant uses that raw-mix to manufacture cement, which is being suggested by their consultants (technical advisors) and is optimal with respect to some objective function. But many a time it is difficult (or even impossible) to use the optimal (or some alternate optimal or sub-optimal) raw-mix suggested by the consultant, owing to some adverse situations which may arise in the environment in which the plant operates. Two such practical situations, when a production manager finds it difficult to work with the raw-mix suggested by their consultant, may be described as follows:

(i) One or more raw materials of the suggested mix may not be available in sufficient quantity.

(ii) The production manager from his experience feels that the raw-mix as suggested, is not very convenient to work with. The burning of that raw-mix in the rotary-kiln might create a coating inside the rotary kiln shell, which will further consume money and time etc. in removing this coating.

Although the above two situations and a number of other similar situations are not of a permanent nature, yet they do occur in the cement industry many a time.

In any situation, the main objective of the production manager is to see that the production does not stop either due to non-availability of any raw material or due to some technical difficulties. The production manager therefore is to look for an alternate raw-mix, which enables him to run the production smoothly and according to specifications, even if it does not optimize the profit criterion.

It may so happen (particularly in an under-developed country where computer facility is not readily available) that, it is difficult to check, whether the raw-mix which the production manager considers suitable to use (at least for some short time periods), satisfies the various feasibility constraints. In such cases a new practical approach is provided here to check whether the chosen raw-mix is feasible or not. If it is not, the production manager uses this raw-mix to run his plant temporarily, until the materials for

the optimal raw-mix are made available and/or some technical know-how is developed so that the plant can be operated without any break.

To use this procedure, the production manager needs to know all the extreme points of the convex polytope generated by the feasibility constraints and the ratios of the differences of the coefficients of the decision variables in the constraints.

The Problem and the Algorithm

In manufacturing cement according to specifications, the restrictions which are imposed on the cement clinker (cement clinker is the final product which is obtained after performing various operations on the raw-mix and which when cooled and mixed with 4 to 6% gypsum gives portland cement on grounding) are found to be linear in character. Also the number of raw-materials needed to manufacture cement are three in number : the main being the lime stone and the other two, called correctives, depend on the quality of lime stone used. The algorithm for checking the non-feasibility of a raw-mix for manufacturing cement has therefore been developed on a set of linear constraints in three variables. Let the linear constraints imposed on cement clinker to manufacture cement, according to specifications be :

$$
\begin{aligned}
& a11\ x1 + a12\ x2 + a13\ x\ 3 \le b1 \\
& a21\ x1 + a22\ x2 + a23\ x\ 3 \le b2 \\
& \quad . \qquad\qquad\qquad . \\
& \quad . \qquad\qquad\qquad . \qquad\qquad (1) \\
& \quad . \qquad\qquad\qquad . \\
& am1\ x1 + am2\ x2 + am3\ x3 \le bm \\
& x1 + x2 + x3 = 1 \\
& \qquad xj \ge 0 \qquad j = 1, 2, 3
\end{aligned}
$$

Where xj (j = 1, 2, 3) is the proportion of j th raw material in a raw - mix.

(In (1) constraints with "≥" inequalities have been changed to "≤" by multiplying both sides of (1) by –1)

Algorithm for Checking the Non-Feasibility of a Raw Mix

Let x(1) = [x1(1) x2(1) x3(1)] ... xk = [x1(k) x2(k) x3(k)]

be all the feasible extreme points [3] of the solution space generated by the feasibility constraints given by (1)

let X* = [X1* X2* X3*] , X1* + X2* + X3* = 1

be the raw mix to be checked for nonfeasibility.

Steps

(a) Look out for a pair of extreme points, if one exists, such that exactly one of the following six conditions is satisfied.

Conditions :

If the pair choosen be (X(q), X(r)) then the conditions are

(1) $X1(q) \le X1^* \le X1(r)$; $X2(q) \le X2^* \le X2(r)$; $X3(q) \ge X3^* \ge X3(r)$

(2) $X1(q) \ge X1^* \ge X1(r)$; $X2(q) \ge X2^* \ge X2(r)$; $X3(q) \le X3^* \le X3(r)$

(3) $X1(q) \le X1^* \le X1(r)$; $X2(q) \ge X2^* \ge X2(r)$; $X3(q) \ge X3^* \ge X3(r)$

(4) $X1(q) \ge X1^* \ge X1(r)$; $X2(q) \le X2^* \le X2(r)$; $X3(q) \le X3^* \le X3(r)$

(5) $X1(q) \le X1^* \le X1(r)$; $X2(q) \ge X2^* \ge X2(r)$; $X3(q) \le X3^* \le X3(r)$

(6) $X1(q) \ge X1^* \ge X1(r)$; $X2(q) \le X2^* \le X2(r)$; $X3(q) \ge X3^* \ge X3(r)$

(b) If a pair of extreme points (X(q) X(r)) exists such that one of the six conditions mentioned in step (a) is satisfied, go to step (d).

(c) If no such pair exists, go to step (e).

(d) If the condition i (i = 1, 2, ... 6) is satisifed, follow the steps mentioned in subalgorithm i and decide accordingly.

(e) Reject the raw-mix.

Subalgorithm - 1

Use this if condition (1) is satisfied

Steps :

(i) Calcuate $\epsilon 1 = X1^* - X1(q)$; $\epsilon 2 = X2^* - X2(q)$
$\epsilon' 1 = X1(r) - X1^*$; $\epsilon' 2 = X2(r) - X2^*$

(ii) If $\epsilon 1 = 0 = \epsilon' 1$, Go to step (viii)

(iii) If $\epsilon 2 = 0 = \epsilon' 2$, Go to step (viii)

(iv) If $\epsilon 2 \neq 0$, Calculate $\epsilon 1 / \epsilon 2$ from the values obtained in (i), otherwise, set $\epsilon 1 / \epsilon 2 = M$ an infinitely large positive number.

(v) If $\epsilon' 2 \neq 0$, Calculate $\epsilon' 1 / \epsilon' 2$ from the values obtained in (i), otherwise, set $\epsilon' 1 / \epsilon' 2 = M$, an infinitely large positive number.

(vi) Look at the Table (1) and decide if any of the following is true.

(I) For atleast one i (i = 1, 2, ... m) with (ai1 – ai3) > 0 and (ai2 – ai3) < 0

$$\frac{\epsilon' 1}{\epsilon' 2} < \frac{\{(ai2 - ai3)\}}{\{(ai1 - ai3)\}} < \frac{\epsilon 1}{\epsilon 2}$$ holds

(II) For at least one i (i = 1, 2, ... m) with (ai1 – ai3) < 0 and (ai2 – ai3) > 0.

$$\frac{\epsilon 1}{\epsilon 2} < \frac{\{(ai2 - ai3)\}}{\{(ai1 - ai3)\}} < \frac{\epsilon'1}{\epsilon'2} \text{ holds}$$

(vii) If any of the inequalities of step (vi) holds, then reject the raw mix, otherwise go to step (viii).

(viii) Accept the raw mix.

Subalgorithm - 2

Use this if condition (2) is satisfied.

Steps :

(i) Calculate $\epsilon 1 = X1(q) - X1^*; \epsilon 2 = X2(q) - X2^*$
$\epsilon'1 = X1^* - X1(r); \epsilon'2 = X2^* - X2(r)$

(ii) If $\epsilon 1 = 0 = \epsilon'1$, Go to step (viii)

(iii) If $\epsilon 2 = 0 = \epsilon'2$, Go to step (viii)

(iv) If $\epsilon 2 \neq 0$, Calculate $\epsilon 1/\epsilon 2$ from the values obtained in (i), otherwise, set $\epsilon 1/\epsilon 2 = M$ an infinitely large positive number.

(v) . If $\epsilon'2 \neq 0$, Calculate $\epsilon'1/\epsilon'2$ from the values obtained in (i), otherwise, set $\epsilon'1/\epsilon'2 = M$, an infinitely large positive number.

(vi) Look at the Table (1) and decide if any of the following is true.

(I) For atleast one i ($1 \leq i \leq m$) with (ai1 – ai3) > 0 and (ai2 – ai3) < 0

$$\frac{\epsilon 1}{\epsilon 2} < \frac{\{(ai2 - ai3)\}}{\{(ai1 - ai3)\}} < \frac{\epsilon'1}{\epsilon'2} \text{ holds}$$

(II) For atleast one i ($1 \leq i \leq m$) with (ai1 – ai3) < 0 and (ai2 – ai3) > 0

$$\frac{\epsilon'1}{\epsilon'2} < \frac{\{(ai2 - ai3)\}}{\{(ai1 - ai3)\}} < \frac{\epsilon 1}{\epsilon 2} \text{ holds}$$

(vii) If any of the inequalities of step (vi) holds, then reject the raw mix, otherwise go to step (viii).

(viii) Accept the raw mix.

Subalgorithm - 3

Use this if condition (3) is satisfied.

Steps :

(i) Calculate $\epsilon 2 = X2(q) - X2^*; \epsilon 3 = X3(q) - X3^*$
$\epsilon'2 = X2^* - X2(r); \epsilon'3 = X3^* - X3(r)$

(ii) If $\epsilon 2 = 0 = \epsilon'2$, Go to step (viii)

Table 1

	a12–a13			am2–am3
a11–a13	$\frac{\{(a12 - a13)\}}{\{(a12 - a13)\}}$			
a21–a23				
am1–am3				$\frac{\{(am2 - am3)\}}{\{(am1 - am3)\}}$

(iii) If $\epsilon 3 = 0 = \epsilon'3$, Go to step (viii)

(iv) If $\epsilon 3 \neq 0$, Calculate $\epsilon 2/\epsilon 3$ from the values obtained in (i), otherwise, set $\epsilon 2/\epsilon 3 = M$ an infinitely large positive number.

(v) If $\epsilon'3 \neq 0$, Calculate $\epsilon'2/\epsilon'3$ from the values obtained in (i), otherwise, set $\epsilon'2/\epsilon'3 = M$, an infinitely large positive number.

(vi) Look at the Table (2) and decide if any of the following is true.

(I) For atleast one i ($1 \leq i \leq m$) with (ai1 – ai2) > 0 and (ai1 – ai3) < 0

$$\frac{\epsilon'2}{\epsilon'3} < \frac{\{(ai1 - ai3)\}}{\{(ai1 - ai2)\}} < \frac{\epsilon 2}{\epsilon 3} \text{ holds}$$

(II) For atleast one i ($1 \leq i \leq m$) with (ai1 – ai2) < 0 and (ai1 – ai3) > 0

$$\frac{\epsilon 2}{\epsilon 3} < \frac{\{(ai1 - ai3)\}}{\{(ai1 - ai2)\}} < \frac{\epsilon'2}{\epsilon'3} \text{ holds}$$

(vii) If any of the inequalities of step (vi) holds, then reject the raw mix, otherwise go to step (viii)

(viii) Accept the raw mix.

Subalgorithm - 4

Use this if condition (4) is satisfied.

Steps :

(i) Calculate $\epsilon 2 = X2^* - X2(q); \epsilon 3 = X3^* - X3(q)$
$\epsilon'2 = X2(r) - X2^*; \epsilon'3 = X3(r) - X3^*$

(ii) If $\epsilon 2 = 0 = \epsilon'2$, Go to step (viii)

(iii) If $\epsilon 3 = 0 = \epsilon'3$, Go to step (viii)

(iv) If $\epsilon 3 \neq 0$, Calculate $\epsilon 2/\epsilon 3$ from the values obtained in (i), otherwise, set $\epsilon 2/\epsilon 3 = M$ an infinitely large positive number.

(v) If $\epsilon'3 \neq 0$, Calculate $\epsilon'2/\epsilon'3$ from the values obtained in (i), otherwise, set $\epsilon'2/\epsilon'3 = M$, an infinitely large positive number.

(vi) Look at the Table (2) and decide if any of the following is true.

(I) For atleast one i $(1 \leq i \leq m)$ with $(ai1 - ai2) > 0$ and $(ai1 - ai3) < 0$

$$\frac{\epsilon 2}{\epsilon 3} < \frac{\{(ai1 - ai3)\}}{\{(ai1 - ai2)\}} < \frac{\epsilon'2}{\epsilon'3} \text{ holds}$$

(II) For atleast one i $(1 \leq i \leq m)$ with $(ai1 - ai2) < 0$ and $(ai1 - ai3) > 0$

$$\frac{\epsilon'2}{\epsilon'3} < \frac{\{(ai1 - ai3)\}}{\{(ai1 - ai2)\}} < \frac{\epsilon 2}{\epsilon 3} \text{ holds}$$

(vii) If any of the inequalities of step (vi) holds, then reject the raw mix, otherwise go to step (viii).

(viii) Accept the raw mix.

Table 2

	a11–a13	a21–a23		am1–am3
a11–a13	$\frac{\{(a11 - a13)\}}{\{(a11 - a13)\}}$			
a21–a22				
am1–am3				$\frac{\{(am1 - am3)\}}{\{(am1 - am2)\}}$

Subalgorithm - 5

Use this if condition (5) is satisfied.

Steps :

(i) Calculate $\epsilon 1 = X1^* - X1(q)$; $\epsilon 3 = X3^* - X3(q)$
$\epsilon'1 = X1(r) - X1^*$; $\epsilon'3 = X3(r) - X3^*$

(ii) If $\epsilon 1 = 0 = \epsilon'1$, Go to step (viii)

(iii) If $\epsilon 3 = 0 = \epsilon'3$, Go to step (viii)

(iv) If $\epsilon 3 \neq 0$, Calculate $\epsilon 1/\epsilon 3$ from the values obtained in (i), otherwise, set $\epsilon 1/\epsilon 3 = M$, an infinitely large positive number.

(v) If $\epsilon'3 \neq 0$, Calculate $\epsilon'1/\epsilon'3$ from the values obtained in (i), otherwise, set $\epsilon'1/\epsilon'3 = M$, an infinitely large positive number.

(vi) Look at the Table (3) and decide if any of the following is true.

(I) For atleast one i $(1 \leq i \leq m)$ with $(ai2 - ai1) > 0$ and $(ai2 - ai3) < 0$

$$\frac{\epsilon 1}{\epsilon 3} < \frac{\{(ai2 - ai3)\}}{\{(ai2 - ai1)\}} < \frac{\epsilon'1}{\epsilon'3} \text{ holds}$$

(II) For atleast one i $(1 \leq i \leq m)$ with $(ai2 - ai1) < 0$ and $(ai2 - i3) > 0$

$$\frac{\epsilon'1}{\epsilon'3} < \frac{\{(ai2 - ai3)\}}{\{(ai2 - ai1)\}} < \frac{\epsilon 1}{\epsilon 3} \text{ holds}$$

(viii) If any of the inequalities of step (vi) holds, then reject the raw mix, otherwise go to step (viii).

(viii) Accept the raw mix.

Subalgorithm - 6

Use this if condition (6) is satisfied.

Steps :

(i) Calculate $\epsilon 1 = X1(q) - X1^*$; $\epsilon 3 = X3(q) - X3^*$
$\epsilon'1 = X1^* - X1(r)$; $\epsilon'3 = X3^* - X3(r)$

(ii) If $\epsilon 1 = 0 = \epsilon'1$, Go to step (viii)

(iii) If $\epsilon 3 = 0 = \epsilon'3$, Go to step (viii)

(iv) If $\epsilon 3 \neq 0$, Calculate $\epsilon 1/\epsilon 3$ from the values obtained in (i), otherwise, set $\epsilon 1/\epsilon 3 = M$, an infinitely large positive number.

(v) If $\epsilon'3 \neq 0$, Calculate $\epsilon'1/\epsilon'3$ from the values obtained in (i), otherwise, set $\epsilon'1/\epsilon'3 = M$, an infinitely large positive number.

(vi) Look at the Table (3) and decide if any of the following is true.

(I) For atleast one i $(1 \leq i \leq m)$ with $(ai2 - ai1) > 0$ and $(ai2 - ai3) < 0$

$$\frac{\epsilon'1}{\epsilon'3} < \frac{\{(ai2 - ai3)\}}{\{(ai2 - ai1)\}} < \frac{\epsilon'1}{\epsilon'3} \text{ holds}$$

(II) For atleast one i $(1 \leq i \leq m)$ with $(ai2 - ai1) < 0$ and $(ai2 - ai3) > 0$

$$\frac{\epsilon 1}{\epsilon 3} < \frac{\{(ai2 - ai3)\}}{\{(ai2 - ai1)\}} < \frac{\epsilon'1}{\epsilon'3} \text{ holds}$$

(vii) If any of the inequalities of step (vi) holds, then reject the raw mix, otherwise go to step (viii).

(viii) Accept the raw mix.

Table 3

	a12–a13			am2–am3
a12–a11	$\frac{\{(a12-a13)\}}{\{(a12-a13)\}}$			
am2–am1				$\frac{\{(am2-am3)\}}{\{(am2-am1)\}}$

Example :

The algorithm given above has been tested on a number of real life problems and found to be quite satisfactory. We show below the application of this algorithm, on one such problem. The problem considered here consists of 21 constraints (including a Sum constraint) in three variables. The extreme points of the solution space generated by these constraints are found to be

X(1) = [X1(1) X2(1) X3(1)] = [0.93096 0.03122 0.03782]

X(2) = [X1(2) X2(2) X3(2)] = [0.95926 0.01165 0.02909]

X(3) = [X1(3) X2(3) X3(3)] = [0.93268 0.04334 0.02398]

X(4) = [X1(4) X2(4) X3(4)] = [0.95922 0.01716 0.02362]

However, the tables displaying the ratios are not provided here, due to the space limitations (but they can be drawn very easily, as in algorithm)

Let the raw mix to be checked is

$X^* = [X1^* \; X2^* \; X3^*] = [0.94 \;\; 0.03 \;\; 0.03]$

Following the steps of the algorithm, we first look out for a pair of extreme points such that one of the six conditions of the algorithm is satisfied. In this case, there is a pair of extreme points (X(1), X(4)) such that

$X1(1) \leq X1^* \leq X1(4)$

$X2(1) \geq X2^* \geq X2(4)$

$X3(1) \geq X3^* \geq X3(4)$

$.93096 < .94 < .95922$

$.03122 > .03 > .01716$

$.03702 > .03 > .02362$

i.e. condition (3) of the algorithm is satisfied, therefore the subalgorithm (3) will be used to check the infeasibility of X*. Following the steps in subalgorithm (3), we have

(i) $\in 2 = X2(1) - X2^* = .0012$

$\in '2 = X2^* - X2(4) = .01284$

$\in 3 = X3(1) - X3^* = .00702$

$\in '3 = X3^* - X3(4) = .00638$

(ii) $\in 2 \neq 0 \neq \in '2$, therefore we cannot immediately say that X* is feasible. Further investigation is needed.

(iii) $\in 3 \neq 0 \; \in '3$ therefore we cannot immediately say that X* is feasible. To ascertain about its feasibility some more investigation is needed.

(iv) Since $\in 3 \neq 0$, we calculate $\frac{\in 2}{\in 3} = .17379$

(v) Since $\in '3 \neq 0$, we calculate $\frac{\in '2}{\in '3} = 2.01254$

(vi) Now table (2) is to be used to see if any of the following inequalities is true.

(I) for atleast one i ($1 \leq i \leq 20$) with $(ai1 - ai2) > 0$ and $(ai1 - ai3) < 0$

$$\frac{\in '2}{\in '3} < \frac{\{(ai1 - ai3)\}}{\{(ai1 - ai2)\}} < \frac{\in 2}{\in 3} \qquad \text{holds}$$

(II) for atleast one i ($1 \leq i \leq 20$) with $(ai1 - ai2) < 0$ and $(ai1 - ai3) > 0$

$$\frac{\in 2}{\in 3} < \frac{\{(ai1 - ai3)\}}{\{(ai1 - ai2)\}} < \frac{\in '2}{\in '3} \qquad \text{holds}$$

In (I) and (II) above, ai1 – ai3 ($1 \leq i \leq 20$) are values displayed at the top of the table whereas ai1 – ai2 ($1 \leq i \leq 20$) are the values displayed at the left of the table

$$\frac{\{(ai1 - ai3)\}}{\{(ai1 - ai2)\}}$$

is (i, i) element of the table i.e. element in ith row and ith column.

(vii) From our table (2), we have

(a) $a51 - a52 = -.03211 < 0$

$a51 - a53 = 1.00000 > 0$

$\frac{\in 2}{\in 3} = .17379 < 31.1429 \not< 2.01254 = \frac{\in '2}{\in '3}$

hence for i = 5, (II) is not satisfied.

(b) $a61 - a62 = .05386 > 0$

$a61 - a63 = -1.00000 < 0$

$\frac{\epsilon'2}{\epsilon'3} = 2.01254 < 18.5667 \not< .17379 = \frac{\epsilon 2}{\epsilon 3}$

hence for i = 6, (I) is not satisfied.

(c) $a71 - a72 = .02419 > 0$

$a71 - a73 = -1.0000 < 0$

$\frac{\epsilon'2}{\epsilon'3} = 2.01254 < 41.3394 \not< .17379 = \frac{\epsilon 2}{\epsilon 3}$

hence for i = 7, (I) is not satisfied.

(d) $a81 - a82 = -.01383 < 0$

$a81 - a83 = 1.0000 > 0$

$\frac{\epsilon 2}{\epsilon 3} = .17379 < 72.3060 \not< 2.01254 = \frac{\epsilon'2}{\epsilon'3}$

hence for i = 8, (II) is not satisfied.

(e) $a91 - a92 = -.02164 < 0$

$a91 - a93 = 1.0000 > 0$

$\frac{\epsilon 2}{\epsilon 3} = .17379 < 46.21072 \not< 2.01254 = \frac{\epsilon'2}{\epsilon'3}$

therefore for i = 9, (II) does not hold.

(f) $a10\,1 - a10\,2 = .04135 > 0$

$a10\,1 - a10\,3 = -1.0000 < 0$

$\frac{\epsilon'2}{\epsilon'3} = 2.01254 < 24.18380 \not< .17379 = \frac{\epsilon 2}{\epsilon 3}$

hence for i = 10, (I) is not satisfied.

(g) $a11\,1 - a11\,2 = -.31893 < 0$

$a11\,1 - a11\,3 = 1.0000 > 0$

$\frac{\epsilon 2}{\epsilon 3} = .17379 < 3.1350 \not< 2.01254 = \frac{\epsilon'2}{\epsilon'3}$

therefore for i = 11, (II) does not hold.

(h) $a12\,1 - a12\,2 = .44572 > 0$

$a12\,1 - a12\,3 = -1.0000 < 0$

$\frac{\epsilon'2}{\epsilon'3} = 2.01254 < 2.24356 \not< .17379 = \frac{\epsilon 2}{\epsilon 3}$

therefore for i = 12, (I) is not satisfied.

(viii) Hence from (vii) we find that there is no i ($1 \leq i \leq 20$) such that any of the inequalities (I) or (II) in step (vi) of the Subalgorithm (3) is satisfied. Hence X^* belongs to the feasible region generated by constraints on cement.

Acknowlegements

This study was partially supported by the Council of Scientific & Industrial Research which is gratefully acknowledged.

□

"Man has such a predilection for systems and abstract deductions that he... is ready to deny the evidence of his senses only to justify his logic."

—Fyoder Dostoyevski

"Had the employers of the past generation dealt fairly with men, there would have been no trade unions."

—Stanley Baldwin,

"Technology... the knack of so arranging the world that we don't have to experience it."

—Max Frisch

Productivity Improvement : The Tata Steel Story

"Productivity" as a concept is gradually becoming a part of corporate parlance in India. In a country where productivity, quality and efficiency have always taken a back seat to production and profit; rumblings of change are now being increasingly heard. This is due to increasing competition and an end to monopoly in many areas.

Simply defined, productivity is the relationship between the outputs generated from a system to the inputs provided to create those outputs. Regardless of perspective; political, economic, engineering, managerial and so forth, the basic definition of productivity always remains, the boundaries, size, type and scope of the system that is being examined.

The successful onslaught of Japanese goods on the American and Western markets in the early 70's, exposed the corporate world to the concept of productivity and quality. The developed countries have now capitalised on these two key words to success. Why then, are we in India, coming to terms with these concepts, only now? One of the main reasons is, the nurturing that Indian business has continued to receive under the wings of protectionism. This fundamental economic insight of generating competition has eluded our nation until only recently. The recent spate in industrial growth with an accent on quality is a proof of this. At the same time, in our bid to avoid monopolies and to promote self-reliance, small-scale industries, employment through labour intensification of jobs, we have overlooked advanced technologies and sacrificed economies of scale, productivity, quality and ultimately a reasonable growth of our own economy.

It is quite true that low productivity performance in many of the industries is simply a reflection of poor, inappropriate or antiquated government policies. It is also long term performance by the other aspects of the overall system: political, economic, social, infrastructural and otherwise. But these factors are now becoming overused scapegoats for own own, individual poor performance. Can entrepreneurs, managers, executives or even whole organisations absolve themselves from all blame? The very essence of productivity management & improvement, is to be able to achieve the highest level of performance possible within the prevailing environment. It has to be realised that good industrial, regulatory and investment oriented policies of the government are not and cannot be a substitute for poor management practices.

On the brighter side, there are a few select organisations in our country, which, through their evolved management practices, organisational culture and overall positive approach, have been able to give their best in the existing circumstances. What makes them tick? What makes them the leaders? What makes them surpass their own best performance year after year?

Learning from the experiences of successful organisations would help in the overall importance of other organisations.

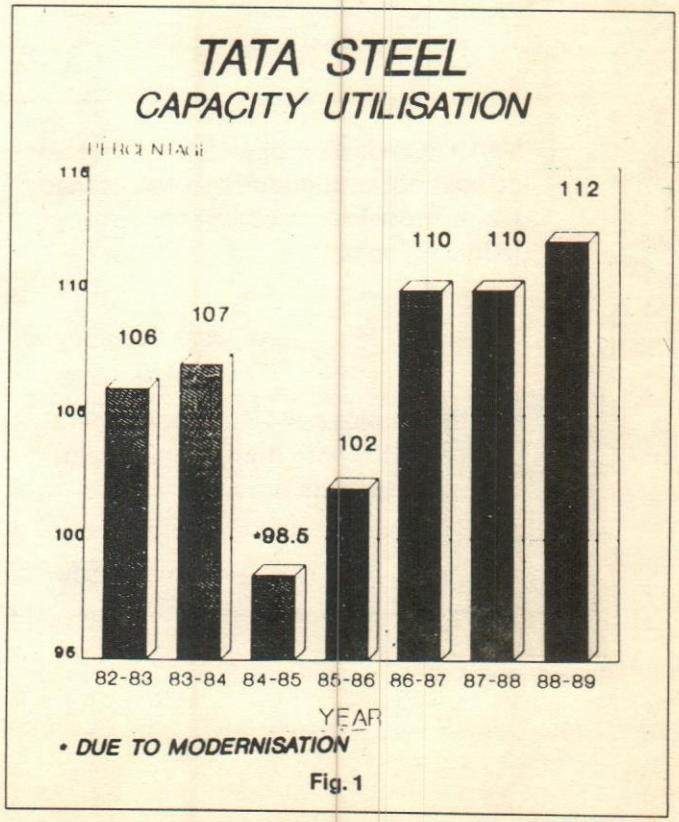

Fig. 1

TATA STEEL, India's only fully integrated steel plant in the private sector, was founded by Sri Jamsetji Nusserwanji Tata in 1907 in Jamshedpur. From a modest beginning of 20,000 t/year, in a time when it was considered impossible to produce even a pin in India, Tata Steel is now gearing up to produce 2.7 million tonnes/year of finished steel in the near future. With its own captive mines & collieries and various other divisions throughout the country, and with a turnover of Rs. 1860 crores, Tata Steel is India's largest private sector organisation, employing more than 70,000 people.

Recognising the fact, that the economy of a nation depends largely on the core sector and on the organisations within this sector, Tata Steel has always strived to contribute to its utmost extent by achieving record performances year after year. It is not easy for any integrated steel plant in the world to do so, especially in the face of extraneous constraints such as availability of coal, power etc. which are somewhat unique to India. In this scenario, Tata Steel, through the sustained efforts of its employees and management, has been able to achieve and sustain a truly remarkable level of performance. The last 7 consecutive years have given annual record performances in production and profit.

How has this been possible? The answer probably lies in the ability of the company to strike a happy blend of operational discipline, a continuous upgradation of technology, proper maintenance of installed plant and machinery, new approaches to problem solving etc.

As such, Tata Steel does not have a formal "Productivity Management System". What it has, instead, is an amalgamation of (i) a vision fuelled by the zeal to change (ii) an institutional framework that works and (iii) an organisation-wide unique culture, which through the synergy of its various facets, helps the company to scale new heights year after year. Some of these facets are as under:

I.The Vision

Foresight, planning and a clear vision of the direction and path ahead are the hall marks of a leader in any field. The ability to anticipate future trends, assimilate current trends and the willingness to experiment; to discard old practices has been a strong point of Tata Steel. This is evident from its continuous endeavour to modernise, expand and to upgrade its technology.

(a) *Modernisation & Expansion*: Tata Steel grows younger by the day. By instituting several modernisation and expansion programmes during the last decade, the company has been able to keep pace with growing market demands. From a modest beginning of 20,000 t/year, and subsequent gradual increases to 2 million tonnes/ year Tata Steel's current modernisation programme envisages a 50% increase in the present production capacity, taking it to 2.7 mtpa.

The ongoing modernisation programme was initiated in 1982-83 and is now in its 3rd phase of implementation. It is aimed at a judicious and systematic introduction of new and appropriate technology to improve production and productivity. Phase-I of the modernisation programme, cost Rs. 225 crores and helped augment steel making facilities through the installation of the L.D. process, V.A.D.R., a continuous casting process along with associated infrastructures (Tar Dolo Plant, T.O.P. etc.). Phase-II cost approx. Rs. 850 crores and concentrated on the infrastructure for improving inputs to the iron-making process through the installation of a new Sinter Plant, Bedding & Blending plant etc. The third phase now begun, will cost an ambitious Rs. 2,500 crores. It will augment both iron & steel-making capacities and includes a 1 million tonne/ year wide hot-strip mill of modern design. On completion of this phase, the saleable steel capacity will increase by 50% and this will be achieved without any increase in manpower, thus increasing labour productivity.

(b) *Technology Upgradation*: In a country like India, where capital is a scarce resource, and the cost of servicing the capital is very high, making the best use of any investment assumes great importance. Tata Steel has a programme

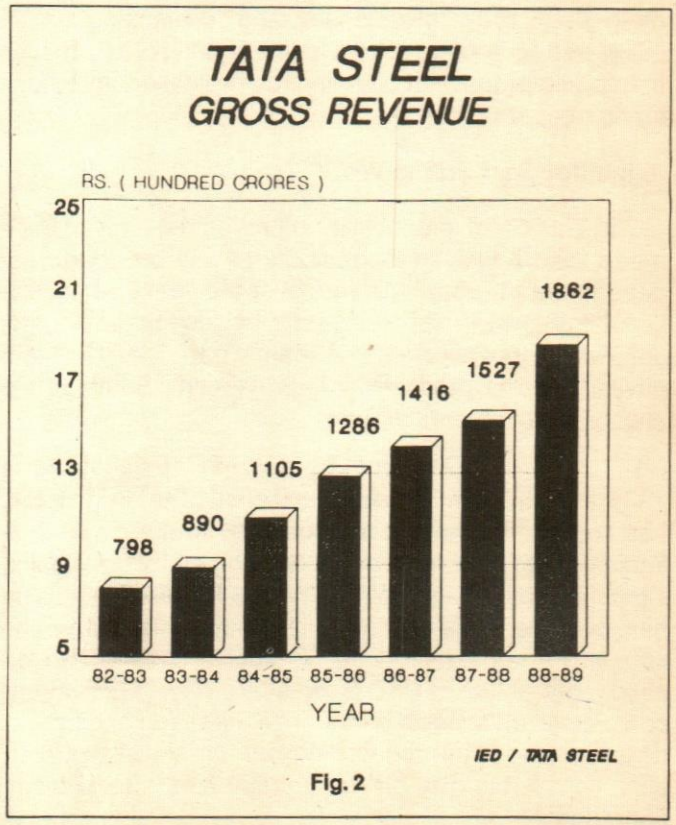

Fig. 2

of continuous upgradation of processes through the infusion of the latest technology, which goes hand-in-hand with their modernisation/expansion programmes. The coal stamp-charging process which enables the continued use of poor quality Indian coking coals to give better quality coke for larger blast furnaces; the installation of moveable throat armour in the blast furnaces for better burden distribution; the retrofitting of the latest KORF technology in our open hearth furnaces for increasing productivity of the furnaces, are amongst the many successful examples of technology upgradation at TISCO.

To operate new processes at peak efficiencies and at the same time, to elicit the best out of old antiquated facilities, some of which are more than 50 years old, requires a dedicated system of maintenance and operating practices. Improvements are continuously being made in operating practices by introducing process control, and in the area of plant maintenance by introducing new techniques for condition monitoring such as thermography, use of radio-isotopes etc.

(c) *Computerisation* : Keeping in trend with the current wave of computerisation, the company has embarked on a massive computerisation programme with a planned budget of Rs. 25 to 30 crores to improve overall plant productivity. Though it started off on a piece-meal approach, the Computer Services Department to-day has more than 100 professionals, and is planning on an integrated computer network for the sharing of information to improve production planning, co-ordination and monitoring of operations.

II. Institutional Frame Work

In Tata Steel, productivity improvement has not been made the exclusive responsibility of any one particular department or group. Instead, over the years, an institutional framework has been built to support and foster creativity, innovativeness, & team-work. These, in turn have helped in productivity improvement. Some of the supporting structures include:

(a) *Research & Development Division* : Established in 1935, the R&D Divn., the first R&D effort of its kind in India, has consistently helped the company to meet the challenges of growth and change. Starting off by developing indigenous materials for World War I & II, the R&D Division has, over the years set new milestones in discovery. The company's largest producer of special steels, can be ascribed largely to its R&D prowess. To-day, its activity encompasses all aspects of resource utilisation and upgradation, process and product development and energy conservation. It has also played a major role in technology upgradation.

(b) *Industrial Engg* : As early as 1948, Mr. J.R.D. Tata spotted the potential for the then newly emerging scientific management technique of Industrial Engineering. Foreign consultants were called to conduct a systematic appraisal of all industrial activities in TISCO and to help form India's first Industrial Engg. Department. To-day, the IED of TISCO, possesses a wealth of talent in its 100 engineers, the majority of them being M. Techs. The department's effort in planning, reorganisation, rationalisation and redeployment of manpower has helped maintain the same workforce strength over the years inspite of increases in plant capacity. Apart from this, it contributes very significantly in areas such as the maintenance of productivity-linked wage incentive plans, methods improvement, value engineering, study of capital schemes, work measurements & job evaluation, simulation, and systems design. Its newly formed Value Engineering Cell alone has contributed upto Rs. 3 crores in recurring savings through the 17 projects that have been implemented so far.

(c) *Plant Engg. & Process Analysis Cell* : This cell was formed in 1986 with the specific purpose of achieving optimal utilisation of available resources through the use of scientific management techniques such as Operations Research, Simulation etc. The achievements of its 7-member group has been quite extra-ordinary, particularly in the allocation of available power to the various units/departments for profit maximisation. Its other achievements include a product-mix operation model for optimal production planning, a model for optimal purchase of scrap through Break Even Price determination, Oxygen distribution model to optimise during periods of low oxygen availability.

Creativity & innovativeness are an inherent characteristic of human nature. Unfortunately, this characteristic is largely latent. Tata Steel recognises this immense potential that is hidden amongst its large number of employees. It has, therefore created a few structures aimed primarily at successfully tapping this latent talent:

(d) *Suggestions Box Scheme* : This scheme was launched in 1932 and is managed by an interdisciplinary committee of 19, including 12 professionals representing management and representatives of the Union. Suggestions are received from all quarters. These are regularly assessed and if approved, tested and finally implemented. To award the suggestions and also to motivate others to contribute through their suggestions, public recognition is given to them by giving them handsome awards at important company functions and by featuring them in in-house publications.

(e) *Innovations Committee* : The Innovations Committee was set up in the mid 70's to study, review and recommend

for implementation, any innovative suggestions put up by the officers of the steel company. Its objectives include considering new ideas in areas ranging from raw materials to finished products in terms of quality, service etc., including areas for diversification of the company's business and manufacture of new products. The committee consists of the GM(W), the Asst. General Managers of different areas/functions, Directors of R&D and Projects as well as other experts in the organisation. In the last 5 years, the committee has received approximately 80 innovative suggestions of which 20 were successfully implemented, 25 dropped and the balance are presently under trial.

While the Suggestions Box Scheme & Innovation Committee rely primarily on voluntary and spontaneous creativity, there are other structures in Tata Steel which enhance creativity & innovativeness through a more formal and structured approach - the participative team approach to problem solving. Primary among these are :

(f) *Value Engineering Cell*: Value Engg. is a technique that enhances productivity through overall function analysis & cost reduction. Only 2 years ago, the company gave shape to the existing unstructured value engineering activities by forming a Value Engineering Cell. The cell comprising a 6-member multi-disciplinary team has produced remarkable results. The 17 projects implemented so far, have resulted in a savings of Rs. 3 crores. The savings potential of the 90 projects on hand is well over Rs. 15 crores.

(g) *Quality Improvement Teams* : Quality & Productivity are, in a way, inter-linked in a complimentary manner. The need for adopting stricter quality standards is a direct outcome of the company's strategy for producing more special steels to satisfy the market demand. In 1988, Tata Steel introduced the world renowned "Juran" methodology for Quality Improvement. The methodology adopts a systematic approach which helps multidisciplinary teams to identify high potential areas and then guides them, step-by-step, through the problem-solving process. A Quality Council consisting of senior executives meets regularly to monitor the progress of these projects and to chalk out strategies for the future. The few projects that have been implemented so far have resulted in impressive savings.

(h) *Quality Circles* : While the just mentioned Juran Quality Improvement teams comprise junior and middle level officers, the Japanese concept of Quality Circles is aimed at the voluntary contribution of employees on the shop-floor. This concept found its way into some of TISCO's departments in 1983. While some circles did not make it, there are several departments where it has been a success. The Foundries department, where it has really taken a firm footing, has many successes to its credit.

(i) *Brain Storming* : Achieving synergy through team work is practised right upto the top-management level through the technique of brain storming on selected important issues. Senior executives of the company meet at the new Management Development Centre at Dimna, on the outskirts of Jamshedpur. Set on the banks of the Dimna lake amidst sylvan surroundings, the extremely peaceful and idyllic climate that this facility provides, is very conducive to free and vigorous exchange of ideas. Many major decisions have been taken at such brainstorming sessions. It also imparts a sense of contribution to consensus in the decision-making process and implementation of such decisions becomes easier with everybody becoming involved

(j) *Collaboration with Academic Institutions* : In 1987, the company initiated collaboration projects with IIT Bombay & IIT Kharagpur, in a few vital areas; one of them being productivity-management. Though the focus so far has been more on improving productivity, than on accurately measuring it and systematically managing it, the "Productivity Management System" being developed in collaboration with IIT, Kharagpur, aims to fill the lacunae. It will help the company measure, evaluate, monitor & plan productivity improvement in all areas of the company's operations including labour & social welfare.

(k) *Foreign Study Tours* : In order to keep abreast of technology development elsewhere in the world, Tata Steel has a liberal policy of sending its executives on foreign tours. On their return, they are expected to examine the feasibility of adapting some of the technologies they have seen, to TISCO's operations. It is the result of such visits that the company has introduced latest/upgraded technology in some facets of its operations. Examples of these are coal stamp-charging, the first indigenous fluidised-bed boiler installation etc. Currently, many teams are being sent abroad with the specific purpose of learning better operating practices for blast furnace productivity improvement.

III. Organisation Culture

Perhaps the most important and the most neglected link in the productivity chain, is that of the human resource. The potential for improvement through this resource far outweighs the same through other resources. Since, it is generally easier to improve productivity through the infusion of capital or new technology, the human aspect has been under-rated or even neglected in most cases. That little extra bit of effort from each and every employee is what makes the difference between achieving less than 100% and achieving 110% capacity utilisation.

The extent of an employee's contribution depends on his sense of commitment and belonging to the organisation and on the challenges, excitement and the opportunities that the organisation provides to those who work in it. To get the best out of its employees, the Management must first create a culture in which individuals identify themselves with their organisation and find it psychologically rewarding to confront problems, and discover solutions for them.

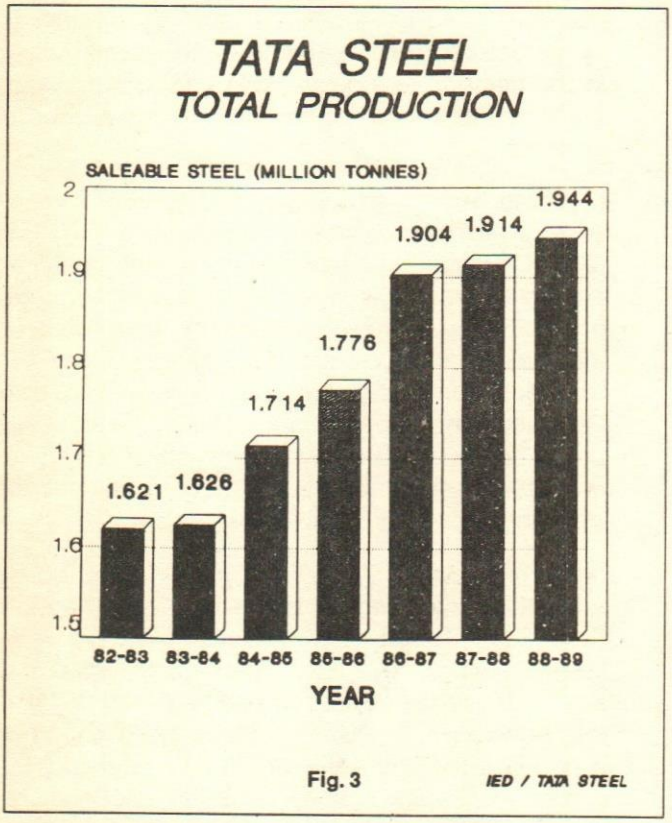

Fig. 3

Tata Steel has been cultivating such a culture since the mid 50's, which is unique in its own way. It is founded on a bedrock of open communication and closer association between employees and management. It is a measure of the power of this culture that all kinds of problems that can be expected to occur in the normal course of operation are easily and amicably settled by joint committees through bilateral discussions. This has resulted in the building of a very high degree of mutual trust between the workers and the management to the extent that there has not been a single strike or work stoppage at TISCO in the last 30 to 40 years. Some of the important features of this work culture that has helped in creating a climate of goodwill in the company can be illustrated as:

(a) *Joint Departmental Councils (JDCs)* : A 3-tier set up of joint departmental councils with equal representation of workers, supervisors and managers/officers have been established in all production/service units and staff departments. It has been the aim of each JDC to study operational results and production and quality problems, discuss possible solutions and make appropriate recommendations to the management. These also include the promotion of welfare and safety, productivity, quality, cost reduction as well as better working conditions. The Annual function of each JDC is attended by top management personnel (the CMD and/or the Joint Managing Director, if in town) and the highest officials of the Tata Workers Union, as Chief Guest or Guests of honour. Opportunity is given to any worker or supervisor of that JDC to ask any question pertaining to his working or living conditions and to receive a satisfactory answer from the head of the department to which his question pertains. Such a system instantly takes care of many important grievances of the workers in a manner that cuts through the red-tape of hierarchy or lengthy chain of command and allows the worker to come face to face with the senior-most officers of the company in the presence of top-management and top-Union officials. Often, innovative suggestions are made by workers and supervisors at such forums for which there is instant recognition in full view of an audience of upto 2000 people.

(b) *Management Dialogues* : Another very unique feature of the TISCO management is the mass dialogue sessions held by the Chairman and Managing Director with the supervisors and officers of the company. In the "Junior Dialogue" sessions which normally last upto 2 hours, the CMD, flanked by the Executive Directors, faces an audience of upto 3000 officers and supervisors at a time, wherein any person is completely free to criticise any facet of the company's operations or to make suggestions for improvement or even to discuss collective grievances. Occasionally, instant redressal is given by the CMD to the delight of the audience. Senior managers are called upon to explain any problematic situation including the corrective measures to be taken. A "Senior Dialogue" is also held by the CMD approximately 6 times a year, in which only the senior managers of the company participate. In such dialogues a free exchange of ideas, suggestions for improvements, grievances and discussion on problems are encouraged and often a consensus of opinion is sought on particular issues. Such dialogues enable the CMD to receive a first hand feedback on what ails or motivates the employees of the company and also provide an opportunity to the senior managers to present their views directly to the CMD.

A "Middle Level" dialogue is held by the Joint Managing Director, wherein only assistant departmental heads are invited to attend in the absence of their subordinates and immediate superiors. Here again, the middle level officers are encouraged to participate and given the oppor-

tunity to air their views or give suggestions for improving the company's operations. The above and similar other mass meetings constitute an open-door approach to managing a company, which in itself is an innovative technique that stimulates a climate conducive to free thinking and creativity.

(c) *Personal Interviews by the CMD/Jt. MD* : The open-door policy of the company goes beyond the mass meetings/dialogues explained above, in that the CMD and Jt. MD spend considerable time and effort, on a regular basis, for holding private interviews with employees or even non-employees by prior appointment to discuss personal grievances, family problems etc. in a confidential manner. Here too, there are some employees who, otherwise too shy to face a large audience, seize the opportunity to make suggestions for improvement with an assurance for anonymity.

The above gives a glimpse of the kind of work culture which has been established in TISCO, which contributes in a large measure to an atmosphere necessary for free thinking, innovativeness, creativity and continuous productivity improvement.

For a developing economy like ours, with a low rate of productivity, the productivity movement effort has got tremendous scope for advancement. We do not have time on our side. Our pace of improvement will determine our fate. We have to ensure a substantial growth in the number of managers and organisations committed and wedded to the cause of productivity so that the cult of productivity and of higher national growth and prosperity spreads nationwide, as fast as possible.

Ashok Pandit
Assistant General Manager (Industrial Engg.)
TISCO, Jamshedpur.

About Quality

"The good news is that we know how to economically manufacture high-quality, reliable products. The bad news is that many manufacturing companies have not learned the good news."

"An executive's exposure to the technical aspects of quality control is similar to a mouse's exposure to a hungry python. If either one fails to learn the strengths, weaknesses, and language of the enemy, they become victims of their own ignorance."

"Customers seldom get compensation for the time, effort, postage, gasoline, shoe leather, and heartburn medicine consumed in their quest for replacements, even when covered by a warranty."

"Customers... are as hard to predict, anticipate, and understand as hyperactive three-year-old children on a diet of chocolate bars and sugar snacks."

Courtsy : Schrock, E.M. & Lefevre, H.L. The Good and Bad News About Quality, Marcel Dekker, 1988.

tank are recorded for all the digesters over a 24 hour period. These time periods are shown as a bar chart in fig.1.

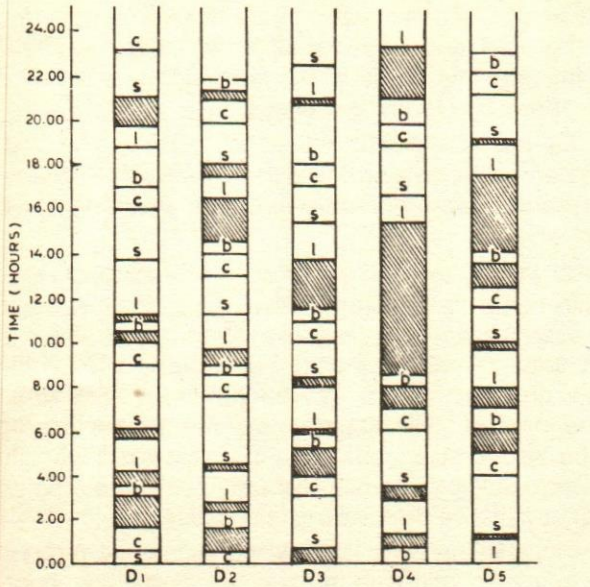

Fig. 1: Scheduling of Digesters

A systematic study of the cooking cycle of the five digesters as shown in Fig.1 revealed the following details. (Govil, 1989; Saxena et. al. 1988)

(1) Out of 13 loading operations undertaken in the day the time taken varied from 60 to 160 minutes with a mean time of 87 minutes.

(2) Of the 14 steaming operations undertaken time varied from 90 to 180 minutes with a mean time of 130 minutes.

(3) The mean time taken in cooking was 60 minutes and this time was found to be constant in each cycle.

(4) Blowing took an average time of 52 minutes and of the 15 blows taking place that day; the longest and shortest were 105 to 15 minutes respectively.

(5) The average idling time for the digesters was 438 minutes (7 hours 18 minutes), maximum idling time was 700 minutes (11 hours 40 minutes), minimum idling time was 275 minutes (4 hours 35 minutes), total idling time for the five digesters was 2190 minutes (36 hours 35 minutes) and a standard deviation in the idle time over the five digesters was 158.16 minutes.

The above analyses clearly shows that the major reasons for these fluctuations appear to be the following :

(1) Empty digester ready for loading is required to wait on a number of occasions as another digester gets loaded. The chip filling arrangement require minor modifications to eliminate waiting time of digester for want of conveyor capacity. The approaches are either to build individual storage bins of adequate capacity for each digester or to relay the conveyor feeding arrangement on top of digesters. This could bring down the mean time of 87 minutes for loading to about 60 minutes or a cumulative saving of about 4 hours.

(2) The digester after complete cooking is expected to blow the material into a blow tank. The mill has two blow tanks and the average blowing time is about 52 minutes, while blowing proper takes just 15 minutes. From the figure it can be seen that the maximum blowing time have been of the magnitude of 105 minutes.

Reblow is rather frequent in the digester operations. Nearly one out of four blows require a reblow and this causes a delay in operations to the extent of 15-20 minutes normally. Occasionally more than one reblow is required. The causes for reblow, however, are not well established.

The present arrangement of blow tank connections permit only one digester to be blown from among first four while 5th digester can be blown independently only when the concerned blow tank is available.

The improvement in this operation can be planned by:

(i) Connecting each blow tank to all the digesters independently so that both the blow tanks are fully utilised.

(ii) Increasing the blow line size connecting the digesters to the blow tanks to reduce the blowing time for each batch.

(iii) If the above alternatives prove inadequate the possibilities of installing additional blow tank should be evaluated.

(iv) The digester designs, particularly around the bottom blow line connection/flow valve location may have to be examined to reduce the reblow occurance. Provision of steam lines (high pressure) around this location with slight steaming before blow will reduce the chances of reblow.

By this the average blowing time can be brought down to 15-20 minutes. In other words a time of about 8.5 hours will be available for additional cooking.

(3) The third major contributor to digester scheduling comes from steaming operations where the average time of steaming is about 130 minutes, while steaming can be completed in just 90 minutes if full

pressure steam is available. When more than one digester is steamed, the steam pressure falls down resulting in an increase in the steaming time. The alternatives available for improving the situation are two fold.

(i) Steam accumulators can be used to store steam at full pressure when digesters do not require full steam. The period when no digester is being steamed or only one digester is being steamed, represents times when excess steam at full pressure is available. At these periods the boiler operations require control to reduce the pressure. By continuing to run the boiler at normal load, the excess steam at full pressure can be diverted to the accumulator. In the present analysis such time period works out to be about 13 hours.

The accumulator can supply additional steam at the time of peak demand to digesters and help in maintaining the desired pressure. This will ensure no increase in steaming time due to fluctuations in steam pressure. Further the smoothening of steam will help improve boiler performance.

(ii) It will be further seen that there is no time during the entire 24 hours cycle when steam was not used to raise the temperature in the digester or for cooking. This clearly indicates that steaming capacity is a major bottle neck in the digester performance and this can be overcome by reducing the specific steam consumption.

The digester steam demand can be reduced by proper control of parameters as listed below in a batch digester.

(a) Loading the digester to the maximum extent and keeping both the ratios low.

(b) Optimising digester scheduling with suitable sizing of transfer lines (Sherban, 1988; Tikka, 1988).

(c) Recovery of heat from relief vapors from digester by installing suitable devices to heat water. This can account for almost upto 3.5% steam-saving.

(d) Using 2-stage steaming with initial heating by low pressure steam of 3-4 kg/cm^2 followed by high pressure steam at 9-10 kg/cm^2.

(e) Blow heat recovery by trapping 0.6 to 0.7 tonnes of vapors per tonne of pulp flashed during blowing. A set of heat exchangers can be used to generate contaminated hot water from this flash steam.

(f) Cold blow technique can be used to conserve steam by recovering the heat by displacing hot black liquor with washer filtrate. This is expected to reduce steam demand substantially (Sherban, 1988; Pasznen and Chan, 1988; Tikka, 1988). The advantage is a higher starting temperature reducing the normal heating/cooking cycle time and reduction in total steam demand.

Alternatively the demand for high pressure steam could be reduced by partly replacing it with low pressure steam for initial heating. Among the above alternatives the mill will have to study the effect of reduction in both ratio on quality of pulp seriously. The mill under study can look at the alternative of recovering heat from relief vapors. Certain amount of blow heat is being recovered from the flash vapours. The capacity at blow heat recovery however is inadequate. Occasionally direct steaming is practised to speed up steaming process.

Under these conditions two-stage steaming and cold blow appear to be two promising alternatives to reduce high pressure steam demand and total steam demand respectively.

Modifying the existing steam lines with minor investment will enable the digesters to have two-stage steaming with first stage at a lower pressure of about 3-4 kg/cm^2 and second stage at a higher pressure of about 9-10 kg/cm^2. The low pressure steam can be obtained from back pressure turbines. This would reduce the waiting time in steaming. As a consequence about 30 minutes saving in the average time of steaming per batch or about 6.5-7.0 hours of cumulative time saving is possible.

The installation of cold blow technique will require significant modifications in terms of additional hot liquor accumulator, white liquor heat exchanger, hot white liquor storage tank besides an air compressor. The advantages expected in terms of steam in cooking would be almost 0.4 million KCal per tonne of pulp compared to conventional hot blow with marginal steam saving in evaporators.

As a short term measure, a detailed energy balance should be made around the existing blow heat recovery section. This section produces hot water at 65-70°C for use in washing section by condensing the blow flash vapors in a 2 stage direct contact condensor and stores water in accumulatic tank and hot water storage tank. The inadequacy of capacity here can be suitably removed.

4. Generally in mills following kraft cooking cycle, holding time at cooking temperature is not changed from cook to cook to correct pulp properties rather it is the chemical charge that is changed. It is a common occurrence in digester operation that while steaming is going on for attaining cooking temperature the steam pressure falls. Consequently, the time for attaining the cooking temperature exceeds the allowed time. The cooking reaction is highly sensitive in high temperature and delignification has already progressed to a significant extent by the time the target cooking temperature has been reached in such cases. Cooking is required to be carried out for lesser time for these cooks. However, in the absence of H-factor integrator instruments this can not be done. Pulps obtained from these cooks therefore show lower K-number and yield. Additionally production goes down. Since steam pressure fluctuations is a

Table 1. Impact of Digester Scheduling/Modifications on Performance

Sl. No.	Operation	Reason for Bottle-Necks	Suggested Improvement	Anticipated saving in time
1.	Loading	Inadequate Feeding Capacity	i) Improved feeding arrangement ii) Additional feed bins	Av. time reduced to 60 mts. Cumulative saving of 4 hours
2.	Blowing	Inadequate Blowing Capacity	i) Alternation in existing Blow tank connections. ii) Increase in size of blow-lines iii) Additional blow tank	Av. time reduced to 30-35 mts. Cumulative saving of 8.5 hrs.
3.	Steaming	Inadequate steam availability at desired pressure	i) Addition of steam accumulator ii) 2-stage steaming iii) Blow heat recovery iv) Cold Blow technique v) H-factor integrator addition	Av. time reduced to 100 mts. Cumulative saving of 6.5-7.0 hrs.
4.	Un-Assigned Waiting	i) Shift change ii) Scheduled waiting	i) Improved management and supervision ii) Checking imbalances in sectional capacity at washing	Significant saving in idle time of atleast 5-6 hours.

perennial problem. A H-factor integrator set at a target H-factor will be extremely beneficial in terms of uniformity of pulp properties and reduced production loss. The reduction in cooking time for longer steaming cycles is then possible reducing the steam demand marginally.

5. From the figure it will be observed that there are long hours of gap between two successive operations due to no apparent reason. There are also human factors which with proper understanding can bring about a significant saving.

The analysis of ideal time during operations showed a peculiar concentration around the shift change periods. The mill in question had shift changes at 6.00 A.M., 2.00 P.M. and 10.00 P.M. The two hour period around shift change i.e. one hour before and one after showed a period of full as far as digester operations are concerned. While cooking was continued other operations invariably received low priority. A quick look at these lost times show a cumulative loss of almost 13 hours in the 24 hour schedule over 5-digesters. With better management of shift changes, it is possible to almost eliminate this loss. In the present analysis it is felt that about 5-6 hours gain can be obtained by a mere supervision during the change hours of shifts.

The capacity of washing section is lower than the capacity of the pulping section resulting in occasional delay in pulping operations. This can be over come by detailed capacity assessment of pulping and bleaching sections.

The other areas of waiting are due to other unassigned reasons or for maintenance activities.

An impact of these measures on scheduling are summarised in Table-1.

The cumulative saving of about more than 24 hours of digester operation is possible. The present production being achieved from 5-digesters can be achieved in 4-digesters or alternatively another 25% additional production is possible from all the 5-digesters. There will still be enough scope for improvement by looking at unassigned delays. The increase in capacity utilisation will have its favorable impact in bringing down the specific energy consumption and improving the economy.

The study reveals the need to systematically analyse the batch digester scheduling so that improvement in performance in respect of capacity utilisation and reduced energy consumption is possible.

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Productivity in Nitrogenous Fertilizer Industry

I.K. Suri & H.H. Jethanandani

From a meagre output of 10000 tonnes at the end of 1950, fertilizer production in India increased to a staggering 6.7 million tonnes in 1988-89. From the economy's point of view, the fertilizers is a crucial industry because of the fact that the performance of its agriculture sector in general and food grains production in particular is heavily dependent on the supplies from this industry. In this report, parameters like capacity, production, energy consumption, maintenance, plant availability etc. are reviewed and major bottleneck areas identified.

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Growth of Fertilizer Industry

Indian Fertilizer Industry has grown substantially in capacity and production from the early fifties when the first integrated fertilizer plant went into commercial production at Sindri in Bihar. Today, India ranks fourth in the world in terms of nitrogenous fertilizers production. From a meagre output of 10,000 MT of 'N' by the end of 1950, fertilizer production stood at 6.712 million tonnes in 1988-89 (Table 1). The planned growth of fertilizer industry in our country is the outcome of an approach basically aimed at achieving self-sufficiency in food production :

Table 1. Capacity and Production of Nitrogenous Fertilizer Plants and and Financial Outlays on a cumvulative basis

	No. of Plants	Capacity** 'N' (Million Tonnes)	Production 'N' (Million Tonnes)	Financial Outlays (Rs. Crores)
1979-80				2496.1
1980-81	36	4.586	2.164	
1981-82	37	4.719	3.143	
1982-83	39	5.174	3.429	
1983-84	40	5.200	3.491	
1984-85	41	5.592	3.917	4109.8
1985-86	46	6.695	4.323	5100.6
1986-87	47	6.800	5.412	6597.6
1987-88	49	7.033	5.466	7020.5
1988-89	52	8.148	6.712	9296.0

** As at the end of the year viz. 31st March.

Source : FAI Fertilizer Statistics : 1988-89. P. 1-32

Production of nitrogenous fertilizers is spread over 52 plants located all over the country. In these plants, a wide variety of feedstocks are used. Hydrocarbon feedstocks of diverse origins like natural gas, associated gas, naphtha, fuel oil/LSHS and coal etc. have been used in the capacity build up phase for augmenting fertilizer production. As a consequence, our country has the distinction of not only using a wide variety of feedstocks but also a wide variety of technologies of different vintages as well. The share of

different feedstocks and change in their usage over the years is shown in Table 2.

Table 2. Feedstock-wise shares in total capacity (%)

	Feedstock				
	Natural Gas	Naphtha	Fuel Oil/LSHS	Coal	Others*
1985-86	31.0	38.0	17.0	7.0	7.0
1986-87	32.9	32.9	17.1	6.6	10.5
1987-88	34.1	35.3	16.6	6.4	7.6
1988-89	41.0	30.5	14.4	5.6	8.5

* 'Others' include Coke/Coal, Electricity, Ammonia external supply.

Source : Fertilizer Statistics : 1988-89

In our country, nutrient 'N' is being produced in the form of Urea, Ammonium Sulphate, Ammonium Chloride, Calcium Ammonium Nitrate as the straight form and also in the form of Complex fertilizers which contains Nitrogen + Phosphorous and Nitrogen + Phosphorous + Potassium. In 'N' production, Urea in prilled form dominated the scene with a share of 82.7% out of a 87.1% share of production of straight form of nitrogenous fertilizers.

Natural Gas is the most preferred feedstock in the production of Ammonia which is the most important intermediate product in the manufacture of nitrogenous fertilizers but due to its meagre availability in the country in the seventies, there were only a few plants based on this feedstock. However, with the availability of natural gas in large quantities from Bombay High, the pattern of feedstock has shifted towards natural gas and in the coming years, it is expected that more of new plants and also some of the old plants will use natural gas or change over to natural gas. This situation has an important bearing on the productivity in the fertilizer plants as such plants are simpler in process, reliable in operations and less energy intensive (Table 3).

Table 3. Energy Consumption by Ammonia Plants based on different process routes & feedstocks

Feedstock	Process Route	Energy Consumption* (MK Calories/Tonne Ammonia)
Natural Gas/ Associated Gas	Reformation	8.0 - 8.5
Naphtha	Reformation Partial Oxidation	9.0 - 9.5
Fuel Oil/LSHS	Partial Oxidation	11.2 - 13.5
Coal	Gasification	16.0 - 17.0

* Battery limit design figures of process licensors

Source : FAI Workshop on Energy Conservation 1983.

Production Performance

The production performance of plants in terms of nitrogen is shown in Table 4.

Table 4. Production & Capacity Utilisation Performance of Plants

	No. of Plants in Prodn.	Installed* Capacity	Production	Capacity Utilisation**
		Million Tonne 'N'	Million Tonne 'N'	(%)
1985-86	46	6.695	4.323	72
1986-87	47	6.838	5.412	79
1987-88	49	7.883	5.466	78
1988-89	52	8.148	6.712	85

* As at the end of the year viz. 31st March

** Capacity Utilisation has been worked out after taking into account the dates of commissioning of new plants/expansions/closures/trial runs.

Source : FAI Fertilizer Statistics : 1988-89 P. 132

Feedstock-wise share in production and its effect on capacity utilisation is shown in Table 5.

Table 5. Share of different feedstocks & capacity utilisation in the production of fertilizers

Year	Natural Gas/ Associated Gas	Naphtha	Fuel Oil	Coal	Others
1985-86					
a) Share in Production %	30.9	37.3	17.4	6.7	7.7
b) Capacity Utilisation %	85.0	85.0	75.0	31.0	85.0
1986-87					
a) Share in Production %	34.6	38.8	17.1	3.2	7.5
b) Capacity Utilisation %	83.0	84.0	82.0	38.0	78.0
1987-88					
a) Share in Production %	40.2	31.8	19.0	2.5	6.5
b) Capacity Utilisation %	92.0	70.0	88.0	31.0	67.0
1988-89					
a) Share in Production %	43.1	31.4	15.4	1.5	8.6
b) Capacity Utilisation %	95.0	84.0	88.0	22.0	85.0

Source : FAI Annual Review 1989

Table 6. Zone-wise Performance in Production & Capacity Utilisation

Zone	1985-86				1986-87				1987-88				1988-89			
	No. of Plants	Capa-city ('000 Tonne 'N')	Prodn. ('000 Tonne 'N')	CU. %	No. of Plants	Capa-city ('000 Tonne 'N')	Prodn. ('000 Tonne 'N')	CU %	No. of Plants	Capa-city ('000 Tonne 'N')	Prodn. ('000 Tonne 'N')	CU. %	No. of Plants	Capa-city ('000 Tonne 'N')	Prodn. ('000 Tonne 'N')	CU. %
East	13	1188.0	389.8	35	13	1253.0	549.3	44	14	1405.0	668.2	50	14	1412.0	609.7	43
North	8	1397.0	1057.8	76	8	1397.0	1135.2	81	8	1397.0	1114.7	80	10	2065.0	1584.3	88
South	12	1314.0	946.0	72	12	1380.0	1146.7	84	12	1372.0	845.5	62	12	1440.0	1188.8	84
West	13	2796.0	1929.3	86	14	2838.0	2581.0	91	15	2897.0	2037.2	98	16	3231.0	3329.6	105
All India	46	6695.0	4322.9	72	47	6868.0	5412.2	79	49	7071.0	5465.6	78	52	8145.0	6712.4	85

Source : FAI Annual Reviews : 1984 to 1989

Table 7. Sector-wise Performance in Production & Capacity Utilisation

Sector	1985-86				1986-87				1987-88				1988-89			
	No. of Plants	Capa-city ('000 Tonne 'N')	Prodn. ('000 Tonne 'N')	CU. %	No. of Plants	Capa-city ('000 Tonne 'N')	Prodn. ('000 Tonne 'N')	CU. %	No. of Plants	Capa-city ('000 Tonne 'N')	Prodn. ('000 Tonne 'N')	CU. %	No. of Plants	Capa-city ('000 Tonne 'N')	Prodn. ('000 Tonne 'N')	CU. %
Public	25	3804.1	2046.7	53.8	26	4003.1	2514.1	62.8	26	4343.2	2649.6	60.9	28	4331.0	3079.0	71.1
Co-operative	4	1156.0	590.0	51.0	4	1198.0	1118.0	93.3	4	1532.0	1200.8	78.3	5	1532.0	1590.0	103.8
Private	17	1802.1	1985.1	110.1	18	1883.0	1780.9	94.53	18	2284.0	1615.2	70.8	19	2283.0	2042.0	89.44
All India	46	6762.0	4322.9	73.0	47	7084.1	5413.0	79.0	49	8159.2	5465.6	78.0	52	8146.8	6712.14	85.0

Source : FAI Annual Reviews : 1984 to 1989

Capacity Utilisation on All India Basis

On an All India Basis, the capacity utilisation has shown an improvement of 13% between 1985-86 and 1988-89.

On Feedstock Basis

a) Gas-based plants showed an improvement of 10% in capacity utilization.
b) Naphtha based plants had a fall of 1.0% in capacity utilization.
c) Fuel oil based plants showed an improvement of 13% in capacity utilization.
d) Coal based plants showed a fall of 9% in capacity utilization.
e) There was no change in the capacity utilization under the category of 'Others' as feedstock.

On Zone-wise Basis

a) Plants in the Eastern Zone showed an improvement of 8% in capacity utilization.
b) In the Northern Zone plants, there was an improvement of 12% in capacity utilization.
c) Plants in Southern Zone showed an improvement of 12% in capacity utilization.
d) There was 9% improvement shown by plants in Western Zone in capacity utilization.

On Sector-wise Basis

a) Public Sector plants had an improvement of 17.3% in capacity utilization.
b) Co-operative Sector plants improved by 52.8% in capacity utilization.
c) Private Sector plants showed a fall of 20.56% in capacity utilization.

Analysis of Trends in Production Performance

On All-India Basis

The contributory factors in an improvement of 13% in capacity utilization are analysed as :

a) Three giant gas-based plants at Vijaypur, Aonla & Jagdishpur based on HBJ pipeline went into commercial production in a single year.
b) Capacity utilization of gas-based plants attained a high level of 95%.

c) Out of 52 'N' plants, 30 plants attained capacity utilization of above 80% against 18 in the previous year due to:

i) Lower downtime and better stream days efficiency.

ii) Revamping & modernisation projects commissioned.

Gas-based

The major contributory factor for improvement in capacity utilization is good performance of gas-based plants at Thal & Hazira and three plants on HBJ pipeline going into production and achieving high capacity utilization (95%) during 1988-89.

Naphtha-based

On an overall basis, there is a fall of 1% in the capacity utilization of Naphtha-based plants between 1985-86 and 1988-89. In 1987-88, the capacity utilization slumped to 70% and again rose to 84% in 1988-89. Analysis of the events shows the following contributory factors :

i) Water shortage faced by one of the Naphtha-based plants in the Southern Zone.

ii) Poor quality of Naphtha as feedstock.

iii) Revamping of Reformer going on in one of Naphtha-based plants in the Northern Zone.

IFFCO-Phulpur plant is one of the typical examples where capacity utilization had a quantum jump after revamping of the Reformer. This is shown below :

Year	Capacity Utilization
1985-86	80.3%
1986-87	95.2%
1987-88	78.7%
1988-89	115.15%

Fuel-oil based

Fuel-oil based plants have shown an improvement of 13%. This has taken place due to de-bottleneckings undertaken, better performance of Synthesis Gas Compressor manufacture by BHEL and commissioning of captive power plants.

Coal-based

Capacity utilization of both the coal-based plants remains very poor. These plants are having major equipment problems which are still unresolved. The problems of these plants are further aggravated due to power shortage, erratic power supplies and poor quality of coal. These plants are in need of major revampings for which actions are yet to be taken.

Zone-wise Analysis

The different zones as standardised by Fertilizer Association of India consist of following States :

Eastern Zone : Assam, Bihar, Orissa, West Bengal
Northern Zone : Haryana, Punjab, Uttar Pradesh
Southern Zone : Andhra Pradesh, Karnataka, Kerala, Tamil Nadu
Western Zone : Gujarat, Madhya Pradesh, Maharashtra, Rajasthan, Goa

Table 8. Distribution of Plants in Eastern Zone

As in 1988-89

S.No.	Name of Plant & Location	Sector	Feedstock (NH3 TPD)	Vintage	End Product	Capacity ('000 tonne)
1.	FCI-Sindri (Bihar)	Public	Fuel oil (900)	1980	Ammonium Sulfate Urea	320 330
2.	FCI-Talcher (Orissa)	Public	Coal (900)	1980	Urea	495
3.	HFC-Barauni (Bihar)	Public	Naphtha (600)	1976	Urea	330
4.	HFC-Durgapur (W.Bengal)	Public	Naphtha (600)	1974	Urea	330
5.	HFC-Namrup	Public				
	a) Namrup-I & II		Natural Gas (200+Gas) (200+600)	1969 Expn. 1976	Ammonium Sulfate Urea	100 330 55
	b) Namrup-III		Natural Gas (600)	1987	Urea	
6.	HLL-Haldia (W. Bengal)	Private	Ext. NH3	1986	DAP	154
7.	PPL-Paradeep (Orissa)	Public	Ext. NH3	1986	DAP	720

(*Contd.*)

Table 8 (*Contd.*)

As in 1988-89

S.No.	Name of Plant & Location	Sector	Feedstock (NH3 TPD)	Vintage	End Product	Capacity ('000 tonne)
8.	SAIL-Rourkela (Orissa)	Public	Naphtha (450)	1962/69/79	CAN	480.0
9.	SAIL-Bokaro (Bihar)	Public	C.O.G.	1979	Ammonium Sulfate	36.3
10.	SAIL-Durgapur	Public	C.O.G.	1960	Ammonium Sulfate	21.2
11.	SAIL-Rourkela (Orissa)	Public	C.O.G.	1967	Ammonium Sulfate	28.2
12.	IISCO-Bumpur (W. Bengal)	Private	C.O.G.	1947	Ammonium Sulfate	23.0
13.	TISCO-Jamshedpur (Bihar)	Private	C.O.G.	1933	Ammonium Sulfate	23.1

Source : Fertilizer Statistics 1988-89

Table-8 (a) Share of Feedstocks in Eastern Zone

As in 1988-89

Feedstock	Share	No. of Plants
Gas	28.8%	2
Naptha	52.50%	3
Fuel Oil	18.5%	1

Notes: Out of a total 14 plants, 7 plants are part of Steel Plants producing Ammonium Sulfate as a by-product from Coke Oven Gas. One plant uses imported Ammonia for making Diamoniun Phosphate.

Table 8(b) Production Performance of Plants in Eastern Zone

S.No.	Name of Plant	Product	Capacity Utilisation (%)			
			1985-86	86-87	87-88	88-89
1.	FCI-Sindri	Urea	33.4	59.4	64.8	61.6
2.	FCI-Talcher	Urea	23.2	49.5	23.6	31.0
3.	HFC-Barauni	Urea	61.0	40.4	50.1	42.7
4.	HFC-Durgapur	Urea	30.39	33.4	38.1	18.0
5.	HFC-Namrup					
	a) Namrup-I & II	Urea & Amm. Sulfate	38.5	53.0	53.3	32.9
	b) Namrup-III	Urea	-	-	35.7	51.1
6.	HLL-Haldia	DAP*	6.0	60.3	75.7	102.5
7.	PPL-Paradeep	DAP	-	58.5	58.6	86.7
8.	SAIL-Rourkela	CAN**	39.6	33.5	35.8	42.1
9.	SAIL-Bokaro	Amm.*** Sulfate	36.0	60.0	69.7	90.7
10.	SAIL-Durgapur	-do-	27.3	22.2	25.0	25.0
11.	SAIL-Rourkela	-do-	28.75	36.2	27.6	44.8
12.	IISCO-Burnpur	-do-	10.6	12.7	14.9	25.5
13.	TISCO-Jamshedpur	-do-	56.25	66.6	58.3	56.2

* Diammonium Phosphate
** Calcium Ammonium Nitrate
*** By-Product of Coke Oven Gas
Start of raw material production

Source: Information derived from FAI Fertiliser Statistics 1985-89.

Eastern Zone

It may be seen that though the installed capacity in Eastern Zone is 1.405 Million Tonnes, the capacity utilization of plants is the lowest (43%).

The reasons of low capacity utilization of plants in Eastern Zone plants are analysed as :

1) Out of 14 plants in the Eastern Zone, 7 plants produce Ammonium Sulphate as a by-product. These plants are part of steel plants vintages of which vary from 1933 to 1979.

2) There are two gas-based plants, the vintage of one being 1969 with an expansion in 1976. The other plant went into commercial production in 1987.

3) Three Naphtha-based plants having 52.5% share in the production of Ammonia are of vintages 1962, 1974 & 1976 respectively.

4) Leaving aside 7 plants which are part of the steel plants and 1 DAP plant, out of the balance 6 plants, the vintages of 5 plants are between 19 and 21 years.

5) Technologies used in these plants are old and energy intensive.

6) Except for two expansions of the gas-based plants, there has been no expansion in other plants.

7) Except for modernization of FCI (Sindri) plant, no modernization has taken place in the other plant.

8) Coal-based Talcher plant remains sick due to unproven technology adopted, major equipment problems, and with no major action on revamping and modernization.

9) The work culture in the Eastern Zone is another contributory factor to low capacity utilization. Repeated labour problems in public sector plants is a major contributory factor.

Table 9. Distribution of Plants in Northern Zone

As in 1988-89

S.No.	Name of Plant & Location	Sector	Feedstock (NH3 TPD)	Vintage	End Product	Capacity ('000 tonne)
1.	FCI-Gorakhpur (U.P.)	Public	Naphtha (550)	1969/76	Urea	284.9
2.	Hari Fertilizers-Varanasi (U.P.)	Private	Coke (40)	1958	Ammonium Chloride	41.0
3.	ICI (India), Kanpur (U.P.)	Private	Naphtha (900)	1969/70/81	Urea	675.0
4.	IFFCO-Phulpur (U.P)	Co-op.	Naphtha	1981	Urea	495.0
5.	IFFCO-Aonla (U.P.)	Co-op.	Gas (1350)	1988	Urea	726.0
6.	Indo-Gulf Fertilisers; Jagdishpur (U.P.)	Private	Gas (1350)	1988	Urea	726.0
7.	NFL-Bhatinda (Punjab)	Public	Fuel Oil (900)	1979	Urea	511.0
8.	NFL-Nangal (Punjab)	Public	Power+F. Oil (300+900)	1961/78	CAN Urea	320.0 330.0
9.	NFL-Panipat (Haryana)	Public	Fuel Oil (900)	1979	Urea	511.0
10.	PNFC-Naya Nangal (Punjab)	Private	Ext. Ammonia	1985	Ammonium Chloride	66.0

Source : Fertiliser Statistics 1988-89.

Table 9(a). Share of Feedstocks in Northern Zone

As in 1988-89

Feedstock	Share	No. of Plants
Gas	32.16%	2
Naptha	32.10%	3
Fuel Oil	32.16%	3
Electricity	3.57%	1

Notes : Out of 10 plants, one plant produces by-product Ammonium Chloride by taking External Ammonia for the manufacture of Soda Ash.

Table 9(b). Production Performance of Plants in Northern Zone

S.No.	Name of Plant	Product	Capacity Utilisation (%)			
			1985-86	86-87	87-88	88-89
1.	FCI-Gorakhpur	Urea	59.5	64.2	59.0	57.25
2.	Hari Fertilizers, Varanasi	Amm.* Chloride	39.0	31.0	41.0	13.0
3.	ICI (India), Kanpur	Urea	86.12	86.54	74.8	83.8
4.	IFFCO-Phulpur	Urea	84.0	88.6	80.48	118.8
5.	IFFCO-Aonla	Urea	-	-	-	76.8**
6.	Indo-Gulf Fertilizers Jagdishpur	Urea	-	-	-	37.7**
7.	NFL-Bhatinda	Urea	71.4	71.9	86.1	76.17
8.	NFL-Nangal	Urea & CAN	85.7	82.7	87.0	86.2
9.	NFL-Panipat	Urea	60.42	80.42	87.23	87.6
10.	PNFC-Naya Nangal	Amm* Chloride	41.2	38.2	40.0	36.7

* By-Product of Soda Ash
** Start of Commercial Production

Source : Information derived from FAI Fertiliser Statistics 1985-89

2) *Northern Zone*

1) Overall capacity utilization of plants in Northern Zone was 88% in 1988-89. There are 10 plants in this Zone. Out of which, one plant produces Ammonium Chloride as a by-product from Soda Ash.
2) There are two gas-based, three Naphtha-based, and three fuel-oil based plants in this zone with one plant being based on electricity which has since been phased out. The share of feedstock is equally distributed among Gas, Naphtha & Fuel Oil based plants.
3) Except for three plants where the vintages vary from 1958 to 1969, the vintages of seven plants vary from 1978 to 1985. In other words, the vintages of majority of plants is in the range of 4-12 years.
4) The technologies adopted in the plants were well proven and energy efficient at Aonla and Jagdishpur in U.P.
5) There are two latest series of Gas-based plants on HBJ Pipeline in this Zone. These plants achieved high capacity utilization during 1988-89.
6) Plants like ICI (Kanpur) and NFL (Nangal) went in for expansions at the appropriate time so that plants could increase and maintain a high level of production.
7) Plants like NFL (Bhatinda) and NFL (Panipat) went in for installation of captive power plants which were commissioned in 1988-89. With these installations, the performance of these plants has improved.
8) Work culture in Northern Zone is good and labour problems are comparatively less.

Table 10. Distribution of Plants in Southern Zone

As in 1988-89

S.No.	Name of Plant & Location	Sector	Feedstock (NH3 TPD)	Vintage	End Product	Capacity ('000 tonne)
8.	SAIL-Rourkela (Orissa)	Public	Naphtha (450)	1962/69/79	CAN	480.0
1.	EID Parry (India) Ennore (Tamil Nadu)	Private	Ext. Ammonia	1963	APS 16-20-0	51.5
2.	FACT (Kerala)	Public	Naphtha	1947/60/62	Amm. Sulfate	
	a) Alwaye Plant		(355)	67/71	APS 20-20-0 16-20-0	
	b) Ambalamedu Plant Cochin-I		Naphtha (600)	1973	Urea	330.0
	c) Ambalamedu Plant Cochin-II		Ext. Ammonia	1976	NP/NPK Mixture & DAP	485.0
3.	FCI-Ramagundam (A.P.)	Public	Coal (900)	1980	Urea	495.0
4.	GFC-Kakinada (A.P.)	Private	Ext. Ammonia (900)	1988	DAP	300.0
5.	MFL-Manali (Tamil Nadu)	Public	Naphtha (750)	1971/76	Urea DAP NAP & NPK	292.0 540.0
6.	MCFL-Mangalore (Karnataka)	Private	Naphtha (660) Ext. Ammonia	1976/86	Urea DAP	390.0
7.	NLC, Neyveli (Tamil Nadu)	Public	Fuel Oil (285)	1966/79	Urea	152.0
8.	Rashtriya Ispat Nigam-Vizag (A.P.)	Private	C.O.G.	1989	Ammonium Sulfate	41.7
9.	SPIC-Tuticorin (Tamil Nadu)	Private	Naphtha (1100)	1976/77/83/88	Urea DAP	512.0 415.0
10.	CFL-Vizag (A.P.)	Private	Naphtha (357)	1967	Urea NP/NPK	347.5

Source : Fertilizer Statistics 1988-89

Table 10(a). Share of Feedstocks in Southern Zone

As in 1988-89

Feedstock	Share	No. of Plants
Gas	-	-
Naptha	74.51	6
Coal	19.35	1
Fuel Oil	6.13	1

3) *Southern Zone*

1) Overall capacity utilization of plants in Southern Zone was 84% in 1988-99. Out of the total 12 plants in this Zone, there are 8 plants producing Ammonia, of which 6 are Naphtha-based, 1 coal-based and 1 fuel-oil based. There is no gas-based plant in this Zone.

2) The vintages of Naphtha-based plants vary from 1967 to 1983 i.e. the plants are 6-23 years old. The oldest plant of FACT-Alwaye (1947) underwent modernization in 1960/62-67 & 71 and one more Naphtha-based plant (600 TPD Ammonia) was added in the Complex in 1973. Similarly, SPIC-Tuticorin

Table 10(b). Production Performance of Plants in Southern Zone

S.No.	Name of Plant	Product	Capacity Utilisation (%)			
			1985-86	86-87	87-88	88-89
1.	FCI-Gorakhpur	Urea	59.5	64.2	59.0	57.2
1.	EID Parry (India) Ennore	APS	60.0	140.0	132.5	176.2
2.	FACT					
	a) Alwaye	APS	74.3	66.2	66.2	77.0
	b) Ambalmedu-I	Urea	37.0	69.5	58.4	79.9
	c) Ambalmedu-II	NP/NPK	160.0	99.0	103.8	116.6
3.	FCI-Ramagundam	Urea	24.3	49.5	23.6	31.0
4.	GFC-Kakinada	DAP	-	-	-	57.6*
5.	MFL-Manali	Urea & DAP	73.3	89.2	25.6	84.0
6.	MCFL-Mangalore	Urea & DAP	70.5	81.2	49.7	83.9
7.	NLC-Neyveli	Urea	84.4	84.8	83.0	91.7
8.	Rashtriya Inspat Nigamvizag	Amm. Sulfate	-	-	-	-**
9.	SPIC-Tuticorin	Urea & DAP	105.1	113.9	88.8	105.9
10.	CFL-Vizag	Urea NP/NPK	97.3	88.8	86.9	103.8

*Start of Commercial Production
**Plant Completion delayed.
Source : Information derived from FAI Fertiliser statistics 1985-89.

plant had first expansion in 1977 and second in 1983. Neyveli plant is a case of timely retrofitting. This plant was established in 1966 using lignite as feedstock. Due to problems associated with the gasification of lignite & equipment problem, the capacity utilization was very low. The plant switched over to fuel-oil as feedstock and the Front End of the plant was suitably retrofitted in 1979. Since then the plant has been running on high capacity utilization.

3) One coal-based plant, FCI (Ramagundam) like FCI (Talcher) in Eastern Zone, is chronically sick. The plant continues to have poor performance and there is further deterioration in the performance due to accumulation of equipment problems, power shortages, frequent power interruptions and bad quality of coal. There is no captive power plant provided in the plant.

4) Work culture in the Zone is good and labour problems are lower.

5) MFL (Manali) has to face a water shortage problem causing loss of production.

4) *Western Zone*

1) Overall capacity utilization of plants in this Zone is 105% in 1988-89, which is the highest amongst all the Zones. This Zone has the maximum installed capacity (3.231 Million Tonnes 'N'). This Zone has the maximum number of plants i.e. 16, of which 10 are gas-based, 2 Naphtha-based and 1 fuel-oil based. Out of the 10 gas-based plants, 5 are of recent vintage (1985-88). Two plants of 1965 & 75 vintages and one plant of 1982 vintage (RCF-Trombay, I to IV 1965 vintage) are undergoing extensive revamping in Ammonia and Urea plants. IFFCO-Kalol plant (1975 vintage) which has been working on high capacity all-through carried out extensive revamping of Reformers twice to sustain high level of production.

2) GNFC (Bharuch's) fuel-oil based plant (1982) has the best production record amongst fuel-oil based plants. Both the Naphtha-based plants namely Shriram Fertilizers & Chemicals, Kota (1969) and Zuari Agro

Table 11. Distribution of Plants in Western Zone

As in 1988-89

S.No.	Name of Plant & Location	Sector	Feedstock (NH3 TPD)	Vintage	End Product	Capacity ('000 tonne)
1.	IFFCO-Kalol (Gujarat)	Co-op.	Natural/ Associated Gas (910)	1975	Urea	392.0
2.	IFFCO-Kandla (Gujarat)	Co-op.	Ext.Ammonia	1974/81	NP/NPK	800.0
3.	KRIBHCO-Hazira (Gujarat) (2 plants)	Co-op.	Natural/Associated Gas (1350x2)	1986	Urea	1452.0
4.	RCF-Thal Vaishet (Maharashtra (2 plants)	Public	Natural/Associated Gas (1350x2)	Plant-I (1985) Plant-II (1986)	Urea	1450.2
5.	RCF-Trombay-I to V (Maharashtra)	Public	Natural/Associated Gas (350)	1965/76/78	Urea Nitro Phosphate Amm.Nitro-Phosphate	1047.0 300.0 360.0
6.	RCF-Trombay V (Maharashtra)	Public	Natural/Associated Gas (900)	1982	Urea	330.0
7.	SAIL-Bhilai (M.P.)	Public	C.O.G.	1955/59/83	Ammonium Sulfate	32.5
8.	SFC-Kota (Rajasthan)	Private	Naphtha (600)	1969/74	Urea	330.0
9.	Deepak Fertilizers & Petrochemicals Taluja (Maharashtra)	Private	Natural/Associated Gas (90)	1983	NH3	90.0
10.	ZACL-Goa	Private	Naphtha (660)	1973/75	Urea NPK DAP	340.0 150.0 150.0
11.	NLF-Vijaipur (M.P.)	Public	Natural Gas (1350)	1988	Urea	726.0
12.	GNFC-Bharuch (Gujarat)	Private	Fuel Oil (1350)	1982	Urea	594.0
13.	GSFC-Baroda (Gujarat)	Private	Natural Gas & Naphtha (500+450) (2 plants)	1967 1969 1974	Urea Amm. Sulfate DAP	367.0 228.0 108.0
14.	GSFC, Sikka	Private	Ext. Ammonia	1987	DAP	328.0

Source : Fertilizer Statistics 1988-89

Chemicals Goa (1973) are achieving 90-100% capacity utilization even though the plants are 17-21 years old. The factors responsible for the good performance of these plants are :

i) Selection of technologies which are well proven & equipment which is very reliable;
ii) Timely expansions, retrofitting & revamping; and
iii) Good work culture & disciplined work force.

3) Western Zone has the advantage of having 5 gas-based giant plants (1350 MTD Ammonia in single stream). Latest, well proven & energy efficient technologies have been used in these plants.

Table 11(a). Share of Feedstocks in Western Zone

As in 1988-89

Feedstock	Share	No. of Plants
Gas	75.73%	10
Naptha	13.56%	2
Fuel Oil	10.70%	1

Table 11(b). Production Performance of Plants in Western Zone

S.No.	Name of Plant	Product	Capacity Utilisation (%)			
			1985-86	86-87	87-88	88-89
1.	IFFCO-Kalol	Urea	104.6	104.6	96.1	99.2
2.	IFFCO-Kandla	NP/NPK				
3.	KRIBHCO-Hazira	Urea	18.9 *	95.2	108.8	114.3
4.	R.C.F.					
	a) Thal	Urea	35.1 *	70.16	89.3	97.6
	b) Trombay-I to IV	Urea NP/ANP	92.7	89.3	94.5	101.0
	c) Trombay-V	Urea	89.4	101.1	78.9	104.6
5.	SAIL-Bhilai	Amm. Sulfate	103.0	85.0	79.1	112.0
6.	SFC-Kota	Urea	107.2	96.7	75.0	93.4
7.	DF & P -Taluja	Ammonia	NA	NA	NA	NA
8.	ZACL-Goa	Urea & DAP	96.6	108.5	101.5	104.0
9.	NFL-Vijaypur	Urea	-	-	14.0 *	83.6
10.	GNFL-Bharuch	Urea	99.2	106.8	110.6	112.0
11.	GSFC-Baroda	Urea	107.0	106.7	105.0	113.5
12.	GSFC-Sikka	DAP	-	-	30.5 *	102.8

*Start of Commercial Production.

Source: Information derived from FAI Fertilizer Statistics 1985-89.

Energy Consumption and Energy Productivity

Nitrogenous fertilizer plants are highly energy intensive and bulk of energy (60 - 80%, depending upon process route) is consumed in the manufacture of ammonia which is an intermediate product. Energy productivity has, therefore, a very important bearing on the productivity in fertilizer plants.

There are mainly three factors which have very significant bearing on the energy productivity. These are :

i) Type of feedstock
ii) Process route followed
iii) Capacity utilization

The first two factors determine the energy consumption pattern and the third factor determines the energy productivity. Plant performance is a controllable factor and provides the basis for determining the efficiency of plant operations.

As stated earlier, in our country, we have nitrogenous fertilizer plants using a wide variety of feedstocks. Natural Gas/Associated Gas is the most preferred feedstock for ammonia production the world over, as it consumes lowest energy amongst the different feedstocks in the production of ammonia. The usage of a wide variety of feedstocks in our country is the outcome of a constantly changing scene in regard to the availability of different feedstocks. If we trace back the history of fertilizer plants, it would be observed that in the early forties with availability of quality coal, the first plant at Sindri was based on coal as the feedstock. By mid-sixties, due to a number of refineries coming up in the country, naphtha was available as surplus and fertilizer production from naphtha was encouraged. A few years later, with the setting up of petrochemical plants in the country, where naphtha is a premium feedstock, the availability of naphtha for fertilizer production became limited. At this stage, as a national policy, use of feedstocks other than naphtha has been encouraged in future fertiliser plants.

During mid-seventies, there was a big jump in the refining capacity and the residues from the refineries in the form of Fuel Oil started posing problems of disposal. In these circumstances there was a shift, in the feedstock policy towards new fertilizer plants being based on fuel-oil. Six fuel-oil based fertilizer plants were established between 1978 and 1986. During the same period, the country had made rapid strides in coal production and abundant availability of low-grade coal was established in order to utilise low-grade coal in large quanities, two plants were set up using coal as feedstock.

Towards the close of seventies with the successful exploration of oil and gas in Bombay High area, the availability of gas was established and logically the Government decided to establish new fertilizer plants in the near by areas and elsewhere using natural gas as feedstock. 10 large size fertilizer plants were thus planned, based on natural gas by making the gas available through pipeline between Bombay High and Jagdishpur in U.P. Out of the ten plants, four plants based on Bombay High at Thal & Hazira and three plants on HBJ pipeline at Vijaipur, Aonla and Jagdishpur are currently operative. Remaining three plants are expected to become operative

during the 8th Five Year Plan period. There are three gas-based plants of vintages between 1969 and 1982. One plant uses natural gas as available in Assam oilfields, one gas-based plant is located in Gujarat using gas as available in the zone. The third plant located at Trombay in Maharashtra has changed over to Associated Gas as available from Bombay High and later on expanded using Associated Gas as feedstock. Table 12 shows the number of plants based on different feedstocks & changes in the feedstock pattern over the years.

Table 12. Feedstock Changes in Fertilizer Plants over the years

Plan Period	Year	Gas	Naphtha	Fuel Oil	Coal
		No. of Plants	No. of Plants	No. of Plants	No. of Plants
I	1951-56	-	-	-	1*
II	1956-61	-	-	-	1
III	1961-66	1	-	-	-
Annual Plans	1966-69	2	3	-	-
IV	1969-74	-	8	-	-
V	1974-79	3	14	-	2
VI	1979-80	-	-	5	-
VII	1980-85	7	16	6	-
VIII	1985-90	13	-	-	-
IX	1990-95	16	-	-	-

*Since scrapped

Source : Information derived from FAI Fertiliser Statistics 1985-89.

From Table 13, it is seen that energy consumption in the nitrogenous fertilizer plants, using different feedstocks, process technologies and vintages has reduced by 22% in a period of six years or at an average rate of about 3.6% per year. This is corresponding to an improvement of 29% in capacity utilization during the same period.

Table 13. Energy Consumption for Ammonia Production (All India Basis)

Year	Total No. of Plants	Capacity Utilisation %	Energy Consumption MKCal/Te NH3
1985-86	46	72	13.6
1986-87	47	79	12.6
1987-88	49	78	12.4
1988-89	52	85	11.5

Source : Data collected from FAI.

Table 14 shows that the energy consumption in plants using natural gas/associated gas/naphtha and steam reformation route, reduced by 8.2% over a period of three years. The improvement in capacity utilization was 12.0% over the same period. The plants based on fuel-oil showed a reduction of 4.5% in energy consumption during the three years. Capacity utilization improved by 6% during the same period. Plants using coal as feedstock had a reduction of energy consumption by 2.2% and a fall of 6% in capacity utilization.

Table 14. Energy Consumption for Ammonia Production Feedstock-wise (All India Basis)

MKCal/Te NH3

Year	1986-87			1987-88			1988-89		
Feed stock	%Cap. Utilisation	Av. Energy Consmpn.		%Cap. Utilisation	Av.Energy Consmpn.		%Cap. Utilisation	Av. Energy Consmpn.	
	(%)			(%)			(%)		
Gas	83	10.06	11.88	92	9.56	11.28	95	9.52	10.91
Naphtha	84	12.35		70	13.32		84	12.30	
Fuel Oil	82	14.44		88	13.74		88	13.75	
Coal	38	32.99		32	31.50		22	32.30	

Source : Data collected from FAI.

Fertilizer Association of India carried out a survey of 20 Naphtha & Natural Gas based plants to analyse the performance of energy consumption in 1986 over a period of 5 years (1980-1985) and arrived at the following :

a) These plants consumed 11.13 MKCalories/Tonne NH3 as against designed energy consumption of 10.18 MKCalories/Tonne NH3.

b) The lowest average energy that could be achieved for 72 hours continuous run was 10.72 MKCalories/ Tonne NH3.

c) The average energy consumption of similar plants was 10.9 MKCalories/Tonne Ammonia in 1981 which stood at 10.5 MKCalories/Tonne Ammonia in 1985 i.e. an improvement of 3.6% over the period of 4 years.

Energy Consumption Performance in Selected Plants

Table 15 shows the actual energy consumption in selected Ammonia plants using Natural Gas/Associated Gas, Naphtha, Fuel Oil and Coal as feedstocks. It would be seen that there are wide variations in the energy consumption and wide gaps between design/guarantee and test run energy consumption.

Gas-based Plants

Between Namrup-I (1969) and Namrup-II (1976), the latter plant is consuming more energy than the older plant. Between two gas-based plants at Kalol (1975) and Trombay-V (1981), the latter plant is consuming higher energy by about 38%. Between Kalol (1975) and Hazira (1985), there is an improvement of energy consumption by about 11%. This, of course, is the outcome of better technologies used in the new gas-based plants.

Table 15. Energy Consumption in selected Ammonia Plants in India

Location of Plants	Vintage Year	Process Route	Capacity MTPD Amm.	*Design/GTR Figures	Energy Consumption (MKCal/Te NH3) 84-85	85-86	86-87	87-88	88-89
Gas Based									
HFC-Namrup-I	1969	Gas Reformation	175	NA	15.64 } 15.82	14.07 } 16.16	16.5	17.3	14.0
HFC-Namrup-II	1976	-do-	600	NA	16.00 }	18.25 }			
RCF-Trombay-1	1965	Gas Partial Oxidation	350	13.78	15.3	15.4	14.6	14.6	15.0
RCF-Trombay-V	1981	Gas Reformation	900	10.16	15.0	14.58	13.6	13.3	13.3
IFFCO-Kalol	1975	-do-	910	9.76			9.3	9.8	9.6
KRIBHCO-Hazira	1985	-do-	1350	8.5	10.25	10.39	-	8.4	8.7
Naphtha Based									
MFL-Manali	1971	Naphtha Reformation	750	12.6	13.25	14.4	13.5	17.8	13.6
FCI-Gorakhpur	1969	Naptha Partial	350	14.69	16.06	15.98	16.53	16.9	17.4
HFC-Durgapur	1974	Naptha Reformation	600	10.42	18.7	18.7	16.78	14.6	18.7
SFC-Kota	1969	-do-	450	NA	12.06	12.12	11.97	11.0	11.1
IEL-Kanpur	1971	-d0-	425x2 425(1981)	NA	9.19	9.56	9.55	14.1	11.1
IFFCO-Phulpur	1980	-do-	900	9.7	-	12.39	11.7	11.8	10.8
Oil Based									
FCI-Sindri	1979	Oil Gasification	900	12.5	17.09	19.31	17.26	17.4	17.9
NLC-Neyveli	1966	-do-	250	NA	13.31	13.39	13.56	13.2	13.2
NFL-Panipat	1979	-do-	900	14.5	14.59	17.44	14.60	14.1	14.5
GNFC-Bharuch	1982	-do-	1350	11.8	11.00	11.23	11.84	11.8	11.8
Coal Based									
FCI-Talcher	1980	Coal Dust Gasification	900	14.2	46.35	46.35	42.12	35.2	69.47
FCI-Ramagundam	1980	-do-	900	14.2	31.09	31.88	27.55	36.4	31.08

Source : Information as collected from Fertiliser Association of India & Plants.

Naphtha-based Plants

Amongst Naphtha-based plants, the performance of Kota (1969) & Kanpur (1971) plants is the best. Both these plants are in operation for the past 19-21 years. Phulpur (1980) plant during 1988-89 was the best in energy consumption performance (10.3 MKCalories/Tonne Ammonia) and has improved upon its energy consumption by 8.85%. This has been brought about by carrying out major revamping of the Reformer which was completed in 1987-88. The performance of Durgapur (1974) plant on energy front continues to be poor due to poor capacity utilization. This is the outcome of constraints which are being carried over from year to year. Except setting up of a captive power plant, no major additions and revamping in the plant have taken place.

Manali (1971) plant had a good track record of production performance and energy consumption. But of late, the energy consumption has increased due to low capacity utilisation as a result of a water shortage problem. The technology adopted in the plant is not energy efficient when compared with present day technologies. The plant has embarked upon major modernisation and revamping schemes in the reformation and gas purification with the primary aim of reducing energy consumption.

Gorakhpur(1969) plant is based on partial oxidation of Naphtha which consumes more energy than reformation route. This partly explains higher energy consumption as compared to other Naphtha based plants using reformation route. Other reasons of high energy consumption are poor capacity utilisation, power interruptions from the Grid and frequent equipment breakdowns.

Fuel-oil based Plants

Amongst fuel-oil/LSHS plants, the performance of Bharuch (1982) is the best (11.8 MKCalories/Tonne NH3). The capacity utilisation of the plant has allthrough been above 90% and the present annual energy consumption is within 4.4% of the guarantee test run figure (11.3 MKCalories/Tonne NH3). Neyveli (1966) plant is steady in energy consumption. Amongst the plants using similar oil gasification process, this plant's energy consumption is the lowest. It may be recalled that, though, the vintage of the plant is amongst the oldest, the plant underwent major retrofitting in 1982 when the lignite gasification process with energy consumption of about 16.00 MKCalories/Tonne Ammonia was changed over to partial oxidation of fuel-oil process resulted in the reduction of about 17.5% in energy consumption. Panipat (1979) plant energy consumption, when compared with Bharuch (1982) at 90% capacity utilisation is higher by 19.5%. In Sindri (1979)

plant, which is comparable with Panipat plant in all respects, the energy consumption is higher by 20.5%. Low capacity utilisation due to equipment problem and interruptions in the oil supplies are the major causes of high energy consumption in this plant.

Coal-based Plants

Coal-based plants at Talcher (1975) and Ramagundam (1975), right from the inception had major equipment constraints causing frequent plant outages which resulted in very low capacity utilisation. In recent years, in addition to equipment constraints, which are yet to be resolved, frequent power interruptions and deterioration in the quality of coal are the other factors which have not allowed these plants to come up in capacity utilisation beyond 40%.

Trends in Energy Consumption

- As would be seen from the data given in Table-15 in respect of 18 plants, 11 plants continue to consume more energy than normal with the exception of plants like Kalol(1975), Kota(1969), Kanpur(1971), Bharuch(1982) and Hazira(1985).
- Plants like Phulpur(1980) & Neyveli(1961) improved upon energy consumption by carrying out major revamping/modernisation.
- In plants like Namrup-I(1969), Namrup-II(1976), Trombay-I(1965), Manali(1971), Gorakhpur(1969), actions like modernisation of plants and/or revamping of sections like Reformation & Synthesis loops etc. are called for to take care of the high energy consumption.
- In plants like Trombay-V(1981), which is only 8 years old, steps are necessary for improvement in capacity utilisation through better operational and maintenance practices.

Plant availability

The performance of fertiliser plant is much dependent upon the availability of plant for production. The overall productivity of Indian fertiliser industry when compared with similar plants in the developed countries is low. With the aim to study the factors involved in the low availability of fertiliser plants, Fertiliser Association of India undertook a survey of 25 Ammonia plants in the country for the periods 1977-79 and 1980-84.

Based on the data collected by Fertiliser Association of India, an analysis of loss of production due to various causes was carried out and presented at Tables 16-17.

The present study team collected data of 8 plants in respect of stream days achieved and expenditure on maintenance, renewals and replacements for the period 1987-88 and 1988-89 (Table 18.) Table 19 gives performance of fertiliser plant and percentage of share in total capacity and production in various ranges of capacity utilisation is shown.

Analysis of Plant availability

1. When compared with average down time of 74.1 days/year/plant during the period 1980-84, the average down time during the period 1985-89 was 48.5 days/year/plant. There has been improvement of 15.6 days in the plant availability. However, when compared with the down time of 48.2 days/year/plant during the period 1984-87, there has been no improvement during the period 1985-

Table-16. Reasons of Loss of Production

Reasons	1985-86			1986-87			1987-88			1988-89-89-		
	Loss in Prodn. ('000MT)	% Loss in Prodn. to overall		Loss in Prodn. ('000MT)	% Loss in Prodn. to overall		Loss in Prodn. ('000MT)	% Loss in Prodn. to overall		Loss in Prodn. ('000MT)	% Loss in Prodn. to overall	
		Loss	Prodn.		Loss	Prodn.		Loss	Prodn.		Loss	Prodn.
1. Power Problems	88.3	12.5	2.0	77.9	13.0	1.4	107.8	11.1	2.0	87.9	8.9	1.3
2. Shortage of Raw Materials	17.5	2.5	0.4	22.1	8.7	0.4	173.3	17.9	3.2	262.4	25.6	3.9
3. Equipment Breakdowns	333.9	47.4	7.7	246.7	41.2	4.56	323.7	33.4	5.8	309.0	31.3	4.6
4. Labour Problems	15.0	2.1	0.35	6.7	1.1	0.1	54.2	5.6	1.0	8.1	0.8	0.1
5. Others	249.4	35.5	5.77	215.3	36.0	4.0	309.8	32.0	5.7	320.3	32.4	4.8
Total	704.1	100.0	16.22	568.7	100.0	10.48	968.8	100.0	17.7	987.7	100.0	14.7
Total Prod. of the year (000 Tonnes)	4323			5412			5466			6712		
No. of days lost/year/plant	54			34			58			48		

Source : Data derived from information as given in FAI Fertiliser Statistics 1985-89

Table 17. Downtime of Ammonia Plants*

Reasons for Failure	Downtime Days/Year/Plant	
	1980-84	1984-87
Mechanical	39.3	30.5
Electrical	4.2	5.0
Instrumentation	3.7	2.4
Process	8.1	3.90
Misc.**	18.8	6.40
Total	74.1	48.2

* Data of 25 plants. 15 Plants work on 80% and above capacity utilisation

** Raw material shortage, water shortage, natural calamities, over-run on turn-arounds etc.

Source: Fertiliser News, Dec. 1987 P. 15-17

89. World wide survey of shutdown of plants carried out in 1985 showed that on an average 35 days/year/plant were lost. Of these, the average of North American plants was 24 days/year/plant. When compared with world figures, it is obvious that the plant availability in our country has to improve further.

2. Tables 16 and 17 show that the maximum loss of production has always been due to equipment breakdowns and mechanical failures. This may be due to any one of the following reasons:

   — Vintage of equipment.
   — Poor design of equipment.
   — Non-availability of spare parts.
   — Poor maintenance.

   This area needs attention by such actions as :

   — Removal of equipment.
   — Replacement with better designed and more reliable equipment.
   — Improvement in supply of spares.
   — Improvement in maintenance.

Table 18. Comparative Production Performance & Maintenance Costs in Selected Fertilizer Plants

Plant	Year of Comm. Prodn.	End Product	Installed Capacity tonnes per Annum	Plant Performance							
				Production				Maintenance			
				Capacity Utilisation %		Stream Days Achieved		Maint. Expend. Per Annum (Rs. Lakh)		Main. Expend. Per Tonne (Rs.)	
				1987-88	1988-89	1987-88	1988-89	1987-88	1988-89	1987-88	1988-89
Naphtha Based											
1. SFC-Kota	1969/74	Urea	3,30,000	74.17 (75.06)	95.34 (93.42)	265.89	235.00	235.00	424.00	206.14	298.60
2. ZACL-GOA	1973/75	Urea	3,40,000	101.50 (101.50)	104.00 (104.00)	322.00	396.00*	386.88	449.00	192.47	217.96
3. ICI-KANPUR	1969/81	Urea	6,75,000	75.00 (74.80)	83.90 (83.80)	279.00	306.00	117.30	121.66	50.56	46.79
4. SPIC-TUTICOR	1975/77/83	Urea	5,12,000	113.00 (88.85)	107.00 (105.96)	345.00	382.00*	117.80	180.28	42.49	54.59
5. GSFC	1967/68/79	Urea-1 Urea-2 GR+DH (CAPRO)	1,03,200 2,64,000 1,48,000 80,000	101.40 99.00 (105.0)	99.20 107.20 (113.50)	344.00 322.00	408.00* 435.00*	585.30	851.83	343.00	217.53
Gas Based											
6. Kribhco Hazira	1986	Urea	14,52,000	109.70 (108.80)	117.70 (114.30)	320.00	257.00**	1154.26	759.12	158.73	99.36
Oil Based											
7. GNFC Bharuch		Urea	5,94,000	105.05 (110.60)	121.81 (112.08)	315.00	256.00	720.00	482.30	133.10	235.29
8. NFL-Nangal Bhatinda Panipat Vijaypur	1961/78 1979 1979 1987	Urea+CAN Urea Urea Urea	10,36,000	88.90 (68.30)	89.00 (83.40)	289.00	276.00	4414.07	4420.49	511.15	672.86

Notes : 1) Figures as given in brackets are from Fertilizer Statistics compiled by FAI and taken as Official Record.
2) Per Te 'N' Maintenance cost has been worked out based on the figures as given in the bracket.
*Out of 15 months operation
**Financial year 1988-89 was of months (July 1988 - March 1989)

Table 19. Number of Plants with Percentage Share in total Capacity & Production in various ranges of capacity utilisation

Capacity Utilisation Range %	1985-86			1986-87			1987-88			1988-89		
	No. of Plants	Share of total %		No. of Plants	Share of total %		No. of Plants	Share of total %		No. of Plants	Share of total %	
		Cap.	Prodn.		Cap.	Prodn.		Cap.	Prodn.		Cap.	Prodn.
Above 100	5			7	20.0	28.9	6	17.0	28.1	14	30.6	41.1
91-100	3	23.0	37.1	3	11.8	15.0	2	5.7	6.6	4	14.8	17.4
81-90	8	17.4	23.0	9	20.4	24.0	6	22.6	29.7	9	19.7	20.4
71-80	6	10.0	11.2	4	6.8	6.8	6	10.7	12.3	4	9.8	9.1
61-70	3	12.5	10.9	5	14.7	13.2	3	3.7	3.7	1	2.6	2.0
51-60	6	15.8	8.3	5	7.5	5.9	4	7.2	6.1	5	4.5	2.9
41-50	1	0.2	0.2	1	3.2	2.0	3	4.2	3.1	5	5.4	3.1
Below 41	13	21.0	9.3	10	15.2	4.2	11	27.9	9.6	10	22.3	3.6
Nil/Data not available	1	0.12	≤	3	≤	≤	3	≤	≤	≤	≤	≤
Total No. of Plants	46	100.00	100.00	47	100.00	100.00	49	100.00	100.00	52	100.00	100.00

Source : Table derived from data given in FAI fertiliser statistics 1985-89.

Economic Aspects of Nitrogenous Fertiliser Production in India

Distribution and Pricing of major fertilizers, particularly straight nitrogenous fertilizers, has been under the government control. During early seventies, in the wake of oil crisis, the cost of imported fertilizers increased significantly. With sharp increase in the input of petroleum products, the cost of indigenous production of 'N' also went up but still it was lower than that of imported fertilizers. Hence, to subsidize the higher landed cost of imported materials, a price pooling arrangement was introduced. The price of Urea was increased from Rs. 1,050/- per Tonne to Rs. 2,000/- per Tonne but at the same time, the indigenous industry had to pay a cess known as Fertilizer Pool Equalisation Charges (FPEC).

While these arrangements enabled the government to maintain consumer price of fertilisers at a low level, increasing cost of production threatened the continued viability of the domestic industry. Under these circumstances, government set up the High Powered Marathe Committee to consider all aspects and recommend suitable pricing system for indigenously produced fertilizers. As an outcome of the recommendations of the Committee, Govt. in 1977, announced a "Retention Price-cum-Subsidy" scheme for nitrogenous fertilisers. This scheme was framed in a way to attract investments from the private sector. For this reason, a reasonable norm of capacity utilisation, and rewarding capital through actual "net worth" and not capital employed method was adopted. It was provided that net worth which consisted of paid-up capital plus free reserves ploughed back, would attract 12% rate grossed up for standard rate of taxation and no tax concessions available as a fiscal measure would be mopped up. This gave a signal for investments in the private sector and a bias in favour using own capital rather than borrowed funds so far.

The results of these measures were obvious from 1980 onwards due to the long time required for implementing investment decision on the ground after completing all formalities of licensing, import of technology and capital goods etc. Table 20 shows the growth of indigenous fertilizer industry after implementation of "Retention Price Scheme" in terms of investments in different sectors.

Table-20. Pattern of Investments in different sectors of Indigenous Nitrogenous Industry after 1977

Period	Capacity ('000 tonnes)	Investment (Rs. Crores) Public	Co-op	Private	Total
1979-80	3902	1841	97.6	557.3	2495.9
1980-85	5241	2550	331.1	1228.1	4109.2
1985-89 (Upto 1.10.88)	8159	4827	1954.1	2514.6	9295.0

Source : FAI Fertilizer Statistics 1987-89.

Parameters of Price Fixation

Under the Retention Price Scheme, the following parameters form the basis of fixing the retention price of the fertilizer to the manufacturer :

- Norms for capacity utilisation
- Variable Costs
- Conversion Costs
- Marketing Costs
- Capital related Costs
- Depreciation Norms
- Dealers Margin
- Inventory Norms
- Equated freight of finished fertilizers

The above norms are fixed by a Committee known as the Fertilizer Industry Coordination Committee (FICC) which works under the Ministry of Agriculture, Department of Fertilizers. The norms are fixed on a plant to plant basis and reviewed from time to time by the Fertilizer Industry Coordination Committee. The basis of fixation of some of the norms is given below :

1) Norms for capacity utilisation as per Govt. Resolution dated 1.11.1977 Retention Prices were fixed at 80% capacity utilisation for Ammonia Plant. These norms were revised in the following manner w.e.f. 1.4.1988:

	Pre-Revision	1st Year	Post Revision 2nd Year to 10 Yrs.	Post Revision Beyond 10 Yrs.
Ammonia Plant				
i) Gas based	80%	80%	90%	85%
ii) Other than Gas-based & Coal-based	80%	80%	85%	80%
iii) Coal-based	60%	60%	60%	60%

2) Variable costs are arrived at for fixation of consumption norms on a normative basis after technical study of each unit which are evaluated at actual delivered costs. There is a scheme of periodical recognition of escalations, which include de-escalation in the prices of these items which are under administered price schemes of Central/State agencies like Gas, Naphtha, Fuel-oil, Coal, Power etc. or are imported like Ammonia.

3) Depreciation norms were recognised equal to about 9% of the plant life for providing incidence of depreciation in the retention price-build up.

The Govt. decided that w.e.f. 1.4.1988, for units set up in 1982 and thereafter, plant life will be taken as 20 years for providing depreciation in retention price. Units set up from 1.4.1988 onwards, depreciation will be provided straightaway @ 4.75% p.a. (SLM). For units set up between 1982 and 1988, the Govt. decided that depreciable assets after accounting of the depreciation cost so far, to spread over the depreciation over the balance period. This amounts to a rate below 2% for plant falling in the period of 1982-88.

A study by the Fertiliser Association of India (FAI) for the year 1987-88 (prior to the introduction of revised norms w.e.f. 1.4.1988) revealed that the profitability of the industry is considerably lower than 12% Post Tax on the net worth inspite of higher capacity utilisation as compared to norms. Table 21 shows profitability before tax for 1985-86 to 1987-88. Table 22 shows production, capacity utilisation & return on networth of 16 plants in the year 1988-89.

Table 21. Production & Pre-Tax Profits for 13 Companies (78% N+P Production) 1985-86 to 1987-88

Year	Production	+% Increase	Profit before Tax (Rs. Crores)
1985-86	3469.6	-	22.46
1986-87	4452.5	28.3	6.46
1987-88	4541.0	2.0	21.02

Source : Chemical Business - December, 1988 - P. 48

It is a general feeling in the fertilizer industry that productivity of the plants cannot improve as envisaged in the Retention Price Scheme, the returns on the capital invested and outcome of efficient running of plants does not provide sufficient incentive to fertilizer plant operators. This is evident from the fact that the prices of Urea as fixed by the Govt. from time to time which is well below the cost of production and for which the government has to pay a staggering figure of Rs. 3250 crores in 1989-90 as Subsidy (Table 23)

Projections for the future

Latest projections on the installed capacity and production of fertilisers as estimated by Fertiliser Association of India upto year 1994-95 are shown in Table 24.

During the 8th Five-Year Plan, it is estimated that the installed capacity will increase by 1.604 Million MT of 'N' and production by 2.10 Million MT of 'N'; a growth of 1.94% in capacity and 2.95% in production with an average capacity utilisation of 81%.

Of the six gas-based plants planned in Seventh Five-Year Plan, only three plants have become operational and the remaining three (representing a nitrogen capacity of about 1 million tonnes) are expected to become operational towards the end of 1992. This would leave a gap of 0.6 million tonnes, out of which, 0.2 million tonnes is expected to be met when Nagarjuna plant becomes operational by about third or fourth year of the 8th Five-Year Plan. A gap of 0.4 million tonnes will be ultimately left by 1994-95. This gap can be filled by carrying out expansions, revamping and retrofitting in plants like Madras Fertilizers, Neyveli Lignite Corporation, Mangalore Fertilizers, Fertilizers & Chemicals Travancore in the Southern region; Hindustan Fertilizers, Durgapur and Barauni in the Eastern region; and Fertilizer Corpn. of India, Gorakhpur in the Northern region.

Conclusions

— With the Seventh Five-Year Plan coming to an end in 1989-90, the production of Nitrogenous fertilizers increased by 6.19% during the plan period.

Table 22. Production, Capacity Utilisation and Return on Networth
(Production and PBT is on annualised basis)

Name of the company	1988-89 Production (000 tonnes) No. of Units	N	P205	N+P205	Capacity Utilisation(%) N	P205	Networth at the beginning of the year (Rs.Lakhs)	PBT of the Year (Rs.Lakhs)	PAT of the Year (Rs.Lakhs)	PBT to Networth (%)
I. PUBLIC SECTOR										
1. RCFL	4	994	119	1113	99	99	75115	8250	6995	110.0
2. FACT	3	277	135	412	104	89	31019	912	-771	2.9
3. NFL	4	830	-	830	87	-	67768	685	528	1.0
4. MFL	1	142	108	250	86	103	1574	1133	986	72.0
5. Paradeep Phos	1	113	288	401	87	87	8924	-1081	-1081	-12.1
6. FCI	4	318	-	318	40	-	57497	-14704	-14074	
7. HFC	4	240	-	240	37	-	56198	-15980	-15980	
8. NLC, Neyveli	1	65	-	65	93	-	1380	42	42	3.0
Total Public Sector	22	2979	650	3629	71	92	299485	-20743	-21813	
II PRIVATE SECTOR										
1. ZACL, Goa	1	211	119	330	107	108	6524	1697	965	26.0
2. SPIC, Tuticorin	1	311	152	463	100	79	28150	1369	1109	4.9
3. GSFC, Baroda	2	323	230	553	109	115	17195	1931	1657	11.2
4. GNFC, Bharuch	1	333	-	333	122	-	19145	1071	884	5.6
5. MCFL, Mangalore	1	129	61	190	82	88	2694	-2851	-2851	-105.8
6. CFL, Viazg	1	89	92	181	106	88	4778	1180	1180	24.7
II Total Private Sec	7	1396	654	2050	111	116	78486	4396	2943	5.6
III COOPERATIVE SECTOR										
1. KRIBHCO	2	785	-	785	118	-	57867	10060	10060	17.4
2 IFFCO	3	802	296	1098	105	96	64778	867	876	1.3
IIITotal Coop. Sec.	5	1587	296	1883	110	96	122645	10927	10927	8.9
Grant Total	34	5962	1600	7562	87	101	500616	-5420	-7943	-1.6

Source : Indian Economy Vol. XI, No. 2, May-June 1990 p. 18

Table-23. Fertilizer : Production, Imports & Subsidies

Year	Production ('000 Te)	Imports ('000Te)	Total Subsidy (Rs. Crores)
1985-86	5756	3314	1924
1986-87	7074	2275	1897
1987-88	7131	983	2164
1988-89	8965	1615	3250

Source : FAI Fertilizer Statistics 1988-89

Table 24. Likely installed capacity and production of Fertilisers up to 1994-95

Year	Installed Capacity ('000 MT 'N')	Production ('000 MT 'N')
1990-91	8262	7100
1991-92	8543	7300
1992-93	9380	7650
1993-94	9380	8600
1994-95	9866	9200

Source : Information collected from Fertiliser Association of India.

— Capacity utilisation touched 85% in 1988-89 which is creditable for a developing country like ours.

— The improvement in capacity utilisation is a result of quite a few factors like:

a) Three giant gas-based plants becoming operative during the plan period and achieving high capacity utilisation.

b) Lesser downtime in the older plants due to power problems as a number of captive power plants becoming operational.

c) Improvement in down time due to lesser equipment break-downs as a result of better maintenance and turn-around performance.

d) Better stream days achieved.

— On energy front, though there has been improvement in energy consumption, yet the same is still on higher side. This indicates that urgent steps are required to improve energy consumption through such means as :

a) Retrofitting and revamping of plant equipment.

b) Modernisation of plants.

c) Expansions in such plants which have become 20-25 years old by 7th Five-Year Plan end.

— There are imbalances in the installed capacity and production in different regions. These need to be removed as it adds to the cost of distribution of fertilisers due to criss-cross movement.

– Recent changes in the retention price scheme has brought in disincentives for the new investments to be made in fertilisers and profitability of the running units has been unfavouravly affected. A review of the changes brought in the retention price scheme has become necessary if the viability of the operating plants is to be maintained.

Aknowledgements

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□

Just Imagine What it Would be Like if

SERVICE

—the people who used your products or services got just what they wanted when they wanted it!

—your staff regularly uncovered and incorporated into your business little things that, in the perception of your customers, set your organisation apart!

QUALITY

—your customers believed that your products and services provided superb quality and value - and your employees were constantly seeking out new avenues to keep it that way!

—quality was an uncompromised tradition that permeated every level of your organization!

INNOVATION

—your employees embraced change as an opportunity to "meet the future."

—your staff had an ingrained sense of common purpose. They just kept finding better and better ways to get the job done!

PRODUCTIVITY

—there was a powerful feeling of focused energy and vitality evident the moment you walked through the door of your organisation!

—your staff members had the necessary skills not only to do their jobs but to be good team players!

Courtesy : Clemmer, Jim & McNeil, Art, Leadership Skills for Every Manager, London, Piatkus, 1989.

Fertilizer Demand During the Nineties

NPC Research Section

There seems to be a tendency in the past to project very ambitious requirements for fertilizers. This may be out of the anxiety to ensure that there is more than adequate availability of fertilizers in all parts of the country. This study attempts to project the fertilizer demand upto 1999-00.

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Ever since the beginning of the First Plan fertilizer industry has received serious attention in India. Fertilizer consumption has grown considerably and consistently during the three decades from the First Plan. From 1951-52 to 1960-61 fertilizer consumption increased almost five fold (Table 1)

Table 1. All India Consumption of Fertilizers

(Lakh Tonnes)

Year	Nitrogenous	Phosphatic	Potassic	Total
1951-52	0.59	0.07	—	0.66
52-53	0.58	0.05	0.03	0.66
53-54	0.89	0.08	0.08	1.05
54-55	0.95	0.15	0.11	1.21
55-56	1.08	0.13	0.10	1.31
56-57	1.23	0.16	0.15	1.54
57-58	1.49	0.22	0.13	1.84
58-59	1.72	0.30	0.22	2.24
59-60	2.29	0.54	0.21	3.04
60-61	2.12	0.53	0.29	2.94
61-62	2.50	0.61	0.28	3.39
62-63	3.33	0.83	0.36	4.52
63-64	3.76	1.17	0.51	5.44
64-65	3.55	1.49	0.69	7.73
65-66	5.75	1.33	0.77	7.85
66-67	7.38	2.49	1.14	11.01
67-68	10.35	3.35	1.70	15.40
68-69	12.09	3.82	1.70	17.61
69-70	13.56	4.16	2.10	19.82
70-71	14.79	5.41	2.36	22.56
71-72	17.98	5.58	3.01	26.57
72-73	18.39	5.81	3.48	27.68
73-74	18.29	6.50	3.60	28.39
74-75	17.66	4.72	3.36	28.74
75-76	21.49	4.67	2.78	28.94
76-77	24.57	6.35	3.19	34.11
77-78	29.13	8.67	5.06	42.86
78-79	34.20	11.07	5.92	51.19
79-80	34.98	11.51	6.06	52.55
80-81	36.78	12.14	6.24	55.16
81-82	40.69	13.22	6.76	60.67
82-83	42.43	14.33	7.26	64.02
83-84	52.04	17.30	7.75	77.09
84-85	54.86	18.87	8.39	82.12
85-86	56.61	20.05	8.08	84.74
86-87	57.73	21.06	8.60	87.39
87-88	56.68	21.63	8.65	86.96
88-89	71.94	27.00	10.74	109.68 *

*Provisional

Source : Fertilizer Statistics, 1988-89

The decade of 1961-62 to 1970-71 was characterised by the introduction of High Yielding Varieties (HYVs) which led to further expansion of fertilizer use. Per hectare consumption levels went up from 2.17 kgs in 1961-62 to 13.61 kgs in 1970-71 (Table 2). Again during the third decade of

Table 2. All India Consumption of Plant Nutrients per unit of Gross Cropped Area

Year	Consumption per hectare (kg)			
	Nitrogenous	Phosphatic	Potassic	Total
1951-52	0.44	0.05	—	0.49
52-53	0.42	0.03	0.02	0.47
53-54	0.63	0.06	0.05	0.74
54-55	0.66	0.10	0.08	0.84
55-56	0.73	0.09	0.07	0.89
56-57	0.82	0.11	0.10	1.03
57-58	1.02	0.15	0.09	1.26
58-59	1.13	0.19	0.15	1.47
59-60	1.50	0.35	0.14	1.90
60-61	1.39	0.35	0.19	1.93
61-62	1.60	0.39	0.18	2.17
62-63	2.12	0.63	0.23	2.88
63-64	2.40	0.74	0.32	3.56
64-65	3.49	0.93	0.44	4.86
65-66	3.70	0.85	0.50	5.05
66-67	4.69	1.58	0.73	7.00
67-68	6.32	2.04	1.04	9.40
68-69	7.58	2.40	1.07	11.05
69-70	8.06	2.56	1.29	12.21
70-71	8.92	3.26	1.43	13.61
71-72	10.38	3.38	1.88	16.14
72-73	11.34	3.58	2.14	17.06
73-74	10.77	3.83	2.12	16.71
74-75	10.75	2.87	2.05	15.67
75-76	12.57	2.73	1.63	16.92
76-77	14.69	3.86	1.91	20.39
77-78	16.91	5.03	2.94	24.88
78-79	19.57	2.73	1.63	23.93
79-80	20.62	6.78	3.57	30.98
80-81	21.25	7.01	3.60	31.86
81-82	22.98	7.47	3.82	34.27
82-83	24.47	8.28	4.19	36.00
83-84	28.85	9.59	4.30	42.74
84-85	30.40	10.45	4.65	45.50
85-86	31.36	11.11	4.48	46.94
86-87	32.02	11.68	4.77	48.47
87-88	32.00	12.20	4.90	49.10
88-89	40.00	15.20	6.10	61.90 *

* Provisional

Source : Fertilizer Statistics, 1988-89

1971-72 to 1980-81, fertilizer consumption kept on growing except for the year 1974-75 when consumption declined by 9.4 percent. There was a record growth of 25 percent per year in the four year period from 1974-75 to 1978-79. The trend of increasing fertilizer consumption continued till the year 1982-83. Subsequently the growth rate in fertilizer consumption has not been as impressive as it was before.

There is a substantial gap between the actual and potential yield of foodgrains in India (Table 3) and closing this gap could be a major source of increasing food output.

Table 3. Actual Vs potential yield on the farmer's land

(Quintals/ha)

Crop	Farmer's field own cultivation-actual yield 1980-81	Yield in national demonstration trials on former's field 1975-76
Paddy	20.07	51.50
Wheat	16.49	38.10
Bajra	4.66	21.40
Maize	11.37	32.40
Jowar	6.73	35.50

Source : Fertilizer Scene in India, FAI, 1984, p.3.

The yields achieved in India are far from the potential yields demonstrated by the research institutions. Nor do we compare favourably with the yields being achieved by major cereals in most other countries (Table 4). More over as yet, nearly 80 percent of fertilizer consumption is

Table 4. Fertilizer use and yield per hectare-Selected countries 1985-86

Countary	Consumption (kg) per hectare of available land	Yield (kg) per hectare	
		Paddy	Wheat
Bangaladesh	54.9	2350	1930
Pakistan	71.6	2351	1899
Sri Lanka	80.3	3095	—
India	41.9	2244	2032
China	154.1	5372	2997

Source : Fertilizer News, October 1987, P.14.

accounted for by the irrigated areas covering 30 percent of cultivated land. The remaining 20 percent goes to 70 percent of the land under rainfed cultivation. With proper efforts and planning, fertilizer consumption in rainfed areas can be stepped up substantially, pointing to the fact that India has enormous potential to improve the fertilizer demand further.

Supply needs to grow to match the growing demand. Supply planning for future will require firm estimates of the future demands which will make the supply path smooth. In the context of Indian fertilizer market, demand projections are necessary to monitor the supply side; to plan the future expansions in domestic capacities, to decide on the volume of imports and also to arrange for the required infrastructure for movement and storage. Any set of projections based only on intuitions or mere averages can not lead us anywhere except to a glut or a shortage in the longrun.

Demand projections refer to what is in store with respect to consumers' capacity and willingness based on

socio-economic, technological, and infrastructure developments that are taking place and are likely to take place in the coming years. Scientific assessment of various factors affecting fertilizer demand would lead us to arriving at rational decisions. There seems to be a tendency in the past to project very ambitious requirements for fertilizers. This may be out of the anxiety to ensure that there is more than adequate availability of fertilizers in all parts of the country. An attempt is made here to project fertilizer demand for the decade 1990-2000.

Fertilizer Demand Forecasting in India : An Overview

Several sets of projections were made for fertilizer demand from time to time by different agencies. Roy L. Donahue (1966) was the first to workout estimates of future demand for FAI. He has based his estimates on the prevailing cropping pattern and recommended doses of application of fertilizers. As against this the Shivaraman Committee (1965) on fertilizers worked out the targets of demand for 1970-71 and 1973-74 on the basis of additional foodgrains production required to attain self-sufficiency in food and continuing the tempo of growth in agricultural production. Ahuja and Sarvan Kumar (1969) estimated the demand for the Fourth Five Year Plan (1969-70 to 1973-74) based on a simple economic model. The projections arrived at by the FAI (1984) are on the basis of a second degree regression line based on a trend. Hanumantha Rao (1986) has examined the relevance of major factors affecting fertilizer consumption at aggregated level in 1985. Srivastava (1986) made projections based on an econometric model.

The wide range of techniques used so far can be classified into four categories: (i) Need based approach (ii) Area-crop coverage approach (iii) Regression approach (trend setting) and (iv) Econometric modeling incorporating major factors affecting (and likely to affect) fertilizer use over the years. Each one of the estimation procedures reflects different types of logical background.

Projecting the requirements of fetilizers needed for agricultural production expansion in general and foodgrains production in particular on the basis of an input-output ratio is the need based approach. Fertilizer requirements are calculated by using specific input-output ratios in order to achieve required quantity of additional production. The additional production needed is either based on specific nutrional levels to be achieved or to reach self-sufficiency in food production from time to time or to achieve a specific rate of growth in agricultural production such as 5 percent envisaged in the five year plans. These are, therefore, in the nature of targets.

Area-crop coverage approach determines the probable trends in cropping pattern and expected coverage of area under fertilizers at recommended doses which are assumed to be achieved at certain levels. Estimates of demand arrived at by this approach are neither targets nor do they reflect the demand originating from the farm sector. They represent "potentials". The results are based on the expert's own assessment which varies from expert to expert. Assumptions made in such studies may not hold true in the long run. This method can be used to a limited extent, to review and revise the demand estimates for a season or an year. But its credibility for long term use is questionable.

Regression approach establishes the quantitative relationship between the dependent variable and other individual or group of factors to extrapolate the trend for future. The broad framework of regression methods adopted in the past was to predict fertilizer consumption by fitting trend equations. The basic limiting assumption here is that the past trend will continue in future also. More over the effect of major factors of relevance to fertilizer consumption are averaged out in the trend equation.

The econometric models incorporate different factors affecting fertilizer demand. The strength and predictive power of the model vary with the identification of the relevant variables, statistical reliability and the techno-economic rationale behind a particular model. An econometric model with high reliability may be considered to be the best to serve the purpose of prediction; all others are either potentials or targets and cannot be considered as projections.

The Demand Model

The price that a farmer pays for fertilizer is of crucial importance in determining the economic incentive for applying fertilizer on his land. Realising this many countries including India subsidise fertilizers (Quibria, 1987). Yet a subsidy on fertilizers alone cannot put the matter right because one of the risks faced by the farmers in developing countries is the output price variation at the harvest time. Reasonable and some what stable support prices for the agricultural produce are helpful in this direction. In countries like India the procurement prices for the main crops are announced long before the start of the season to enable the farmers to decide the area under each crop in advance. Hence, instead of taking the price of fertilizers alone in the model, a more effective method would be to take the ratio of the price of fertilizers to that of agricultural output.

Growth in fertilizer demand is also underscored by the dependence of proven yield increasing technologies on

fertilizers. Bulk of the growth in fertilizer consumption has occurred after the introduction of HYVs. The complementarity between HYVs and fertilizer use is clear even on unirrigated land. After the introduction of HYVs in the mid-sixties the growth of fertilizer demand, more often than not, is associated with the growth of the area under HVSs. Also, given the fact that the amount of fertilizer applied on unirrigated land is much less than what is being used on irrigated land, the further spread of HYVs would help to exploit the potential demand available in the unirrigated land.

Besides the input-output price ratio and the spread of HYVs, there are other important factors such as weather, rainfall, irrigation potential, credit availability, cropping pattern etc. influencing the fertilizer demand. But almost all these variables are closely related to one another denying the usage of all in one equation. For intance, irrigation potential, to some extent, is essential for the spread of HYVs whereas the factors like the credit availability, rainfall etc. cause variations in the availability of irrigation facilities. Any change in the cropping pattern has a significant effect on the area devoted to the HYVs and the shift, if any, in cropping pattern is effected by the factors such as yield risk, procurement or output prices, the rainfall level, weather condition etc. Therefore, the dominant variable seems to be the spread of HYVs which includes the effect of almost all the other factors. However it cannot be expected to include the effect of fertilizer prices or the profitability of using fertilizers which, therefore, has been included separately.

The demand model is, thus, formulated as :

D = f(PR, HYV)

Where PR = Fertilizer-produce price ratio,

HYV = Area under HVYs

In the past, the functional forms used for the estimation of demand have been either linear or log-linear. Log-linear is often preferred to the linear form mainly to gain the advantage of using elasticities instead of ordinary partial derivaties. Here, both the forms are estimated and the selection of the final form is based on the relative performance of the prediction. The estimation of the model is performed using the Ordinary Least Squares method for the 17 year period from 1972-73 to 1988-89.

Table 5 contains the results. The results are free from multi-collinearity and autocorrelation and are along the expected lines. The significance of the variable HYV is encouraging.

Future Values of the Explanatory Variables

Having obtained the estimates of the relevant parameters, the data on the future values of the included

Table 5. Regression Results

Form of the relationship	constant	PR	HYV	R^2	DW
Linear	(—) 196.441	(—)1036.205	0.216*	0.981	1.88
	(0.31)	(5.24)	(29.04)		
Log-linear	(—) 7.769*	(—) 0.516*	1.593*	0.966	1.51
	(10.07)	(3.57)	(3.57)		

*Significant at one percent level.

Figures in parenthneses are the t values.

variables are essential to carry out the prediction. Looking at the past values of the price ratio, it has been observed that almost all the values over the past ten year period or even before fall in the neighbourhood of the mean value. The deviations from the mean have only been negligible suggesting that the government has in the past, acted in a balanced manner while announcing the fertilizer and procurement prices. Therefore, judging from the past, it is just plausible to assume that the price ratio will continue to be consistent and fall in the neighbourhood of the mean. Hence, the future values of PR are assumed to remain constant in the range of the mean ratio. This assumption is reasonable at least in the long run. It has been observed that the HYV follows a linear trend and so the future values are predicted using the linear trend. Other trend forms like the log linear, semilog and quadratic have also been tried but the linear variant came out successful offering an accurate prediction.

Fitness of the Model

Before using the estimates for predicting the future, it is better to verify the fitness of the model for such a job. This can be done by performing an *ex-ante* prediction of the known demand in the past. The model is re-estimated for the ten year period from 1972-73 to 1981-82 and the predictions are obtained for the five years from 1982-83 to 1986-87. Projections are also obtained using a simple linear trend to see how effective is the trend approach for prediction. Incidentally the five year period, for which the projections are arrived at, is the reported glut period. All the predicted and actual values of demand are given in Table 6. The table also contains the official projections. The percentage deviations of the predicted values from the actuals are given in Tables 7.

The last column values of Table 6 formed the basis for planning the supplies during the period 1982-83 to 1986-87, the so called glut period. A quick look at the errors of prediction would suggest that both the forms of econometric equations performed well with minimum errors. Due to its accuracy in predicting the immediate year 1982-83, the loglinear model appears to be the best for the short

Table 6. Actual and Predicted Demand (1982-87)

(in lakh tonnes)

Year	Actual demand	Predicted demand			Official projections
		Linear regression	Log-linear regression	Trend	
1982-83	63.87	65.79	63.66	61.03	72.04
83-84	77.10	73.12	72.48	68.06	72.00
84-85	82.11	77.45	78.07	74.23	84.00
85-86	84.74	85.20	87.76	83.80	95.50
86-87	87.38	88.36	90.92	90.92	103.00

term prediction. For a longer duration a linear model is preferable because the average error is minimum in that case. More over the error seems to decline over a period of time. The difference, if any, between the predictive power in both the forms of the model is only marginal and therefore, can be ignored.

Table 7. Errors in Prediction

(Percent)

Year	Linear	Log-linear	Trend	Official projections
1982-83	(—) 3.02	0.33	4.45	(—) 12.80
83-84	5.17	5.99	11.72	6.62
84-85	5.67	4.92	9.60	(—) 2.30
85-86	(—) 0.54	(—) 3.57	1.11	(—) 12.70
86-87	(—) 1.12	(—) 4.04	(—) 4.04	(—) 17.87

The Glut Period

The reason for the glut between the years 1982-83 and 1986-87 has been widely identified as the slow consumption growth due to the drought. The sluggish growth, it is argued, has made the realistic official projections erroneous. But the performance of the regression equations does not support this view. The accurate prediction by the econometric model that too for a period which happens to be characterised by a glut suggests that the response of the consumers to various policies cannot be termed as inconsistent. Their behaviour seems to have been regular and consistent with the past normal years. So the overprojections cannot be justified in the name of "abnormal years". There is one more reason to show that the sluggish consumption growth cannot be held responsible to have made the projections unrealistic. In four of the five years, the actual consumption levels have been well above the levels indicated by the trend. From this it follows that there should have been shortage instead of a glut as a result of overconsumption during these years. Apparently there was no revolution expected during that period to have shot the demand over and above the trend levels. This leads us to believe that the glut was due to overoptimistic demand projections and the resultant supply pressure. During three of the five years, there have been overexpectation to the tune of more than ten percent over and above the already reached overconsumptiom level. The anxiety to ensure that there is more than adquate availability all the time might have led to such projections which turned out to be unrealistic.

The situation after 1986-87, or say 1987-88, cannot be considered as unsafe. The unlimited stock level started showing favourable downward trend not mainly due to an impressive increase in demand but due to the efforts made to adjust the supply side. After the crisis in 1986-87, when there was no place for the incoming fertilizers in the already full ware houses, the imports were suspended and even before that manufactures themselves produced much less than they could, realising that the cost of wastage is much higher than the loss due to under production[1]. Here again an effort was being made to make every one believe that the present situation has been as a result of the impressive consumption growth, hiding the fact that mainly the supply has gone down to bring back the balance. It is true that there has been a growth in demand from 1987-88 but certainly the increase was not abnormal or unexpected. Nor was the growth sufficient to accomodate the already piled up stocks.

Also the fact that there was a drought between 1983-84 and 1987-88 should not lead us to conclude that without drought the demand could have finished all the mammoth stocks for the simple reason that the stocks themselves were equal to or more than the actual consumption observed.

Projections Based on the Demand Model

In the preceding section, two aspects have been established. First is that the past demand projections were overoptimistic. This overoptimism was unwarranted especially when the world supply position has been comfortable and there was no risk of a shortage[2]. Secondly the econometric model developed in the previous section has been shown performing well, on *ex-ante* grounds, for prediction. As demonstrated, the predicted values are very close to the actuals, the maximum prediction error being 6 percent. The model can now be used for predicting the future and the maximum prediction error of 6 percent may be recommended as inventory stock level over and above the predicted demand to be kept at any point of time. Since the linear variant of the model predicts the future more ac-

[1] Under the Retention Pricing System, every unit is required to maintain 80 percent capacity utilization to become eligible for the subsidy or in other words the existing prices do not allow any profit if the unit produces less than 80 percent capacity.

[2] See Appendix 1

curately for the long run, the predicted values based on the linear demand model are presented here [3]. The breakup of the total demand among the nitrogenous, phosphatic and potassic fertilizers is worked out approximately on the basis of the composition of the total demand in the past. The projections are given in Table 8. The supply necessary to feed the projected demand is also estimated and reported in Table 9. The expected error of prediction, i.e., 6 present, is added to the projected demand for this purpose.

Table 8. Fertilizer demand projections for 90's

(in million tonnes)

Year	Total demand	Nitrogenous	Phosphatic	Potassic
1990-91	10.69	7.11	2.52	1.06
91-92	11.67	7.43	2.64	1.10
92-93	11.65	7.75	2.75	1.15
93-94	12.13	8.07	2.86	1.20
94-95	12.61	8.38	2.98	1.25
95-96	13.09	8.71	3.09	1.29
96-97	13.57	9.02	3.20	1.35
97-98	14.05	9.34	3.32	1.39
98-99	14.53	9.66	3.43	1.44
99-00	15.01	9.98	3.54	1.49

Table 9. Anticipated supply based on projections*

(million tonnes)

Year	Total demand	Nitrogenous	Phosphatic	Potassic
1990-91	11.33	7.53	2.67	1.13
91-92	11.84	7.87	2.79	1.18
92-93	12.35	8.21	2.92	1.22
93-94	12.86	8.55	3.04	1.27
94-95	13.37	8.89	3.16	1.32
95-96	13.88	9.23	3.28	1.37
96-97	14.38	9.56	3.39	1.43
97-98	14.89	9.90	3.51	1.48
98-99	15.40	10.24	3.63	1.53
99-00	15.91	10.58	3.76	1.57

* Anticipated supplies are the projected demand plus assumed inventory level of 6 percent.

Table 10 reports the official projections of demand for the five year period from 1990-91 to 1994-95 for nitrogenous and phosphatic fertilizers.

Two Assumptions

The projections arrived at by the present study involves two crucial assumptions, the first is the expectation that the average price ratio will prevail in future and the second one relates to the future spread of HYVs at the same rate as the trend rate of growth. Judging from the past, the above assumptions appear to be reasonable. But

[3] Appendix 2, however, provides the values based on the log linear demand model and the linear trend for general reference.

Table 10. Official projections of demand

(million tonnes)

Year	Nitrogenous	Phosphatic
1990-91	8.31	3.53
91-92	8.18	3.78
92-93	9.26	4.03
93-94	9.75	4.28
94-95	10.00	4.55

Source: PTI Economic Service, (1990).

the prevailing mood of a 50 percent share of the plan investments for rural areas and also the case being put forward for higher and stable farm output prices, make these assumptions some what shaky. In tune with the importance given to agriculture, the Draft Agricultural Policy Resolution, for instance, calls for a growth rate of 6 percent in agricultural production as against the past rate of 3 to 4 percent[4]. This, the Resolution says, will mean larger allocation of resources to agriculture which has come down from 32 percent in the First Plan to 21 percent in the Seventh Plan. Indications are that, at least, 40 percent of the plan outlays would now be allocated for agricultural sector resulting into some drastic measures such as incentive prices, profitable technologies and input and services support. Such measures will lead to a revision of support prices based on new norms, extension of HYV technology to more crop varieties in addition to the existing varieties, and creation of sufficient infra structure to spread the yield improving technology etc. So far, the introduction of HYVs has not made any impressive impact in some of the regions in the country and the current thrust may facilitate these regions to adopt HYVs.

It is possible that the support prices of the agricultural produce may be revised upwards but at the same time the fertiliser subsidy cannot also be expected to continue indefinitely owing to the increasing resources constraints. The revision of support prices as indicated by the Resolution is likely to alter the fertilizer-agricultural output price ratio and may even bring it down somewhere near the least observed ratio so far which is 1.96. At the same time if the fertilizer subsidy is eliminated in the long run, the ratio may be brought back to the currently existing level of 2.68 or even beyond that. While the former case would lead to an increase in fertilizer demand at a rate much higher than what has been already arrived at, the latter case may balance the act and make the projections realistic.

On the other hand, efforts are going to be doubled to spread HYVs technology to more regions and crops. In such a case, the assumed growth rate of HYVs will be an understimation of the likely future growth. Since this now seems to be a certainly, we need to revise our estimates

[4] For more details, see PTI Economic service, July 1, 1990.

to accommodate the likely impact of a higher growth rate of HYVs, say 5.5% per annum instead of the earlier 3.69 percent.

Keeping the above aspects in mind, the demand estimates presented in table 8 have been revised to incorporate the likely changes. Apart from the higher rates of HYV growth, the alternative price ratios of 1.96 and 2.68 are also considered. Using the revised growth rate of HYV, the demand estimates are obtained for the average, the current, and the lowest price ratios. The resultant fertilizer demand estimates are given in table 11. Depending on the likely ratio of prices being closer to any one scanario, we

Table 11. Projections incorporating the likely changes in policies

(million tonnes)

Year	Projected demand at the		
	average price ratio	existing price ratio	observed minimum price ratio
1990-91	10.96	11.48	12.22
91-92	11.79	12.31	13.06
92-93	12.67	13.19	13.93
93-94	13.60	14.12	14.86
94-95	14.58	15.09	15.84
95-96	15.66	16.18	16.92
96-97	16.75	17.27	18.01
97-98	17.91	18.42	19.17
98-99	19.12	19.64	20.38
99-00	20.40	20.92	21.67

can select the respective more appropriate projection. The additional information with the relaxed assumptions makes the projections more flexible and hopefully accurate depending on the likely future price scenario. It must be remarked here that the likely measures, if taken, would require considerable time to take off and hence for the immediate future, say for the next three years, the earlier estimates are still relevant.

Conclusion

The main aim of the study has been to project the fertilizer demand for the nineties. An econometric model has been specified and estimated for this purpose. According to the estimates, the demand in 2000 A.D. is expected to be 15 million tonnes. Keeping in mind the likely changes on the policy front in favour of the agricultural sector, the above projections appear to be an understimation. Hence the revised projections were obtained to accommodate the changes. Under the changed environment demand for the same year can be expected to be between 20.4 million and 21.7 million tonnnes. The higher projection, which is more than double the current demand, warrants huge investments in fertilizer if the dependence on imports is to be prevented from rising. The needed supply to meet the projected demand has also been worked out to give an idea of the required capacity in future.

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APPENDIX - I
World fertilizer market

(million tonnes)

Year	Production	Consumption	Excess supply
1972-73	78.82	76.91	1.91
73-74	87.55	83.59	3.96
74-75	93.32	82.37	10.95
75-76	70.09	68.09	2.00
76-77	100.26	96.29	4.06
77-78	106.45	100.46	5.99
78-79	113.70	108.01	5.69
79-80	118.90	111.73	7.17
80-81	124.73	116.51	8.22
81-82	119.61	114.81	4.80
82-83	119.94	114.55	5.39
83-84	130.88	125.43	5.45
84-85	140.07	130.67	9.40

*excluding potash
Source: FAO Year Book, Various issues

APPENDIX - II
Projections based on log-linear regression and linear trend

(million tonnes)

Year	Log-linear regression	Liner trend
1990-91	10.95	11.30
91-92	11.67	11.87
92-93	12.24	12.43
93-94	12.84	13.00
94-95	13.47	13.57
95-96	14.13	14.14
96-97	14.82	14.71
97-98	15.54	15.28
98-99	16.05	15.84
99-00	16.83	16.41

Eliminating the Human Factor

"In Ten Thousand Working Days", Robert Schrank comments: "Managers are always complaining about those workers—if only they would do as we tell them, we would surpass our quotas." Looking at workers as an exotic type of hardware will result in workers looking at their jobs as an exotic type of money machine. In both cases, the incorrect point of view will lead to disastrous results. Machines are meant to serve people and people are most effective when they are participating and not being subservient.

A story is told of a group of scientists from all the major industrialized nations who after years of work finally produced the ultimate computer, a machine which was theoretically able to manifest the ultimate in knowledge and intelligence. After some debate, the first question the group put to their creation was "Is there a God?" The machine whirled, twirled, and spewed out its response: "There is now."

—Courtesy : Clemmer, Jim & McNeil, Art, Leadership Skills for Every Manager, London, Piatkus, 1989.

Steel Casting Industry

Directorate General of Technical Development

There are 85 steel casting units in the organised sector with a total installed capacity 205,000 tonnes per annum. The capacity utilization, around 50 percent, is extremely low. If the capacity registered in the recent past is even partially installed, there will be a further fall in the capacity utilization. This study reviews such aspects of the industry as demand, technology and quality, R&D, modernisation, energy conservation, export potential etc.

Excerpted from a recent Report with the same title by the Directorate General of Technical Development.

Introduction

The Steel and Alloy Steel Castings form the basic substantive structure around which most equipments or machines are built, and hence, have a very important and essential role to play in the growing markets for capital goods. Almost all heavy equipment for nuclear, thermal and hydro generation, steel and metallurgical plants, cement plants, heavy transport equipment, construction equipment, defence, mining, oil and natural gas exploration and many others require castings of diverse chemistry of metal and very wide yet stringent physical and mechanical properties.

The art of smelting iron was known in India from the vedic times and it is said that India is the first producer of carbon steel.

The metal foundings on modern lines for mass production of industrial castings were, however, started in India only in the latter part of the 19th Century. Today this sector manufactures a wide range of castings in various specifications such as plain carbon, stainless steel, wear-resistant, heat-resistant, corrosion-resistant and creep-resistant steel. The weight of these castings ranges from a few grams to 100 tons single piece and from simple castings to most intricate and sophisticated ones of radiographical quality to meet the ever increasing technological requirements of advanced nations and overseas markets. The industry caters to even such sophisticated industries as petro-chemicals, heavy electricals, thermal, nuclear, oil exploration, ship building, defence, aerospace, cement etc.

Steel Castings

Steel castings are used in applications mainly involving high tensile strength, toughness, malleability, ductility etc. where iron castings would normally crack or break under the tensile loads. Typical examples of usage of steel castings include cast steel bogies frames, high tensile couplers, manganese steel points and crossing for railways, body castings for a variety of valves for refineries, petro-chemicals, fertilizers, thermal power plants, steel,

paper and sugar mills; ni-hard rings, chrome, molybdenum balls, bull ring segments and rollers for coal units and thermal power plants; kiln drives, girth gears and support rollers for cement plants; rolling mill stands, gear blanks etc. for different industrial uses and so on.

The essential difference between cast iron and cast steel is in the amount of carbon present in the metal (0.1 - 0.8% in cast steel as against 2 -4% in cast iron) and in the metallographic structure. Secondly, in steel, carbon is not present in free state but it forms a solid solution in iron. Steel castings are also amenable to heat treatment which widens their area of application. A number of alloying elements such as nickel, chromium, molybdenum, manganese, silicon, boron, tungsten etc. are added to produce a variety of wear resistant, heat resistant, corrosion resistant, creep resistant and other varieties of steel castings. Steel castings of plain carbon steel, special alloy steel and stainless steel find a variety of applications.

Capacity and Production

There are 85 units in the organised sector with a total installed capacity of 2,05,000 tonnes per annum for the manufacutre of steel and alloy steel castings (Table 1). This capacity is exclusive of those in certain major captive units with the main steel plants, railways, defence establishments, etc. and also in several small scale units registered with the Directorate of Industries in various states.

Table 1. Capacity of Production of Steel Castings in India

Year	Installed capacity (in tonnes)	Production (in tonnes)	%age of capacity utilisation
1981-82	1,75,000	80,000	45.7%
1982-83	1,82,000	85,000	46.7%
1983-84	1,96,000	88,000	44.9%
1984-85	1,97,000	89,000	45.2%
1985-86	1,98,000	90,000	45.9%
1986-87	2,00,000	99,100	49.5%
1988-89	2,05,000	99,500	48.5%

The present capacity utilisation is around 50% and if the capacity as registered in the recent past is even partially installed, there would be a further fall in the capacity utilisation. Even in the past, the capacity utilisation of the steel castings industry has been low.

The major factors contributing to the low capacity utilisation/stagnation in steel castings have been:

(i) low rate of growth in production and poor capacity utilisation in the major end user industries like industrial machinery and general engineering.

(ii) substantial imports of castings under project imports.

(iii) growth industries like the automobiles and the machine tools virtually do not use any steel castings.

(iv) integrated capacities were not available for the manufacture of certain heavy castings required for power, mining, metallurgical and cement industries and for certain sophisticated items like valve for the chemical and petrochemical industries resulting in their imports to satisfy demand.

(v) constrained availability of basic raw materials such as steel scrap.

(vi) severe power cuts; and

(vii) technological obsolescence.

Constraints for the Steel Foundry

Some of the major problems faced by the Indian Steel Foundry Industry are stated to be:

(i) Output of foundry is dictated by the demands of other industries. Therefore, the ups and downs faced by the other industries get directly reflected in the level of output that is demanded from the foundries.

(ii) Product mix is fairly large and off-take of individual casting is not large enough to specialise in selected items.

(iii) Most of the foundries are unable to implement their modernisation/replacement programme owing to very high customs duty levied on the equipment with latest technology.

(iv) A large number of existing foundries are based on obsolete technology and they are not able to manufacture high quality sophisticated castings. The capacity already created for general castings is enogh and the demand for high quality castings is increasing and most of the existing units are not taking full advantage of this due to poor facilities available with them.

(v) Frequent power failures, voltage fluctuations and power cuts hamper production rate. Optimum utilisation of electrical furnaces is hindered by continuous power cuts.

(vi) Very little R & D work has been undertaken by the steel foundries. Over and above, there is no separate R & D Centre for foundry industry.

(vii) Lack of good support from auxilliary units like good pattern shop and tool room facilities. To have more

flexibility of product mix, higher investment is required on pattern shop and tool room.

(viii) Shortage of steel scrap, its increasing price and inconsistency in the quality has affected the economics of the foundries.

(ix) Non-availability of washed and graded sand causes lot of foundry scrap.

(x) The high incidence of excise duty on resins used for manufacture of cores makes it uneconomical for use.

Future Prospects

The future for the steel foundry industry certainly lies in the efficient units which stay alive to produce castings at the internationally competitive prices and constantly update and upgrade their processes and incorporate new developments which would benefit the end users. The applications of the steel castings would mainly be revolving around the rail-road applications, oil exploration and hydro-carbon industry, petroleum and refineries, petrochemicals process industry and fertilizers like cement plants, steel and metallurgical plants for mining and construction. With new developments taking place in the defence and nuclear industry, they also require steel and alloy steel castings but future prospect of the steel castings industry is certainly tied up very much with not only meeting the demands of the Indian market, but also taking a strong foothold in the international market and dominate to a good extent in the export markets.

Eighth Plan Requirements of Steel Castings

Estimates by the Sub Group on Steel Castings formed under the Working Group for Machine Building Industry (Department of Heavy Industry) set up by the Planning Commission for formulation of 7th Plan 1985-90 are given in table 2.

Table 2. Demand Estimates for Steel Castings

	1985-86 (in tonnes)	1989-90 (in tonnes)
Railway Castings	35,000	51,000
Petro chemicals, Fertilizers ONGC (mainly valves)	10,000	14,000
Thermal and Hydel Power plants (mainly rings and balls)	2,500	5,000
Cement plants	1,000	2,000
Steel, metallurgical plant, mining etc.	18,500	7,000
Industrial castings	25,000	35,000
Exports	—	10,000
	92,000	1,24,000

For an annual growth rate of 8% for the engineering industry, the demand for steel castings placed at 85,000 tonnes in 1985 was projected by Confederation of Engineering Industries (CEI) to grow at 4%. Coupled with import substitution, the demand for steel castings for 1990 was estimated at 1.10 lakh tonnes per annum.

The demand estimates for 1990 projected by CEI at 1.10 lakh tonnes is certainly more realistic and therefore could be considered as the basis for estimating the demand for steel castings by the end of Eighth Plan viz., 1995. Considering the annual growth rate for steel castings industry at 4% and an export target of 60,000 tonnes, the demand in 1995 is estimated at 1,80,000 tonnes.

Strategy to Meet Future Demand

The present installed capacity of the organised sector is around 2.05 lakh tonnes. As against this, the demand in 1995 is estimated at 1.30 lakh tonnes. Therefore, the future demand can be met by the existing units; consequently there is no need for creating fresh capacity in this field. However, in order to keep pace with the stringent and sophisticated requirements of user industries and to exploit the vast potential for exports of steel castings, it is imperative that some of the leading and efficient foundries should go in for modernisation and technological upgradation. This in turn would call for massive investiments in latest production and quality control equipment leading to substantial expansions. The present policy of the Government does not permit expansion normally at the existing location if the same is not in permissible category. However, addition to the capacity as a result of modernisation upto 49% of the existing capacity is permitted even at the existing location.

A substantial capacity has been registered by the Directorate General of Technical Development (DGTD) and Secretariat for Industrial Approvals (SIA) in the recent past. Although exact data on the same is not available, this would not be less than 20 lakh tonnes. It would thus be desirable to examine why such a large number of foundries are sought to be established when the demand during Eighth Plan is very much below the existing installed capacity.

Foundry Inputs and Costs

The major inputs in a steel foundry are steel melting scrap and ferro alloys as raw materials, graphite electrodes, refractory and resins as auxiliary materials and electrical energy. The broad break up of the cost of production in a typical steel foundry is given in table 3.

Table 3. Foundry Cost Structure

1984-85 (Actual)	Rs. (in lacs)
Total costs	975
Fixed costs	
Personnel related exp.	103
Repairs & maintenance	27
Travelling, office exp.	4
Depreciation, insurance	55
Interest on fixed assets	21
Interest on WIP	38
Material overheads	31
Supporting services	65
General Admn. OHs	17
Penalties	2
Total	363
Variable costs	
Scrap & ferro alloys	238
Direct expenses	83
Moulding materials	64
Lining materials	9
Oil	22
Gases	6
Tools & consumables	27
Contract services	11
Fettling & heat treatment subcontract	24
Rejection, replacement	50
Electricity	76
Total	610

From the above cost break up it is seen that variable costs account for 62.7% in the total cost while fixed costs account for 37.3%. The direct raw materials including scrap and ferro alloys account for 24.5% while other consumables and utilities account for 29.5% of the total cost. The balance 8.7% is accounted for by rejections and replacements and sub contract charges for settling and heat treatment etc.

The prices of majority foundry inputs with 1980 as the base (prices of different inputs as 100) upto 1985, show increases ranging from 126% to 272% for different raw materials and consumables.

The prices of foundry chemicals and raw materials in India (as in 1985) were much higher than the corresponding international prices. Comparison of price of foundry materials such as ferro chrome; ferro scrap; silica; chromite, zircon & olivin sand; graphite electrodes etc. between India and Japan reflects high Indian prices in respect of 14 out of 17 selected raw materials and chemicals by 22% to 140% (Annexure I) whereas the Japanese prices were higher in respect of three materials. Thus high prices of foundry inputs in India seem to have, among other things, substantially contributed to price disadvantage of Indian castings in the international market. In respect of steel castings, the available data on detailed break up of variable costs (as in August 1985) made available by CEI is given in Annexures II and III. Comparison between major elements of variable costs of steel castings between the Indian foundry and the international foundry may be seen in Annexure IV.

Technology and Quality

The steel casting industry is both vast and complicated. It is vast because it encompasses manufacture of castings with intricate shapes, dimensions and finishes, made out of various alloys of steel materials. It is complicated because the activities in a foundry spread over pattern shop, melting, moulding, heat treatment, machining, etc., cover several disciplines. Foundries vary from small jobbing shops to huge mechanised foundries.

Casting industry is on the threshold of taking a quantum jump into the modern technology. Many of our traditional methods of making cast products, therefore, are necessarily to be significantly modified and upgraded so as to match the more and more stringent and increasing demands of cast products for Power, Railways, Steel Plants and other sectors.

At the present juncture when the demand on the foundry industry to produce castings of superior metallurgical quality and to close dimensional accuracy for reducing machining time and for acceptability in machine centres with numerical controls is fast increasing, there are no options open but to consider adopting new technological processes, tools and techniques wherever possible. It should be recognised that modern techniques and equipment not only improve productivity but also ensure better quality and thereby reducing rejections, rework and ultimately the costs. This in turn would help the industry in promoting exports.

Following are some of the areas where technology upgradation could be attempted:

Pattern making : The designs for pattern equipments are developed manually based on past experience. With the advent of inexpensive microprocessors, it has become

possible to develop computer aided designs for patterns and methodings for risering etc.

Sand reclamation : With the continuously escalating transporting costs, investments on sand reclamation plants are proving beneficial.

Moulding and core making : While high pressure moulding lines or flaskless system with highly automated transfer mechanisms may call for very high investments, not commensurate with the production volumes, the need for highly compacted high integrity moulds and cores cannot be overlooked. Higher pressure moulding machines with appropriate level of automation should be considered. Similarly, cold settling processes for cores using 1Furan Resins or phenolic resins should be introduced.

Melting and Powering : Induction furnaces using medium frequency and variable inductive power with solid state electronic controls have become popular. Energy saving of 10% to 12% are reported with these furnaces, which however require clean good quality scrap. Progressive change over to induction melting could be considered.

Where large volume production is invisaged, introduction of oxygen assisted rapid melting techniques in U.H.P. Arc Furnaces can be considered for introduction.

High technology castings require very clean steel with very low content of gaswes like O, N and H. Modern processes like Vacuum Degassing, Vaccum Oxygen Decarburisation etc. will have to be progressively adopted.

Ladles with disposable linings to reduce labour and improve ladle utilisation have been developed.

Fettling and Finishing : There can be substantial reduction in the quantum of work in the fettling and finishing of castings, if greater care is taken in the earlier stages of manufacture of castings. Use of manipulators is becoming popular to reduce the handling of castings during fettling and finishing.

Heat Treatment : Heat Treatment practices generally consist of Normalising, Templering and oil/Water Quenching. Very few foundaries have furnaces which are capable of close control on temperatures which are extremely important in the manufacture of sophisticated alloy castings. However, reputed foundries which cater to vital industries are fully equipped with accessories such as temperature recorders, automatic control for burners, arrangements for rapid quenching and most important of all well designed furnaces to achieve close control of furnace temperatures.

Considerable attention needs to be paid towards energy saving measures in the heat treatment furnaces. Installation of modern fuel efficient burners, recuperators, bricks or pads made of ceremic fibre and close monitoring of the temperatures of the exhaust gases will also help in achieving substantial reduction in the consumption of furnace oil. Table 4 gives an idea of the technological gap existing in the Indian steel castings industry vis-a-vis world's latest technology.

To sum up, the steel foundry industry, to become viable, will have to take immediate measures for technological upgradation through an optional blend of its own efforts and of imported technology. The foundries must also take steps to get their facilities certified as adequate by recognised agencies like the Lloyds, the Bureau Veritas etc.

The latest specialised equipment and process for steel casting industry have been identified as under:

Pattern Making : Polyurethane, metallic epoxy and special plastic patterns.

Pre-programmed computers for weight estimation, designing of gating/risering, etc.

CAD/CNC facilities : Moulding press equipment for hydrocarbon patterns.

Moulding . V-Moulding process and equipment.

H-Moulding process and equipment.

No-bake moulding process and equipment including continuous resin mixers.

Micro processor controlled mullers and faster mixing and feeding of sand.

High pressure and larger size, mass production, moulding lines including impact and shoot squeeze moulding machine.

Sand reclamation plant.

Ceramic moulding and back up sand plant equipment.

Core Making : Cold box core making machine.

Hot box core making machine.

Melting : Solid state thyristor controlled medium and high frequency induction melting furnace.

Vaccum melting and ladle refining technique and equipment.

Ultra high power furnace transformer for faster melting.

Oxy-fuel assisted melting.

Table 4. Technological Gaps Existing in the Steel Casting Industry

Areas	Existing Technology	World's Latest Technology
PATTERN MAKING		
Quotation, evaluation, estimation and tendering (costing and pattern equipment)	Manually, based on past experience/information.	Computerised evaluation for competitive cost with well established data base.
Design and drafting of equipment and casting from component drawing.	Manual drafting and partial drawing only.	Computerised drafting, computer graphic for design for patterns equipment and casting suitable for NC machines.
Pattern materials.	Wood, grey cast iron aluminium, araldite, thermocol.	Pressed plywood, bronze, SGI, plastics, metallised plastics and wood, electroless nickel/ hard chromium, teflon coating on metallic patterns.
Equipment	Conventional machining with skilled labour.	CAD/CNC machining with less skilled labour, flexible machining centres.
Inspection of equipment.	Conventional inspection.	3-D coordinating machines with digitalized equipment.
Pattern salvage/reclamation.	No. standard practice.	Using computerised wear estimation. Salvaging with the help of wear coating or polyurethane coatings. Using inserts to reduce replacement time.
MOULDING		
Sand testing.	Conventional.	Silica programme, thermolab, wet tensile testor, friability tester, compactibility controller.
Moulding sand preparation and handling systems.	Batch type sand mullers.	Microprocessor controlled sand mullers and high intensity sand mixers with computerised control of all the conditions Addition of water automatically adjusted based on temperature & moisture of the return sand.
Hand moulding.	Green sand, silicate CO_2 Dry sand moulds, sweep moulds, chamotte moulding.	Full mould process, air set and cold setting moulds with sand slingers, vacuum moulds.
Machine moulding.	Conventional green sand using pinlift rollover machines pneumatic system (Jolt squeeze moulding machine)	Moulding machines with high pressure, shoot & squeeze, impact, vacuumpress, air impulse system.
CORE MAKING		
Core making process.	Oil sand, shall core, hot box, silicate/CO2 cold setting.	Liquid catalysed, No bake, and gas catalysed cold bake system, warm box process, Q process, SO_2 process, shell and alpha set process.
Core supply.	Conventional methods - store & supply.	'Just in time' cores made and supplied. No storage.
Core assembly and transfer equipment.	Conventional equipment.	Jigs with multi-axis rotation for easy assembly at a faster rate. Hot melt adhesive and metallic screws to avoid core movements.
Core making machines.	Semi-mechanised.	Automated machines used and more attention for pollution free atmosphere.
Sand reclamation.	Limited	Economically operated to realise the total benefit of costly core processes.

(*Contd.*)

Table 4 Contd.

Areas	Existing Technology	World's Latest Technology
MELTING		
Primary melting furnances.	Rotary oil fired crucible furnaces & electric melting arc and induction furnaces of main frequency.	High/medium frequency induction furnace. AOD process and vacuum degassing for secondary refining.
Holding furnace.	Mains frequency induction channel furnace.	Mains frequency induction channel induction furnace, electric furnace with graphite heating elements for holding
Melt control.	Wet chemical analysis and temperature measurement.	Emission spectrometers, gas analysers.
Pouring.	Manual pouring ladle.	Automatic pouring (auto pour).
Refractory materials.	Conventional.	Much superior quality. Ceramic fibre as insulating material.
Lining technique.	Manual compaction.	Mechanised compaction.
Raw materials.	Conventional raw materials available in India.	Pre-heated quality raw materials, computerised charge optimisation employed.
Computers/microprocessors in melting.	Not present.	Extensively used for energy conservation and operations
FELTTLING & INSPECTION		
Decored sand removal.	Decoring in vibrators/shake out and manual.	Resonant vibration technique, hydroblast cleaning, shot blasting for decoring, cryogenic/ chemical cleaning.
Surface cleaning.	Continuous shot blasting.	Shot blast with manipulators, hydroblast and chemical cleaning.
Flash removal.	Chipped manually using hammers.	Automatic grinding and thermal deburring.
Surface grinding.	Portable swing frame pedestal grinders, manually.	Snag grinders, manipulators, robots used in fettling.
Jigging.	Manual jigs used.	Non-contact piezo electric system and electrical averaging employed.
Casting quality.	Conventional testing, ultrasonic hardness, file test.	On line ultrasonic X-ray and magnetic flux inspection for crack detection, radiography test.
Inner casting cleanliness.	Visual inspection or by cutting.	Fibroscope/Endoscope.
Simulation testing for service conditions.	Not pursued.	Accoustic emission, internal stress measurements and Hollography.

Fume extraction equipment.

Autopour equipment.

Weighing machine for accurate weighment of liquid metal while pouring.

Fettling/Finishing : High production gas cutting, arc cutting and powder washing torches.

Well balanced mechanical welding units.

Mechanisation of fettling operations by adopting fettling manipulators and robots.

NC machines with CAM and CAD attachments for profile machining.

Acid pickling facilities and passivation of high alloy corrosion resistant castings.

Automatic grinding and thermal deburring.

Resonant vibration technique, hydroblast cleaning, shot blasting for decoring.

Inspection/Quality Control Equipment : Latest pneumatic and electronic equipments for testing various parameters

input of foundry knowledge and training is quite obsolete and it needs revamping the course. Thus, course should be redesigned to meet the modern foundries' requirements. Major problems lie in the development of pattern makers, which has been a scarce commodity in the present situation. Normally, carpenters were converted to pattern makers; the advent of new concept in pattern making calls for specialised intensive courses on pattern making. The present need of foundries is to have qualified and trained personnel in foundry practices for which government could initiate exclusive schemes in various institutes to develop skills, in the field of foundry technology.

Modernisation of Steel Foundry

Modernisation is required at almost every stage of production of castings, starting from the receipt of incoming raw materials, inventory control methods, production planning and production control techniques, pattern design, methoding, manufacture and inspection, sand testing and control, melting processes, operations and melt control, inspection techniques and preparation and compliance of test criteria. The nature and extent of modernisation required by the foundry industry could vary, from one type to the other and would be guided by the economic considerations. Modernisation of a steel foundry is mainly undertaken for any one or more of the following reasons:

i) for the production of value added items with a view to increase the profitability and to reduce competition by entering into specialised areas of production.

ii) for improving the quality standards of castings as demanded by the customers.

iii) for the purpose of adopting the cost reduction process.

iv) for ancillarising the production to cater to the needs of repetitive type of castings required by giant sector plants.

Market Survey: The first and foremost activity, before embarking on any modernisation programme is to do a thorough market survey. The most important aspect is to identify the products and the probable market share that we can get out of this. The stress here also is to identify certain value added items where the profit margin could be more and the competition less.

Quality Assurance : It is extremely important to have

a) a well established quality assurance technical personnel.

b) standard testing equipment in the area of NDT.

c) sound organisation structure to emphasise on quality performance at every level of manufacture of castings.

In this connection, the Bureau of Indian Standards have brought out a well thought of comprehensive IS Standard No. 12117-1987 which gives the guidelines of Q.A. System. According to this, the steel foundries could be categorised into Class A or Class B depending upon the facilities existing in the company. Hence it is essential that the modrnisation programme takes care of this area in all seriousness. Investment is to be made in the area of sand testing equipment, sand laboratory, spectrometer for chemical testing and all the NDT testing apparatus of standard makes. Sufficient stress is also to be given to training of personnel to operate these highly sophisticated machines and certificates obtained by the well known training organisations like BARCH and NDT Association etc. It is also required to periodically calibrate all these testing equipment by authorised calibration set up/organisations.

R & D : Another very important area where the steel foundries build up their image is by organising a Research and Development Centre. The research projects could be in the area of quality assurance, cost reduction or productivity improvement. In a highly competitive field of production of steel castings, it is these facilities of the peripheral areas which bring additional benefits to the company.

Cost Reduction : With the continuously escalating cost of sand as well as transporting cost, the sand reclamation is a must for the foundry. The main advantages of sand reclamation are less sand cost per tonne of castings and less material handling. Considerable attention needs to be paid towards energy saving measures in melting and heat treatment furnaces. Installation of modern fuel efficient burners, recuperators, bricks or pads made of ceramic fibre and close monitoring of the temperature of the exhaust gases will also help in achieving substantial reduction in the consumption of furance oil.

Secondary Metallurgy : The demand for quality steel with stringent requirements for critical applications has been responsible for emergence of secondary refining process as an independent step. The secondary refining can be classified into two categories, namely:

— non-vacuum processes e.g. stirring process, injection process, ladle furnace, MRP process.

— vacuum processes e.g. tap-degassing, ladle vacuum degassing, vacuum oxygen decarborisation, vacuum circulation process, vacuum arc degassing, DETEM etc.

Secondary refining processes have different objectives and different effects on metallurgical quality of steel. Therefore, the selection of process depends entirely on the type of castings to be made. The main purpose of secondary metallurgy treatment are as under:

a) Desulphurisation.

b) Decarbonisation.

c) Degassing of hydrogen, oxygen and nitrogen.

d) Alloying homogenisation.

The above mentioned operations have basically two objectives:

i) Reduction in production cost and increase in productivity.

ii) To meet the increasing demand for steel with regard to the quality.

Energy Conservation

The Foundry Industry is highly energy intensive and its optimum utilisation is very essential. In recent years, due to increasing energy crisis with spiralling prices of oil and depleting reserves of coal and coke, more and more foundries all over the world are becoming energy conscious and serious efforts are being made to save energy in all operations of foundry. The steel casting industry requires energy to operate melting furnaces, heat treatment furnaces and other machines/equipment.

About 70% of the total energy input normally is used to melt and super heat the metal. Hence all possible innovations and precautions have to be taken so as to minimise wasteful expenditure on energy in melting.

By replacing the arc/mains frequency furnaces with high/medium induction furnaces, there can be a saving of 20% on power consumption. In addition, since the high frequency furnaces operate on low tension supply, the connected load to the casting units will reduce and for every KVA of maximum demand saved, the units can save around Rs. 35 per unit of maximum demand saved. Similarly, the use of high speed mixer in the casting units will give a saving of about 35% in power consumption for preparing moulding sand. The experience has shown a substantial saving in oil by replacing refractory lining in the oil fired heat treatment furnaces by ceramic fibre lining and modifying the burner system. Furthermore, software packages are understood to have been developed for energy audit by personal computers in this industry. The Steel Casting Research and Trade Association of England who have developed an energy audit package claim that such a system if put into use correclty, can save about Rs. 16 lakhs in an year in a casting unit producing about 4,000 MT of castings annually.

Energy saving in arc furnace : The arc furnace melting is highly energy intensive. In large electric arc furnaces, power consumption is approximately 600 KWH per ton. More power is required during refining and holding and is of the order of 180 KWH per ton for ordinary grade steel. Energy conservation in the arc furnace can be achieved by the following methods:

i) Increased utilisation factor of the power supply.

ii) The lid should be kept open for as less a period as possible.

iii) Holding of hot metal should be for a minimum period.

iv) The charge should be pre-heated.

v) Furnace lining should be repaired constantly.

vi) By employing oxygen lancing, say for a period of 15 minutes, the melting period is shortened by considerable time and results in lowering of electric energy by approximately 60-70 KWH per ton.

Energy saving in induction furnace: In a high frequency induction furnace for steel melting, the heat balance is shown as :

1.	Heat to charge	59%
2.	Heat to cooling water	3%
3.	Heat to electrical losses	22%
4.	Heat to radiation losses	16%

The energy in induction melting can be saved considerably if the following steps are taken :

i) The furnace should be loaded in such a way that the maximum voltage is reached with a maximum current and a high power factor.

ii) Induction furnaces having a basic lining generally consume more power as compared to acidic lined ones.

iii) Use of ceramic fibre insulation material between the layers of main refractory lining has resulted in saving of heat losses through crucible walls.

iv) Oxygen is the fuel introduced in an electric furnace which replaces electric power input to the furnace. This reduces melting time and increases rate of melting.

Inability to ensure prompt delivery at short notice from the buyers.

These problems can be solved with proper guidance and support from the Government alongwith active initiative of the industry. Growth in international trade in castings is stated to be quite encouraging. Import of steel castings in US market in 1983 was reported at 2,40,000 tonnes. The castings import in U.K., France and West Germany which has been steadily rising, stood at US $546 million in 1985-86 (whereas India's export to the entire EEC were only of the order of US $ 4.5 million accounting for less than 0.1%).

The casting industry has to make concerted efforts in taking the exports in a big way. This would not only earn foreign exchange but also the following tangible and intangible advantages can accrue to the industry if enlightened policy of overseas markets is followed by the industry:

Capacity utilisation which is at present about 50% can improve.

The quality culture in the Indian foundries which is today not very satisfactory, will necessarily improve.

Foreign contacts with discerning customers will assist in the inflow of new ideas, techniques and technologies in the steel casting field.

When raw markets for different products of the industry have to be continuously tapped, the required R & D efforts will get a fillip.

When foundries are able to increase the volume of production, new techniques of rapid melting of steel in UHP furnaces etc. can be adopted.

The Defence, Power, Petro-Chemicals, Fertilisers, and Aerospace sectors are considered to be major consumers of castings and the bulk of their requirements are still being met through imports. Having regard to this and the supply made by the indigenous manufacturers to these sectors could be considered as import substitution and with a view to encourage castings manufacturers, it is imperative that Government should extend certain incentives as deemed export status. This would be in line with the Government's decision already taken in respect of supplies to ONGC. Further, IPRS benefits may also be extended to deemed exports which would no doubt go a long way in making the indigenous industry competitive with respect to international competition, and thus improve the capital utilisation apart from conservation of precious foreign exchange.

While IPRS has been welcomed by the industries, it has been observed that the settlement of the claims under the scheme takes unduly long time. It is therefore suggested that the entire process to settle claims under IPRS be streamlined so as to facilitate settlement within the period of 30 days after despatch of goods.

The casting industry is lacking badly in marketing facilities abroad. What is needed is an intensive marketing follow up abroad. It is recommended that the Government should finance the cost of marketing agency abroad. This would undoubtedly help to augment exports in a big way.

The current exports of steel castings are estimated to be 5000-6000 tonnes. It is felt that the Indian Steel Foundry industry should set itself a target of exporting at least 60,000 tonnes equivalent to Rs. 150 crores of castings per annum by the end of the Eighth Plan period. Having regard to the world market for steel castings, this target is quite modest and capable of achievement if determined efforts are made.

Conclusions and Recommendations

Demand and Supply : There is a considerable surplus capacity available in respect of steel and alloy castings; the capacity utilisation being less than 50% in terms of installed capacity.

The data on captive foundries and SSI units should be compiled through sponsoring authorities.

The existing foundries should be encouraged to modernise their foundries instead of generating new capacities.

Industrial Policy : A large number of units are being registered with Secretariat for Industrial Approvals (SIA) for manfuacture of steel and alloy steel castings. Prior to this, a substantial capacity has already been registered by DGTD. Therefore, it will be worthwhile to examine as to why such a large number of steel foundries are sought to be established when the demand for steel castings during the Eighth Plan is very much below the installed capacity of the existing units.

With a view to enable the steel castings units to utilise surplus melting capacity available with them, they may be permitted to manufacture steel and alloy steel ingots/ billets within the overall approved capacity for steel castings.

Presently the units are being approved to manufacture various types of steel castings in different nomenclature. In order to provide flexibility as well as to allow maximum capacity utilisation, it is desirable that the industry be broadbanded to enable them to manufacture all types of steel and alloy steel castings within their overall

capacity. This principle has already been agreed to by the Government in respect of a number of other industries.

Substantial capacity for manufacture of castings is available with the various user industries as captive facilities. In order to generate more demand for castings, it is suggested that no further expansion be granted to existing captive units and also the new units should not be allowed to set up their own captive facilities in this regard.

Some of the user industries insist on supply of finished casting due to heavy rejection/size when machining is carried out at the user's end. It would, therefore, be desirable if the casting units are also allowed to manufacture finished castings within their overall capacity. This would go a long way in reducing losses due to rejection of finished castings.

Modernisation and Replacement : Most of the steel foundries in India are using outdated technology and equipment resulting in high rejections, poor quality, extensive rework and therefore leading to high costs. The imports of latest technology and modernisation of facilities in foundry industry are essential if timely development can supply castings which meet the stringent requirements of end-users at reasonable cost are to be ensured. It is imperative that individual foundry identifies the type of products, technology and specialised manufacturing/quality control equipment needed for the same and accordingly prepare their modernisation plans.

Following measures will encourage steel foundries to embark on modernisation programmes:

There is a need for further reduction in interests on soft loans for modernisation/replacement programmes.

Certain capital goods required for the manufacture of quality castings and for modernisation purposes are yet to be developed indigenously. The prices of these capital goods have gone up 3 times during the last 10 years and the situation has been further aggravated by the impact of exchange rates increase in the last 2-3 years. Over and above this, a high rate of customs duty makes these equipment prohibitively expensive. The other important factor is the exhorbitantly high cost of modern equipment as compared to the conventional equipment. While Government has already reduced the customs duty on certain equipment required for modernisation of foundry industry to a level of 40%, there are many more equipment not being made in the country, and which still attract a high rate of customs duty. Therefore, the equipment required for modernisation of foundry industry be permitted for import at nil or a very low rate of customs duty. Presently, intricate patterns, core boxes and moulds are allowed to be imported under OGL. In view of their limited indigenous availability, it is suggested to bring down the customs duty on such items for the foundry industry.

100% depreciation in the first year itself on capital investment on pollution control equipment, equipment for energy conservation and in-house power generating equipment should be allowed for income tax purpose.

Import of Technology : The accent on stringent quality standards, cost reduction etc. call for advanced technology in the field of steel casting industry. Hence, there is need for induction of latest technology in this field. In this connection, the technology upgradation scheme would facilitate removal of technology obsolescence in the foundry industry. It is now for the industry to take initiative and come up with viable schemes and proposals for technology upgradation. It is also expected that the Government would consider extending this scheme for the 8th Plan period as well.

The norms for classification of steel foundries for quality assurance brought out by the Bureau of Indian Standards (BIS) is considered to be a major step forward towards the promotion of the concept of quality culture in the steel casting industry.

As there is need for induction of latest technology in the castings industry, liberal import of technologies for such areas may be permitted.

The procedure for availing the services of foreign technicians need to be simplified.

Research & Development and Training : After assessing the need for setting up a separate R & D Institute in the field of ferrous castings, the industry should initiate steps in this direction, and assistance from the Government of India and World Bank/UNDP may be sought.

In order to keep pace with the changing technological scenario, Government should initiate exclusive schemes for various existing Institutes to develop skills in the field of foundry technology.

Foundry Inputs : Steel melting scrap is an important input to the foundry industry. Due to limited availability in the country, its imports are inevitable. It attracts the customs duty of 25% plus Rs. 500/- per tonne as countervailing duty. Since no excise duty is levied on indigenous scrap as it is not a manufactured item, Rs. 500/- per tonne as CVD on imported scrap should be removed. Further, due to scarce availability of consistent quality of heavy melting scrap in the country, steel castings units may be allowed to import directly under actual user licence.

Ferro alloys should be permitted for import under OGL until they are produced in the country in the required quality and quantity by at least two satisfactory sources.

Resins used for foundry applications may be exempted from excise duty of 25% advalorem. The high incidence of duty is discouraging the foundries from using resin bonded sand under their technology upgradation scheme.

Foundry industry require electrical energy to operate melting furnaces and other foundry equipment. Therefore, the steel foundry which is a highly power intensive industry, equipped with electric arc and induction furnaces should get concessional power tariffs and may be treated as continuous process unit.

Export of Steel Castings : The steel foundry has to make concerted efforts to undertake exports in a big way. This would not only earn foreign exchange but also help the industry in achieving better utilisation of their installed capacity.

Consequent to sharp appreciation of currencies of the principal castings manufacturers and exporters as well as reluctance of highly paid labour to work in severe environmental conditions, there is a tremendous scope for Indian casting industry to penetrate the international market on an enhanced scale. With the export incentives such as IPRS now available to the industry, a modest annual target of Rs. 150 crores of export of steel and alloy steel castings should be set for itself by the industry to be achieved by the end of the 8th Five Year Plan.

There is a need for intensive marketing follow up abroad which would undoubtedly augment exports in a big way. It is recommended that Government should finance the cost of a marketing agency abroad.

In view of the vast potential for exports of steel castings, close and continuous monitoring of the progress and performance of steel casting industry is desirable. Therefore, there is a need for creating a proper data base.

The supplies of castings to Defence, Power, Petro Chemicals, Fertilizers and Aerospace sector should be considered as import substitution and consequently Government should extend certain incentives such as deemed export status. This would be in line with the Government's decision already taken in respect of supplies to ONGC.

Use of Computers : The foundries today are realising the importance of computers in finding answers to many of their problems. It is suggested that industry should maximise the use of computers and develop appropriate information systems and modules with the help of the same.

Pollution Control Measures : The casting industry has been indentified as one of he highly polluting industries by the Government. The Industry should therefore take appropriate measures for environmental pollution control by installing the required emission control equipment. The industry should give due importance to good house keeping and safety practices. Government should consider extending incentives for installation of pollution control equipment.

Energy Conservation : Steel foundry being a highly energy intensive industry, appropriate measures should be taken by the Steel Casting Units to conserve energy.

Material Conservation : The industry should go in for sand reclamation as it results in less sand cost per tonne of castings and less material handling.

Interaction with User Industries : In order to have a better interaction between industry and the users such as automotive industry, Defence, Railways, Power etc. there is a need for setting up user sector oriented sub groups under the aegis of the Development Panels already constituted for the Casting Industry. This would help in better understanding of the long term requirements of user industries and would enable the casting industry to plan their production facilities as well as upgrading their technologies so as to meet the emerging requirements.

Any policy decided by the Government should be on a long term basis and not be changed atleast for a period

of five years. This would enable the industry in planning things on a long term basis and achieve the objectives.

As a result of a number of recommendations made in the preceding paragraphs particularly for lowering down the import duty on equipment, materials etc., there seems to be loss of revenue to the Government. However, the spin-off benefits as a result of modernisation, increased productivity, increased exports, and increased import substitution in the coming years, will more than offset the revenue loss and would result in the accelerated growth of this industry whose present capacity utilisation is around 50%.

Annexure I

Comparison Of prices of Fundry Rawmaterials Between India and Japan

Material		Indian Rs./kg	Japanese Rs./kg	Difference Of Price %
Ferro Chrome HC		15.70	12.54	25.20%
Ferro Chrome HC		13.20	9.83	34.28%
Ferro Chrome LC		32.10	16.22	97.90%
Ferro silicon	WIPS 12.20			
	Granules 11.40	23.60	9.83	140.08%
Silicon manganese		10.27	5.90	74.07%
Ferro manganese HC		5.94	5.90	0.68%
Ferro Manganese LC		—	11.31	
Ferro molybdenum		143.20	75.22	90.37%
Steel Scrap	HM	2.35	1.62	45.06%
Manganese steel scrap		2.79	1.57	77.70%
CIX - 2 scrap		—	2.95	
Silica sand		0.25	0.88	-(252.00%)
Chromita sand		—	2.11	-(28.96%)
Zircon sand		1.83	2.36	22.46%
Olive sand		2.28	1.03	121.36%
Graphite electrodes	Q 150 mm	48.15	29.25	64.61%
Silicon carbite stopper	Rs=22	38.50	34.66	11.08%
Silicon carbite nozzle	Q 37mm	29.75	46.46	-(57.84%)
Clay sleaves	Q 100 mm 6.87			
	Q 125 mm 9.72	16.59	14.26	16.33%

(Note : Rates as on 13.2.1985)

Annexure II

Details of Materials Used in Manufacturing perton of Production

Description	Basic Price Rs.	Duty Rs.	Target Rs.	Sales Tax CST Rs.	Freight Rs.	Total Cost Rs.
Raw Materials	4711.12	546.57	18.99		85.59	5362.27
Deoxidents	286.00		6.60	0.33		292.93
CONSUMABLES						
a) Melting	398.08	26.56	19.34	0.17	1.45	445.60
b) Mould	2891.14	42.30	147.08	11.96	277.60	3370.08
c) Core	437.25	7.52	19.35	2.46	37.66	504.24
d) Ladle Nesting	305.75	35.67	38.64	0.67		380.73
e) Sleeves	317.30	38.08	19.55			373.93
f) Shot Blesting	79.06	9.49	4.87			93.42
g) Gas Cutting	877.98	78.68	105.23		36.00	1097.89
h) Nest Treatment	19.40	3.88	0.70			23.98
i) Fettling	1112.09	111.08	31.81		23.20	1277.58
j) Welding	360.52					360.52
k) Maintenance	86.58		3.19		0.63	90.40
l) Laboratory	41.76	12.87	0.80	1.00		56.49
m) Pattera Shop	80.78		0.83			81.01
n) Quality Upgradation	35.36		0.40			35.76
Power & Fuel						
a) Power	1440.00	96.00				1536.00
b) Fuel	1388.78	52.82	158.40			1600.00
Furniture Oil						
a) Ledle Besting)	395.35	17.87	45.45			458.67
b) Nest Treatment)						
Radiographic Testing	630.00	570.00				1200.00
	15884.30	1649.39	620.03	16.65	462.13	18632.50

Annexure III

Cost Per Ton of Input Materials in a Steel Foundry in India VIS-A-VIS Steel Foundry Abroad

Sl. No.	Nomenclature	Consumption per MT of Castings	Indian Foundry		International Foundry		Difference
			Rate per unit	Value	Rate per unit	Value	
			Rs.	Rs.	Rs.	Rs.	
	MELTING MATERIALS (RAW MATERIALS AND DEOXYDANTS)						
1.	Mild Steel Melting scrap	1,395kg	3.16kg	4,408	1.25kg	1,755	2,664
2.	High Carbon Ferro Manganese	19	6.93	132	3.41	65	67
3.	Low Carbon Ferro Silicon	14	12.80	179	7.14	100	79
4.	Electrode Carbon	0.95	10.20	10	5.10	5	5
5.	Aluminium	5	11.55	158	7.00	35	123
6.	Calcium Silieide	4	30.00	120	17.85	71	49
7.	Pure Selenium	0.10	750.00	75	300.00	30	45
		(i)		5,082		2,050	3,052
	MOULDING MATERIALS AND RAFRACTORIES						
1.	Alkyd Resin Binder	112kg	24.60kg	2,755	12.25	1,378	1,377
2.	Co-reactant	7	34.50	242	17.75	121	121
3.	Activator	22	50.00	1,100	25.00	550	550
4.	Refractories			317		150	167
		(ii)		4,414		2,199	2,215
	CUTTING AND WELD UPGRADATION						
1.	Oxygen Gas Cylinders	7 Nos.	64.28/Each	450	12.13/Each	225	225
2.	Dry Acetylene Gas Cylinders	1 No.	428.16	420	214.04	214	214
3.	Welding Electrodes			140		80	60
		(iii)		1,018		519	499
	SHOT BLASTING (MATERIAL COST)	(iv)	7kg	12.65/kg	89	6.33/kg	45	44
					89		45	44
	HEAT TREATMENT & LADLE HEATING (FURANCE OIL HEATING)		112.2Ltrs	2.91 Ltr	327	1.40/Ltr	157	170
		(v)			327		157	170
	POWER				2,440		1,100	1,340
		(vi)			2,440		1,100	1,340
	FETTLING MATERIALS							
1.	Grinding Wheels		0.08 No.	900/Each	72	450/Each	36	16
2.	Cut Off Wheels		1.73	47	81	24	42	39
3.	Mounted Pointes							
	A-11	7.00	12.18	85	3.50	25	60	
	A-34	10.00	9.10	93	2.50	25	65	
		(vii)			331		128	203
	QUALITY ASSURANCE	(viii)			1,204		600	600
	TOTAL	(i-viii)			14,805		6,789	8,121

Note: (Indian Input Material Prices are Exclusive of Levise such as Central Excise, Octroi, Sales Tax etc. etc. Payable by Foundry)

ANNEXURE - IV

Cost in Rupees Per Tonne of Steel Casting

Sl. No.	Foundry inputs	Indian Foundry	International Foundry	Difference	
				Value	Percentage
1.	Raw materials and Deoxydants	5082	2050	3032	148
2.	Moulding materials and refractories	4414	2199	2215	101
3.	Cutting and weld upgradation	1018	519	499	96
4.	Shot blasting (material cost)	89	45	44	98
5.	Heat treatment & Ladle heating (furnace oil heating)	327	157	170	108
6.	Power	2440	1100	1340	122
7.	Fettling materials	331	128	203	159
8.	Quality assurance	1200	600	600	100
		14901	6798	8103	119

And More About Quality

"Quality catostrophes are like land mines. If you anticipate their presence and plan to avoid them, they seldom blow up. After one explodes, it's easy to see what you should have done-if you live through the blast."

"The bosses are not always wrong. Supervision and management is so complex that textbook solutions may not apply in many cases."

Good briefers know how to emphasize important points without omitting critical parts. They also know how to condense the last 30 minutes of a presentation into a 5-minute summary as soon as the boss starts to fidget."

"Some of the worst quality disasters occur when someone wants to make a minor change like substituting a new raw material or redesigning a functional product. Unfortunately, few people give adequate thought to the question, "Is the new better than the old?"

Courtsey : Good and the Bad News About Quality by Edward M. Schrock and Henry L. Lefevre, Marcel Dekker, 1990.

Incremental Capital Output Ratios For Indian Economy

NPC Research Section

In an earlier study we have dealt with capital and labour productivities in the various sectors of the Indian Economy during the period 1950-51 to 1988-89, (Productivity Vol. 31 No. 1, 1990). In the present study an attempt has been made to arrive at the Incremental Capital Output Ratios (ICOR) for various sectors of the economy during the same period. The four decade period has been truncated in to five year periods, coniciding with the Five Year Plans.

Incremental Capital Output Ratio (ICOR) is measured here as the ratio of gross capital formation at 1980-81 prices during the period to the change in the Gross Domestic Product (GDP)at 1980-81 prices during the same period. Data on Gross Capital Formation and Gross Domestic Product are taken from the National Accounts Statistics of the Central Statistical Organisation. Gross Domestic Product from Agriculture (excluding allied activities) is arrived at by taking 3 year moving averages in order to eliminate the impact of cyclical fluctuations caused mainly by weather. It is observed that during the Annual Plans (1966-67 to 1968-69), the Incremental Capital Output Ratio (ICOR) had shown exceptionally a very high figure of 15.61 for the manufacturing sector. For the registered manufacturing sector the ICOR of 43.89 works out to be exceptionally high. Therefore, the ICOR for this sector is calculated for the period 1966-67 to 1969-70. During the Sixth Plan (1980-81 to 1984-85) period the ICOR for all the sectors except the Community, Social & Personnel services would have been higher had 1978-79 instead of 1979-80 as base been taken. The overall ICOR works out to be 5.84 instead of 4.96 if 1978-79 as base was taken. It is to be remembered that 1979-80 was an exceptionaly bad year for the Indian economy. The data for the entire Seventh Plan (1985-86 to 89-90) for all the sectors are not available. While the GDP figures are available for all the sectors upto 1988-89, the Gross Capital Formation data are available only with respect to registered manufacturing sector, agriculture excluding forestry & fishing, Railways & communication, Public Administration & Defence and for the total economy during the same period. Therefore, for most of the sectors the ICOR is calculated for the period 1985-86 to 1987-88.

Table 1 : Incremental Capital Output Ratios for Indian Economy (1951-89)

	1951-55 to 1955-56 (First Plan)	1956-57 to 1960-61 (Second Plan)	1961-62 to 1965-66 (Third Plan)	1966-67 to 1968-69 (Annual Plans)	1969-70 to 1973-74 (Fourth Plan)	1974-75 to 1978-79 (Fifth Plan)	1980-81 to 1984-85 (Sixth Plan)	1985-86 to 1988-89 (Seventh Plan)
Agriculture & Allied Activities	1.36	2.50	9.51	2.20	5.48	3.33	2.78	5.77*
Mining & Quarrying	3.50	1.81	4.08	8.14	17.72	12.05	7.79	Very high
Manufacturing	3.77	5.65	5.27	7.84@	6.90	5.48	5.68	4.67*
a)Registered	7.00	7.86	6.86	9.32@	7.65	7.37	5.81	5.25
b) Unregistered	0.82	1.56	1.82	4.91@	5.45	3.02	5.34	3.19*
Electricity Gas & Water Supply	19.60	16.17	19.15	15.72	24.91	15.81	20.51	18.59*
Construction	1.29	1.60	1.69	1.49	-Ve@@	1.37	3.16	2.92*
Trade & Commerce	1.57	1.45	0.89	2.48	3.68	2.75	4.21	3.94*
Transport, Storage & Communication	13.45	13.64	16.80	14.32	13.89	8.37	7.69	8.70*
Finance & Real Estate	10.37	11.65	9.66	9.78	7.17	5.42	5.71	3.79*
Community, Social & Personal Services	5.41	6.73	4.59	4.06	5.27	4.85	4.25	4.02**
Total	3.89	5.28	5.23	5.66	7.72	5.15	4.96	4.33

Note
* For the period 1985-86 to 1987-88.
@ For the period 1966-67 to 1969-70.
@@ GDP in the Sector during this period shows a decline.
** Relates to Public Administration & Defence. Excludes other services.

Poultry	Large	1070	476	20	910	403	17
	Medium	300	109	73	208	83	55
	Small	120	68	91	100	64	85

- Investment costs does not include land costs
- Annualised operating costs : (operating cost + maintenance + depreciation + interest)
- Annual depreciation cost by applying straight line method
- Annual interest rate at 18% on total investment
- To achieve the existing stream disposal standards of 30 mg BOD/l, the treatment system envisaged is extended aeration activated sludge process.

* Total slaughtering fee collected per year.

Pollution from Slaughter Houses : Cost Implications for Abatement & Control

Production and Availability of Oilseeds and Oils in India

NPC Centre for Agricultural Productivity

The production and productivity statistics of oilseeds are usually confined to five crops namely groundnut, sesamum, rapeseed/mustard, linseed and castor. However there are others also which have large potential to augment the oil supply for food and non-food purposes. The significant ones among these are nigerseed, safflower, cottonseed, coconut, sunflower and soyabean. Some of these crops like soyabean and sunflower have immense potential as oilseeds crops and area under these crops have been rising very fast since last one decade. Area, production and yield of these oilseed crops/plantations are given in table-1.

Table-1. Area, Production and Productivity of Oilseeds in India (1987-88)

Oilseed	Area (000 ha)	Production (000 tonnes)	Yield (Kg/ha)
Groundnut	6735	5673	842
Castorseed	453	185	408
Sesamum	2097	562	268
Rape & Mustard	4508	3370	748
Linseed	1151	372	323
Nigerseed	652	175	268
Safflower	1066	451	423
Cottonseed	6471	2187	338
Coconut	1428	1116	782
Sunflower	1657	610	368
Soyabean	1681	980	583

Source : Agricultural Situation in India, Jan 1989 to Dec. 1989

The yield potential of oilseeds have not been fully exploited. There are wide gaps in yields at the research stations, demonstration farms and farmers' farms. The yield comparisons with some of the other oilseed growing countries reveal that average yields in the country are lower than those in rest of the world. Only in case of castorseeds, our yields compare well with those of other countries. The productivity comparisons of oilseeds between India and the rest of the world are given in table-2.

The production of oilseeds has not kept pace with demand for oils in the country. As a result large quantity of oils are imported every year. The imports of oils have risen from a nominal figure of 29 thousand tonnes in 1975-76 to over 2 lakh tonnes in 1989-90. The demand supply gaps of oils are shown in table-3. The gap is being plugged through imports in order to check price rise of oils in the domestic market. While the total edible oil imports have been rising, their share in the total import bill has stayed around five percent.

Table-2. Productivity Comparisons of Oilseeds between India and Rest of the world (1984)

(Unit kg/ha)

Oilseed	India	Rest of the world (Row)	India/Row X 100
Groundnut	870	1232	70.60
Soyabeans	784	1735	45.20
Sunflower	731	1233	35.10
Rapeseed	673	1472	45.70
Sesamum	244	377	69.60
Linseed	299	617	48.50
Castorseed	639	639	100.00

Source : Background Paper, Seminar on oilseeds organised by FICCI, 1988.

Table-3. Demand and supply gaps in edible oils

('000 tonnes)

Year	Production	Imports	Total Availability	Total Demand	Gap
1975-76	2802	28.6	2831.6	4505.5	1673.9
1976-77	2365	169.8	2534.8	4608.5	2073.7
1977-78	2618	1288.0	3906.0	4713.6	807.6
1978-79	2762	821.0	3583.0	4820.2	1237.2
1979-80	2412	1149.0	3561.0	4929.0	1368.0
1980-81	2557	1074.0	3631.0	5039.2	1408.2
1981-82	3217	995.0	4212.0	5153.1	941.1
1982-83	2746	1150.0	3896.0	5269.1	1373.1
1983-84	3299	1634.0	4933.0	5387.4	904.4
1984-85	3487	1368.0	4855.0	5504.9	649.9
1985-86	3321	1703.3	5024.3	5604.2	579.9
1986-87	3411	1837.0	5248.0	5715.2	467.2
1987-88	3501	1970.7	5471.7	5826.11	354.4
1988-89	3591	2104.4	5695.4	5937.8	242.4
1989-90	3681	2238.1	5919.4	6048.8	129.4

Note : 1989-90 figures are based on projections

Source : Agricultural Situation in India, Feb. 1990.

Energy Conservation Potential in Distilleries

NPC Energy Management Division

It is estimated that 12 million GJ of energy is consumed in the 200 and odd distilleries spread all about over the country. The total annual energy bill is estimated to be Rs. 51 crores to produce 825 million litres of alcohol. The energy consumption in this sector constitutes 0.54% that of the industrial sector. The electricity consumption is about 73.5 million KWh corresponding to 0.07% of the total electricity consumed in the industrial sector.

The NPC conducted energy audits of eight distilleries under a project sponsored by the Department of Power. The findings indicated the energy Consumption Trends in these units.

The 8 units covered, produced 74.1 million litres of alcohol in the year 1987-88 at an average capacity utilisation of 52% in the distillery. The Grade-B Molasses served as the main supporting raw-material for the alcohol production. The molasses with 45% sugar content was fermented in batch fermenters for further separation after dilution. The ethanol formed at the end of fermentation, is separated in a distillation train. The average alcohol concentration was in the range of 6.5 - 7% and the final product purity was 95%.

The fermentation efficiency was found to be in the range of 78-82%. New fermentation technologies have come to adoption in our country. However, none of the units studied had adopted this technology so far. Two units were likely to adopt continuous fermentation technology to increase the alcohol yield. The alcohol yield was in the range of 212 to 246 litres per ton of molasses at an average of 231 litres per ton except in one unit where the alcohol yield was in the range of 265 lit/ton of molasses which is quite high compared with distilleries operating under similar process conditions.

Energy Use

About 1.07 million GJ of energy has been bought by the distillery industries, covered under the study, in the year 1987-88 in the form of coal, furnace oil, diesel and electricity, in addition to agricultural wastes. The energy bill amounted to Rs. 458 lakhs. The thermal energy purchased is quite high in proportion. The electrical energy consumption as a percentage of total energy varied in the range of 1—6%, with an average value of 2.75% of electrical energy.

The specific energy consumption in terms of KWh/KL of alcohol and ton of Steam/KL of alcohol is the indicator normally used in this sector to assess the plant energy performance. These ratios, for the units studied, are

i. **KWh/KL of alcohol**

Minimum	Maximum	Average
39	231	89

ii. **Ton of Steam/KL of alcohol**

Minimum	Maximum	Average
2.56	4.3	3.0

In terms of monetary value, the units spent Rs. 43/GJ of energy. For thermal energy, the units paid Rs. 287/GJ (173 Rs/Ton of Steam) and electricity Rs. 37/GJ (1.05 Rs/KWh). The energy cost of the product is estimated at about Rs. 618 per KL of alcohol with an average split of thermal to electrical in the ratio of 85 : 15. The total electricity consumed by the distilleries in these 8 units is 6.6 million KWh. The electricity consumption is mainly for the pumping loads consuming a share of 75-80% and the rest for meeting the fan power, lighting etc.

Energy conservation opportunities have been identified in these units in the areas of :

Steam Generation
Fermentation
Distillation

The scope of reduction in energy use and cost is indicated in Table 1.

The section-wise conservation potential observed is presented in Table 2. Greater saving potential has been identified in the thermal energy using Boiler House and Process. The scope for electricity conservation, however, is limited mainly because of its lesser share in the overall energy mix.

Table 1. Unitwise Scope of Reduction in Energy Use & Cost

Distillery	Energy usage Reduction %	Energy Cost Reduction %
D1	13	44
D2	35	42
D3	40	31
D4	12	22
D5	27	24
D6	18	18
D7	22	22
D8	10	9
Average	21	29

Table 2. The Section wise conservation potential identified (%)

Section	D1	D2	D3	D4	D5	D6	D7	D8
Boiler House	13	88	94	41	91	2	37	47
Process	82	12	3	49	6	97	63	45
Electrical	5	-	3	10	3	1	-	8
Base : (lakhs Rs)	20	48	10	11	4	11	19	11

Legend : D1 to D8 : Unit code

Based on the experience of the sample Energy Audit studies, the energy consumption trends and the savings potential in the sample units are presented along with the estimates for the Distillery sector as a whole in Table-3.

Table 3. Energy Scenario & Savings Potentia in sample Units & the Distillery Sector Projections

Item	Sample Units base year 1987-88	Sector (Estimated)
Annual Production (10^6KL)	74.13	825
I. Energy Use		
Total Energy (10^6GJ)	1.07	12.0
Thermal (COAL eq. 10^3T)	56	621.0
Electrical (10^6KWh)	6.60	73.5
ii. Energy Cost (Lakh Rs)		
Total Cost	458	5100.0
Thermal	389	4340.0
Electrical	69	760.0
iii. Energy & Cost Savings		
Total Energy (10^6GJ)	0.22	2.4
Thermal (COAL eq. 10^3T)	12	130.0
Electrical (10^6KWh)	0.44	4.7
Total Cost(Lakh Rs)	134	1492.0
Thermal Rs. (Lakh)	129	1441.0
Electrical Rs. (Lakh)	5	51.0

"Intellectuals love the idea of humanity but do not necessarily love the actual individuals who compose it. Insensitivity to the needs and views of other people is a characteristic of those passionately concerned with ideas."

—Paul Johnson

"The test of first-rate intelligence is the ability to hold two opposed ideas in the mind at the same time, and still be able to function."

—F. Scott Fitzgerald

News & Notes

MANAGEMENT CONSULTANCY CAPABILITY IN INDIA

Management Consultancy Services in India today show a distinct polarisation into two noticeable and significant categories. On the one hand, there are renowned firms and institutions who are exclusively providing services for various types of client-organisations both in India and abroad. These consultancy organisations have made a mark as institutions of excellence and their names are ample testimony to their quality, competence and calibre. On the other hand, there are several individuals having 'celebrity' status who are practising management consultants. These individuals are normally leaders in specific fields of activity and are, generally, people who had held senior line management positions such as Chief Executives or Managing Directors of various industrial and commercial organisations. They are, normally, found offering advisory services in strategic areas of developing new marketing strategies and identifying and entering into new client sectors. They are mostly also found in the areas of Behavioural Sciences and Human Resources Development in addition to such other areas as choice of appropriate technology and design of organisation structures. Between these two extreme ends of this spectrum i.e. large organisations and freelance consultants, there are a large number of small and medium scale consultancy organisations and other individuals who have formed themselves as associates rendering management consultancy services; states a recent NPC Report on 'Assessment of Management Consultancy Capability in India' sponsored by the Department of Scientific & Industrial Research (Ministry of Science & Technology) of the Government of India. The Report is released in two volumes i.e. the Main Report and the Compendium of the Study Data.

Services in the field of Marketing and Project Management dominate followed by Production Management and Financial Management. In addition, there are organisations who are providing specialised software services which are predominantly concerned with installing computerised systems. While there are a large number of experts in the fields of Behavioural Sciences and Human Resources Development, the number of management consultancy studies in such areas are extremely small, according to the Report. A majority of management consultancy services have been directed to the manufacturing industries with a special emphasis on consumer goods, consumer durables and engineering industries.

The scenario about a decade back showed most of the clients from the private sector with the major group being the professionally managed large national organisations. During the last five years, there is a noticeable change in the trend. Various public sector and joint sector organisations including government departments have come forward in engaging management consultants. As far as the small sector is concerned, hardly any major study has been carried out by the management consultancy services. The need for consultancy services and the capacity of the client organisations to pay for such services are unfortunately two unrelated issues.

The Report identifies the emerging challenges for consultants in the nineties as

(i) **Strategic management services to the corporate sector**
(ii) **Innovative management systems and structures for the service sector**
(iii) **Orienting the huge and monolithic infrastructure/service sector to modern management practices.**
(iv) **Extending a support role to bring in efficiency and better management of efforts of the government in the socially relevant development projects.**

The Report cites the fact that a fairly significant number of organisations have rendered management consultancy services to various countries located all over the world as a reliable indicator of the market potential for export of management consultancy services. Perhaps what is required is a centralised concept of providing the requisite information to various user countries about the nature, type and extent of such services that could be provided by Indian management consultants. This is an area that needs to be further developed as no such agency exists at present. Each consultancy service that has been carried out abroad has been done on the basis of efforts and strategies adopted by the individual organisation or the management consultant. As an overall strategy for promoting export of management consultancy services, this approach may not yield substantial results, according to the Report.

Indian management consultants have the latest knowledge, adequate experience and a high degree of work commitment. What they need is a better understanding from the clients of their role as agents of change, a remuneration from their employers which could be higher than their peers in industry/government, and an Association which could project itself to a greater degree through publicity or other means and creation of an image of professionalism in the eyes of the client organisations. Given the fact that more awareness is being created in the minds

of various organisations of the role of consultants, high degree of consultant capability and a rising demand, the future is quite bright for Indian consultants in the home market. The Report expresses the hope that the nineties would see a further boost to the demand and appreciation of Indian management consultants. With appropriate support from developmental organisations, the consultancy services can well be exported in a big way to developing countries, particularly in the SAARC region and Afro-Asian continent. The recommendations of the report cover the following broad areas :

a) **Quality and Effectiveness of Management Consultancy**
b) **Professional Associations/Regulatory Mechanisms and Information Service**
c) **Publicity and Advertising**
d) **Exports (tapping the global market)**
e) **Support from Industry, Governmental Agencies/Professional Associations, etc.**

A NEW "HUMAN DEVELOPMENT INDEX"

A new yardstick to measure "human development" shows that high levels of human development can be achieved even at modest income levels so long as people are placed at the centre of development. The Human Development Index (HDI) is one of the most innovative features of the *Human Development Report (1990)*, published for the United Nations Development Programme (UNDP) by the Oxford University Press. It combines life expectancy, adult literacy and purchasing power into a single measure, focusing on how economic growth translates into human well-being. It is calculated as a national average but can also be broken down by gender, income, region, or social groups.

The index has its greatest value in measuring the disparities among developing countries. Industrialized countries tend to cluster together, with only five years of difference in life expectancy and four percentage points of difference in literacy among the 19 highest-ranked countries. Sri Lanka shows best that human development can be reached on fairly low income, since its GNP is only 38th of 130 countries, but its HDI ranking is 83. Costa Rica, which has no standing army, ranks a high 103, because its average life expectancy is 75 years, its literacy rate is 93 per cent and its average adjusted real income is $3,760

The central messages of the Report are :

Development does work. While North-South income gaps remain enormous, with 1987 average per capita income in the South still only 6 per cent of that in the North, human gaps are narrowing. Average life expectancy in the South is already 80% of the Northern average and adult literacy 66%.

There is no automatic link between economic growth and human development. Some countries have successfully translated their economic growth into human progress. These include Sri Lanka, Costa Rica, Botswana, Malaysia, Chile, Colombia, Jamaica, Kenya and Zimbabwe. Others have conspicuously failed to improve their human development levels to match rapid economic growth. Examples are Brazil, Pakistan and Nigeria.

Most developing country budgets can accommodate additional spending for human development by squeezing the expenditure on military, inefficient state enterprises, unnecessary government controls and social subsidies benefitting the rich.

Large external resource flows will be needed in the 1990s, specially targeted towards human development, in order to address the large backlog of human deprivation that still remains.

The human development index and a more coherent approach towards people-focussed development are put forward by UNDP - the largest multilateral grant assis tance agency in the world and the primary coordinator of the United Nations' development activites - as a contribution to the development dialogue of the 1990s.

The Report was prepared by a team of eminent development economists under the guidance of Mahbub ul Haq, former Minister of Planning and Finance of Pakistan, currently serving as special advisor to the UNDP Administrator. It is the first in a series to be published annually on the human dimension of development, and marks the 40th anniversary of UNDP. It examines the progress made in human development over the past 30 years by developing and developed countries, explores the reasons why some countries have advanced and others lagged, and suggests practical examples of what has worked in recent years.

The Report analyses the record of significant human progress in the developing countries over the last three decades. Life expectancy has increased from 46 years to 62 years. People in the developing world have now the prospect of living 16 years longer than their parents did only 30 years ago. Adult literacy rate has jumped from 43% to over 60%. Child mortality rates have been halved. Nutritional levels, on average, have improved by 20%. In these fields, developing countries have accomplished in about three decades what it took industrial nations nearly a century to achieve.

But the Report warns against any complacency about the human development record of the past three decades:

- An immense backlog of human deprivation still remains as a challenge for the 1990s: one billion people in absolute poverty; 900 million without education; well over 1 billion without safe drinking water; around 100 million completely homeless; some 800 million who go hungry every day; 150 million malnourished children under five (one in three); and 14 million child deaths before the age of five.
- Human progress is not equally shared among various regions. Sub-Saharan Africa, in particular, has the lowest life expectancy and literacy rates and the highest infant mortality rates.
- National averages conceal wide disparities within countries in human development levels as between rural and urban areas, between females and males, and between rich and poor.
- After rapid progress in the 1960s and 1970s, the 1980s have witnessed a stagnation or even reversals in human achievements, particularly in Africa and Latin America.
- North-south gaps have narrowed only in basic human survival levels. When we consider higher learning and technology, the gaps are continuing to widen, with major implications for increasing gaps in future economic opportunities.

The central message for policy makers is clear. There has been a significant change in human lives in the developing world over the last three decades, despite their continuing economic problems. The change could have been even greater if developing countries had chosen their development priorities better and if the rich nations continued to transfer larger resources to the poor nations. In the midst of the usual gloom about economic performance of the developing world, this is a message of hope and an inspiration for the future.

The Report points out that human costs of adjustment have been unacceptably high in many developing countries in the 1980s. These costs were often avoidable, a matter of policy choice and not compulsion.

The Report is particularly severe on the rising military expenditures in developing countries which increased three times as fast as in the industrial nations over the last 30 years, from 7% of global military expenditures in 1960 to over 20% by now. In some of the poorest countries, military spending is two to three times larger than their spending on education and health. There are eight times more soldiers than physicians in developing countries. The Report notes sadly that military expenditures of some developing countries went up in the 1980s even as their social expenditures fell. "Obviously, the poverty of their economies was no barrier to the affluence of their armies." In the changed climate of the 1990s, search for a peace dividend is as important in the developing countries as in the industrial nations.

The Report is candid and even-handed in its treatment of the responsibility of both developing and developed countries for the accumulating backlog of human deprivation. It points to the limited options available to developing countries in the 1980s for accelerated human development because of negative resource transfers, falling commodity prices, mounting debt burdens and deteriorating external environment. The Report points out frankly that if international assistance continues to lag and if trade outlets continue to shrink in the industrial countries, "the compulsions to migrate in search of better economic opportunities will be overwhelming-a sobering thought for the 1990s."

But the basic message of the Report is a hopeful one. Remaining human deprivation can be overcome in a manageable period of time. It is achievable only if both developing and developed nations collaborate in designing and financing suitable human development strategies at the country level. □

FARM SIZE & PRODUCTIVITY

"Small farmers tend to apply more labour per unit of area for irrigation and other improvements, achieve higher cropping intensities, grow crops which are more labour using and, thus, realise higher output per hectare of net area sown than large farmers who essentially depend on hired labour" according to Prof. C.H. Hanumantha Rao, of the Institute of Economic Growth, Delhi and a former member of the Planning Commission. The findings of his studies were presented at a seminar on 'Improvement of Agricultural Structure in Japan' organised by the Tokyo based Asian Productivity Organisation (APO). The papers presented at the Seminar along with a summary of findings are now published by the APO in a volume with the title Improving Agricultural Structure in Asia and the Pacific'.

According to Dr. Rao, both low cost of family labour and low cost supervision in traditional labour intensive agriculture favour small farms, where labour is abundant. Farm Management studies done in India brought out the inverse relationship between farm size on the one hand and labour input and output per hectare on the other. This picture began to change with the introduction of new technology after the mid-sixties. In the initial stages of technological change, large farmers, owing to their better access to knowledge and resources and because of their

capacity to bear risks, took the lead in the use of high yielding varieties of seeds and fertilizers so that the output on their farms grew faster than on small farms. This resulted, in course of time, in the weakening or in some places even the disappearace of the inverse relationship between farm size and output per hectare. This prompted some analysts to assert that in the context of the new technology, large farmers are as efficient as, and even more efficient than, small farmers. Quite a few studies even showed "increasing returns to scale' in Indian agriculture.

Dr. Rao found that such observations and studies reflected a number of infirmities in understanding. First, the higher output per hectare of net sown area among large farms was achieved not through higher cropping intensities involving greater use of labour but by stepping up significantly the yield per hectare of certain individual crops through the intensification of inputs like fertilizers. Also, such farmers resorted to highly labour displacing mechanization like harvest combines. Thus the 'disappearance' of inverse relationships between farm size and output per hactare was accompanied by the sharpening of the inverse relationship between farm size and labour input per hactare. Insofar as cropping intensity among large farms continued to be lower than among small farms, the inefficiency of resource-use persisted in a land-scaree and labour-abundant economy. In effect, therefore, to a considerable extent, there was a substitution of capital (embodied in mechanical as well as bio-chemical inputs) for labour. This had an adverse effect on employment and income of hired labour whose number has been increasing and getting increasingly 'casualized' on account of the ability of the large farmers to do away with permanent labour.

Secondly, the finding of 'increasing returns to scale' could not be sustained as it reflected merely the higher rate of adoption of new technology among large farms. Since the new technology is size-neutral, though not resource-neutral, there was no basis for the emergence of the phenomenon of increasing returns to scale, in the strict sense of the term.

The thrid phase seems to have started around the mid-seventies, that is, nearly a decade after the new technology was first introduced. During this period, because of nationalization of major commercial banks, development of other formal institutions for the supply of rural credit, and the earmarking of credit in favour of small and marginal farmers at lower rates of interest, the small farmers' access to modern inuts improved significantly, even though their dependence on informal institutions for credit is still greater than for large farmers. In the course of time, therefore, the rate of use of high yielding varieties of seeds and the use of fertilizers per hactare among small farms caught up with that among large farms. The inherent advantages of small farms in regard to higher cropping intensity through greater labour-use and better supervision persisted. The net result has been the continuance or 'reappearance' of the inverse relationship between farm size and output per hectare. However the inverse relationship between farm size and labour input per hectare continued to become sharper, lowering the elasticity of employment with respect to agricultural output. This must have resulted in worsening the relative income position of the wage labour, even when there was a rise in real wages in certain pockets owing to higher growth of output and rising seasonal demand for labour. □

ENERGY SCENARIOS FOR 2009-10

The primary electricity demand (Hydro & Nuclear) in India will be about 217 TWh implying a growth rate of about 6% over the period 1988-89 to 2009-10. This is as per the *Business As Usual* (BAU) Scenario projected based on past trends and energy intensities of gross domestic product. This projection is made by the Tata Energy Research Institute (TERI) in their recent Report with the title 'Getting Off This Fuelish Path'. Primary electricity generation is expected to be 319 TWh in 2009-10. The conservation measures will have no impact on primary electricity demand, but will have a significant impact on secondary electricity demand like for Coal and Natural Gas. The demand for natural gas is likely to sky rocket to 175 million cubic meters per day, requiring gigantic levels of investments in infrastructure and market development, according to the TERI report.

The total demand for non-coking coal in the *Business As Usual* scenario works out to be 626 million tonnes. Going by the assumptions on likely availability of coal, this would work out to an import level as high as 200 million tonnes if the demand has to be met. The *low conservation scenario* has a marginal effect on total non-coking coal demand reducing imports by 22 million tonnes. The *high conservation scenario* has a vey significant impact on coal demand bringing down the import levels to 82 million tonnes. A large part of this decline is due to reduction in industrial usage of non-coking coal. The TERI Report places a high level of demand for pertroleum products, at 186 million tonnes under the *business as usual scenario* implying a growth in import of POL products of over 7.6 per annum during the period. While the *low conservation scenario* indicates an oil demand of 126 million tonnes, the *high coriservation scenario* which takes into account large-scale renewable energy programme, predicts a reduction

in oil demand of about 108 million tonnes. An important implication in the oil sector brought out by the Report is that the additions to recoverable reserves that would be required during this period in order to be able to sustain the increase in oil production to reach the level of 70 million tonnes by 2010, would be in the range of 1550 million tonnes. Thus, while in the last 20 years, we have cumulatively added 900 million tonnes of domestic oil reserves in the next 20 years, we would need to increase this to over 1500 million tonnes if we aim at getting the reserves to production ratio constant.

Demand for conventional energy form in the *high conservation scenario* is significantly lower than in the *low conservation scenario* partly due to higher efficiency levels in industrial energy use and in the tansportation sector and partly because of the large scale utilisation of renewable forms of energy. The *high conservation scenario* would exploit a wind potential of 20,000 MW and produce 1.75 TWh through the use of photo voltaiecs. Solar cookers emerge as economically viable and the upper level of penetration of solar cookers which was set at 100 million tonnes would be acheived as an optimal solution. In the event that this upper bound and penetration on solar cooker is removed, it is found that solar cookers would substitute for kerosene to the extent that all imports of kerosene are eliminated. Solar water systems are also economically attractive as compared to electricity based heating devices and 1.4 million domestic solar hot water systems are indicated, substituting for electricity use. Biogas gas plants to the tune of 13.5 million family site plants are indicated, according to the report.

Energy demand under the *Business as usual scenerio* is quite unsustainable. This point is brought forth force fully when one looks at the foreign exchange requirements of these levels of energy demands. In the *business as usual scenario* foreign exchange requirements for the year 2009-10 would be close to Rs. 86000 crores in 1989 prices; equal to the cumulative out flow of foreign exchange for oil over the period 1983-88. The *low conservation scenario* brings down these requirements to the level less than Rs. 48 thousand crores and the *high conservation scenario* reduces it to approximately Rs. 20 thousand crores. As compared with the ceiling placed on out flow of foreign exchange for import of POL products at Rs. 7,500 crores for 1990-91, this brings out very clearly the need to not only adopt all the measures that have been included in the *high conservation scenario* but also to identify technological changes, fuel substitution options and alternative fuels for further compressing the burden that the energy sector is likley to place on balance of payment, according to the Report.

CHALLENGES BEFORE THE AUTOMOBILE INDUSTRY DURING THE 90S

"The proverbial `global economy' is now becoming a reality. The World today is being shaped by forces and events that go far beyond anything we have ever faced before", according to a Report presented in the Manufacturing Competitiveness Frontiers (June 1990 issue). The challenges, the worldwide automotive industry would face in the next decade, will be formidable. And perhaps no reality more clearly illustrates how difficult the future would be than that of the intense automotive competition, according to the Report.

The Report estimates an excess worldwide automotive capacity reaching about 8.4 million units during the current year. This is nearly 20% more cars and trucks than customers will demand, and the impact will be felt most severely in Northern America where nearly six million units of the excess capacity will be aimed. "Over capacity of this magnitude means we will be facing a brutally competitive worldwide environment. It means, there will be manufacturers today that will be able to survive to the end of the Centruy, if that long, in their present sizes and structures. Although some manufacturers will be more formidable than others, the effort of all producers to capture large market shares will most certainly squeeze the margins for every market participant". A second challenge during the 90s is that of emerging markets - those which are still relatively untapped by worldwide automotive industry. Sixty precent of the growth in vehicle sales during the next 20 years is expected to be in markets where major automotive firms have little or no manufacturing presence today. These, include Eastern Europe and the Soviet Union (where recent efforts have vastly improved the potential for economic growth) as well as China, India and many other markets in Asia, the Report forecasts.

The 90s will present enourmous opportunities; however, they could well see the industry facing more difficult challenges than ever before. There will be aggressive competition. The political and economic environment will change, especially in the emerging countries that are moving towards reform. Environmental concern will continue as a critical issue. Consumers' needs and desires will change. Training the work force will continue to promote a formidable task. And customers satisfaction will become a paramount concern, adds the Report.

INDUSTRIAL PERFORMANCE AND PRODUCTIVITY

"Amidst buoyancy in industrial investment and growth, industrial inefficiency across the subsectors of manufacturing has persisted. Management deficiencies, inaccu-

rate market forecasting, inefficient working capital, labour unrest and cost escalation are citied as key factors leading to a low level of industrial performance", according to a recent UNIDO report on India's industrial performance during the decade 1976/77-1986-87 (UNIDO, India New Dimensions of Industrial Growth, 1990). The report found that the labour productivity grew at an annual average rate of 5.5 per cent in industrial chemicals and electrical machinery during the period 1975-85 revealing largely the incidence of technical progress that has gone into the production process in these two segments of Indian manufacturing. Significant strides seem to have been made in raising labour productivity in miscellaneous products, food products, furniture (excluding metal) and glass products. Several factors, such as product mix, degree of specialization, innovation, research and development, influence labour productivity. Qualitative factors determining labour productivity do not lend themselves readily to quantification. The inherent qualities and skills of involved workers play a significant role in raising productivity levels, but factors such as working enviornment, labour relations and overall atmosphere influence labour productivity, and here the responsibility is largely that of the employer.

The report also revealed that the share of value added in gross output fell from 23.2 per cent in 1975 to 18.6 per cent in 1986, reflecting input cost escalation. Only in three subsectors of manufacturing (food, tobacco and leather) did the share of value added in gross output rise, rather marginally. Rising industrial costs create difficulties for manufacturers in stepping up production and sharpening the competitive edge of their products in the world market. The report attributes the sharp fall in the share of value added in gross output in iron and steel from 27.2 per cent in 1975 to 17.3 per cent in 1986 to the production of alloy steel. The Indian alloy steel producer is not able to enhance the price competitiveness of his product in the international market because the cost of inputs in India is far above that of the European Economic Community (EEC) countries Japan, Republic of Korea and Taiwan. As far electric power, which is a major input in this industry, the cost ratio is 1 : 2 in favour of the foreign producer. "This highly import-dependent industry suffers from the lack of indigenous sources of raw materials, such as nickel for alloying, and the insufficient quantity and low quality of locally available melting scrap or sponge iron. Imported inputs are becoming increasingly expensive in the wake of the sliding value of the Indian rupee against key currencies. High customs duties also add fuel to the escalating cost structure", adds the Report.

Rising capital costs due to inflation, changing external value of the rupee and the incidence of heavy import and excise duties have led to huge increases in investment costs in new units with identical capacities, and even the modernization and expansion schemes cost much more than in earlier years. Even with the introduction of concepts such as development rebate, investment allowance, differential rates of taxation and tax holiday concessions, the disturbing rise in the incremental capital output ratio (ICOR) has seriously affected the profitability of operations especially where productivity has been low due to inefficient labour, inappropriate technology and substandard raw materials, according to the UNIDO report.

Indian industries are particularly handicapped on account of prolonged delays in implementing the projects. The overrun in expenditure is 25-50 per cent even when the projects are slightly delayed, as in a period of 4 or 5 years the volatile exchange rates and interest rates generally tend to cause an upward revision of the cost estimates. The cost escalation is prohibitive where the contours of the project are changed during implementation. An increase in the capital-output ratio can be prevented only with better use of capacity, upgrading of technology, improvement in labour productivity and increase in value added. In general, the non-wage content of value added has tended to decline because of the increase in the wage component with rising emoluments and the absence of a proportionate improvement in productivity. These problems need to be tackled effectively if scarce resources are to yield the desired returns. The much-needed internal generation of resources needs to be secured especially when the revamping of operations of the public sector enterprises involves heavy capital expenditure.

An imporvement in the capacity utilization rate in recent years is somewhat reassuring against the earlier sombre picture of industrial efficiency, according to the Report. The capacity utilization rate has steadily improved in the 1980s, with the implementation of modernization and expansion schemes and increases in demand. The average capacity utilization rate for all industries rose from 73.3 per cent in 1980/81 to 80.0 percent in 1985/86. There was a marginal decline to 79.1 per cent in 1986-87 in the wake of unfavourable weather conditions and slower economic growth. No tangible improvements were recorded in 1987/88. The oil refineries worked at 100 per cent of capacity and the operating ratio for the integrated steel plants of the Steel Authority of India Limited (SAIL) was 75 per cent. The cement industry used only 68.4 per cent of its facilities, partly due to rapid additions to capacity and delays in getting over teething troubles in the new plants. There were, of course, difficulties relating to supplies of coal and power. The heavy chemical enterprises (caustic soda) had an operating ratio of 76.6 per cent.

One feature of the industrial scene is encouraging. The new fertilizer, cement, mini-steel and petrochemical firms have been achieving capacity utilization up to 110-120 per cent. Fresh investments could, therefore, be in areas which accelerate growth and where capacities could be enhanced in order to achieve the twin objectives of import substitution and export promotion, according to the Report.

THE SUBSTAINABLE FUTURE: FOOD, ENERGY & AGRICULTURE

"The 1990s will witness a mass transfer of skills from the industrial to agricultural sciences for two reasons. First sustainable management of agro/ecological systems and energy efficient utilization of their products can help overcome environmental damage and global warming threats. Second, the customer of the 21st century will demand exotic or `natural' products and will pay high prices for them. Meeting these needs will be achieved through developing an array of farming systems ranging from zero input forest and rangeland schemes to intensive hydroponic production units, and producing food with out added chemicals under environmentally sustainable conditions. With these two factors in play, agriculture will be one of a few industries that can claim it actually increases profits by implementing energy and environment saving technique", according to Dr. Stephen New, a Vice-President in the international Development Group. In his article in the 10th Anniversary Commemorative Volume of the RCG/ Hagler Baily, Inc. (Chartering a sustainable Future) Dr. New asks" what better way to absorb much of the atmospher's excess carbon dioxide than to gear up the photo synthetic performance of our planet"?

Heavy industrial manufacturing, food processing or petro-chemical production are massive consumers of energy and generators of green house gases. These industries can be made more energy efficient, through the development of new or improved agricultural systems. Biomass products used in the renewable energy industry, for example, not only offer environmentally sound alternatives to fossil fuels, but in many cases cost saving options. Millions of cars in Europe are now powered by hydrocarbon gases such as propane, for cost efficiency and technology developments mean renewable plant materials can now be converted directly to hydro-carbon fuels. As commercial incentives motivate engineers and economists to move from power stations to the farms, the photo synthetic car could become a reality, according to Dr. New.

Tropical hardwoods are thermally efficient and can replace cement based construction materials in many applications. Under sustainable cropping systems hardwoods require production inputs of 300-350 Kilo Calories per kilogram of raw wood compared with a minimum of 20,000. K.Cal/Kg. for Cement. Cement, steel, clay, and plastic based materials look even less attractive when ecological pricing mechanisms are applied. Similar arguments can be advanced for other natural materials such as cotton, jute, sisal, rubber and leather in comparison to their synthetic substitutes, says the article. To meet the future needs pharmaceuticals may increasingly be farmed with willow plantations for Aspirin, Amazonian Oaks for AIDS vaccines and rosy periwinkle farms for leukemia drugs offering immediate commercial opportunities for crop diversification. The only industry to lose in this new progression will be the agrochemical producers, who are even now giving way to organic farmers in the face of market demand for chemical free foods. In addition to the appeal, organic farming holds for consumers, the economic benefits of chemical free system are fast becoming apparent; continues the article.

Many of the energy intensive farming methods followed by the industrialised nations actually have negative energy conservation ratios. Increasing fossil fuel prices will diminish the competitiveness of energy inefficient agriculture. The agricultural work places of the future will be relatively closed systems with positive energy conversion ratios and complex cropping patterns., sustainable over the long run. They may combine biomass fuel, food and pharmaceutical cropping with in the same extensive mega-plantation.

Tropical fruits have immediate sales potential and prices will remain high because the technology required for their successful mass marketing has not yet been developed. Of the genuine tropical fruits only banana and pineapple have received significant research alternation. The potential return on investment is high for the privately funded research and development of these crops. It is difficult to imagine that future generations will continue to rear herds of large drug dependant mammals in confined spaces for mass consumption. The present decline in demand for meat based products will continue and animals may come to be viewed as participants in energy efficient mixed production systems. Ruminants have the unique ability to convert many agricultural waste products into easily assimilable organic fertilizer with out large inputs of fossil fuel. Perhaps even the historical role played by draught animals will also be re-assessed in the nineties, since they are more energy efficient than machinery in the performance of many agricultural operations. Carcass and other animal wastes will be useful by-products of agri-silviculture systems where annual food and fibre crops are integrated with long term planting of trees for timber and animal fodder; according to Dr. New.

To day, a hard disc to a farmer is more likely to mean the cutting edge of a plough than a data base of market information, and the best agricultural practitioners have generally been unable to reduce their successful methods to programmable instructions. The reason for this is simply that the farms are transient and chaotic natural ecosystems, that exhibit discernable patterns of behaviour only over the very long term, making agriculture slow dif-

ficult to design and hard to replicate. Most researchers admit that the "feel" of the soil, the "look" of animal or the "smell" of the fruit often appear more reliable indicators than a barrage of scientific measurements. This is changing rapidly as new modelling and engineering techniques are applied to agricultural systems and processes. Given the central role of a diversified agricultural industry in the production of energy substitution crops combined with the need for a new range of user friendly food and pharmaceutical products which can only be grown in complex, managed eco-systems agriculture will be the science of the future. In the nineties, it will be cool to be a vegetarian agricultural development consultant in a leather jacket. And by the year 2000, a generation of ageing nuclear physicists will wisper in hushed tones of parental pride, "My daughter is at Hardward. She is going in to farming", adds the article.

THE PRODUCTIVITY GAP : THE AUTOMOBILE INDUSTRY

According to a WORLD LINK report (May/June 1990) Japanese Auto-companies had roared so far ahead of all competitions in terms of quality, design cycle times and production volume per model that researchers could document a 2 to 1 differential in productive capacity with western industry. Japanese efficiency set off a pitched industrial battle of epic proportions which still finds Japanese auto producers way out in front and steadily imposing themselves in every market and product sector they set out to conquer.

Meanwhile strategic allianees, corporate restructuring, layoffs and massive investments in high-tech retooling have brought about what amounts to a second industrial revolution in automotive technology and management. Today, lean consumer oriented production systems—drawing on the most flexible, innovative engineering and design talent—have virtually put an end to the traditional assembly line approach to manufacturing. So, while customers have more to choose from, the industry as a whole is headed for trouble as companies run out of fuel and ideas in the exhausting race to be competitive. Even higher international performance standards, over capacity and an increasingly rigurous environmental agenda mean that some companies will not servive the decade, atleast not in their present form, according to the Report.

What is more useful than the 'Crisis mongering, protectionism and Japan bashing' is some hard thinking about the industrial strategy needed to match the quality standards arrived at with such ease by the best run Japanese companies, argues the Report. Satatistics reveal that Japanese systems, whether functioning in Japan or in a US transplant, take 17 hours to manufacture a car. Europeans and Americans take 36 and 25 hours respectively. More importantly the Japanese design a car in 46 months and use 1.7 million manhours. Europeans and Americans accomplish the same task in 60 months and use 3 million or more man hours :

This productivity gap is attributable to the Japanese mastering of a 'lean' just-in-time production system - as opposed to the centralised mass production system of most Western companies. It is lean because it uses less of everything; from human effort to inventories, to material and investment in tooling and production. It is faster, higher and cheaper. Under the old system customers took their choice from what the factory was capable of producing. The new system begins by defining customers' needs and supplying them with a flexible and demand driven approach to product design. In lean production, authority is distributed away from departments and administrators and diffused to product development teams. "US producers have made substantial progress in assembly but relatively little in product development, which indicates just how much easier it is to turn around a manufacturing plant than a whole set of white collar engineering and design activities" maintains the Report. "Lean production implies a big change in corporate culture, a substantially different relationship between automanufaturers and suppliers of components and a whole new approach to the design and assembly of automobiles. If it takes a crisis to drive these points home to executives, then perhaps a crisis is just what is needed", according to the Report.

□

Book Review

Achieving Managerial Excellence: Insights from Indian Organisations *by S.K. Bhattacharya, Macmillan India Limited, New Delhi, pp 169, 1989 Rs 80/-*

This book provides valuable insights into the successful working and managerial qualities of some selected companies of India. A rather slim book with 14 equally slim chapters, it contains several well distilled important chapters. After devoting the first four chapters to methodological issues, the author has listed out his impressions and observations regarding the working of ten select Indian companies using well known organisation diagnosis model. His list includes six corporations in private sector - Asian Paints (India) Limited, Bajaj Auto Limited, Hindustan Lever Limited, ITC Limited, Larsen & Toubro Limited and Reliance Industries Limited, two in public sector- Bharat Heavy Electricals Limited and Hindustan Machine Tools Limited, one financial institution viz. Industrial Credit and Investment Corporation of India Ltd., and finally Gujarat Cooperative Milk Marketing Federation Limited, better known as Amul.

The author, basially being an expert on finance, used past financial performance of Indian organisations in order to identify excellent ones. Along with this he used qualitative analysis and opinion polls to come to final selection. ITC, Hindustan Lever, Amul, HMT, BHEL, etc. are definitely Indian hallmarks in terms of the performance of these companies. The author uses 5-10 year time frame to study the entrepreneurial and operational management practices.

The book takes case studies of how these organisations acted on several real life managerial issues. These cases, in turn, have been evaluated on the basis of 7-S McKinsey model for organisation diagnosis viz. superordinate goal, strategy, structure, system, staffing, skill and style. This model has already gained sufficient recognition among academicians and practitioners.

By way of example the author dwells on the succesful entry of Asian Paints in to Indian rural market with right product features and an appropriate distribution channel which is a successful Indian case of effective strategic management in a severely competitive environment dominated by multinationals. Similarly product group based divisions and their integration with corporate structures as followed in ITC, HMT, etc. manifest skilful handling of delicate organisational issues by in Indian companies. The other examples are the systems of project appraisal of Indian investments by ICICI, computerised distribution planning by Asian Paints and production planning and control for timely delivery by L & T. The author has also shown his understanding of the human factor in reflecting superordinate goals in Asian Paints and, Bajaj Auto Ltd., managerial styles in BHEL and ICICI; human resource management approaches in L & T and Hindustan Lever; and operational and managerial skills in L & T and Reliance India, etc. The author also takes up the issues of corporate culture, which is believed to be omnipresent in every action taken up in a corporate environment and which transcends time, hirearchical level, region etc.

The methodology adopted by the author regarding the selection of top performers and also the analytical framework used for its understanding calls for a critical look. This is because the approach is highly impressionistic and devoid of any analytic-structural understanding.

One has reservations about the author using 7-S McKinsey model. By using this foreign model as a frame of reference the author may have overlooked the uniqueness of corporate environment in India. Similarly the author overlooks the role of input in strategic management primarily because it uses the Kinsey paradigm. Nevertheless this book is a pace setter amongst the literature of its genre.

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Rural Development In Taiwan - Some Lessons *by J.S. Tomar; Agricole Publishing Academy, New Delhi, 1990, 160 P, pp. Price Rs. 150/-.*

In this book, the author has presented interesting statistics about the changes which have taken place during the preceding 4 decades. It is fascinating to note that in such a short period, a poor country like Taiwan has not only become self-dependent but has the world's third highest foreign exchange reserves with its per capita income being $ 5,000. These laudable achievements have

been possible only due to the export oriented growth strategy of Taiwan. This is borne out by the fact that in 1952, agricultural exports accounted for 95% of total exports. This has gradually declined to less than 7% at present although the absolute amounts of exports have been constantly increasing.

This book highlights the factors responsible for the rapid growth of the industries in Taiwan and the progressive decline of dependence on agriculture from 52% in 1952 to 22% in 1985.

The author in his book has enumerated the reasons responsible for the rapid growth of Taiwan. These include both internal as well as external factors. The author points out clearly that in developing countries a similar approach may be useful for balanced development of agricultural and industrial sectors.

This book has a limited text, based entirely on secondary data and information provided by the government of Taiwan during the authors brief visit to Taiwan. It would have made the book more interesting, if the public reaction to Taiwan's progress was also included.

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Dry Farming Technology in India by *P. Rangasamy Agricole Publishing Academy, New Delhi, 1990, 204 P, Rs. 200/-*

The book is a revised version of the author's Ph. D thesis on 'Economics of Dry Farming in Selected Areas' submitted to University of Delhi.

In the intrcoductory chapter the author has highlighted the importance of dryland farming in the Indian context, delineated the dry land areas in India, outlined the efforts made in the past for developing rainfed areas and described the institutional framework for popularising the dry-farming technology. Finally, the author has discussed the significance of technology changes for economic growth. The objectives of the study are outlined as (i) to estimate the profitability of new dry farming technology as compared with that of traditional practices (ii) to analyse the risks and returns associated with fertilizer application under dryland conditions; (iii) to examine the factor saving biases of new technology.

The author has evaluated the dry farming technology in two project areas, (i) Tiruneveli district and (ii) Hyderabad district. The chief sources of irrigation here are rainfed tanks and wells which are largely unreliable. It has been found through field experiments that the technology package for dryland farming was profitable for commercial crops viz. cotton and castor but not for cereals, bajra and jowar. A greater complimentarity was found between rainfall and fertilizer application. The responses were poor in case of latter group of crops.

The risk aversion has been pointed out as one of the strategies adopted by the farmers to overcome the vagaries of nature. Farmers are usually selective in the use of modern inputs, preferring drought resistant varieties over HYV, disease resistant varieties over use of pesticides and grow mixtures rather than single crop as an insurance against risky weather.

There is under application of fertlizer in dryland areas. A trade off between risks and returns suggests that there is need for higher investments to increase yield and returns but farmers are short of funds. So credit availability to farmers in these areas can bring the yields to the optimal levels. The author has also pointed out factor saving bias in new dryland farming technology. Among different size groups, the factor savings are more for small farms as compared to medium and large farms.

The priorities for dryland areas are outlined as extension of irrigation facilities to dryland areas, research in techniques for moisture conservation and moisture use efficiency, crop diversification and inter-cropping, evolving HYVs for stability of yields, developing a low cost technology and extension of credit facilities to the farmers in dryland farming areas.

The book not only provides a case study for dryland farming areas but also acts as an illustration of a methodology for carrying out such an analysis. The tools and techniques used by the author are commendable and can be useful for economists and agricultural scientists. The results arrived at can be equally important for planners and policy makers.

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A Review on Planning and Measurement in Your Organisation of the Future *by D.S. Sink and T.C. Tuttle, Institute of Industrial Engineers, USA, 1989, 331 p, $ 46.25*

The most important feature of this book is its focus on prescribing solutions rather than describing problems and/or opportunities. It emphasizes on how to develop planning for improving the performance of the organisation. These considerations, according to the authors, hold the key to success for the 'Organization of the Future'.

The book begins with a chapter on the implications of 'The New Competition' and the characteristics of the Organisation of the Future'. The chapter cites the examples of three organisations in an attempt to highlight 'The New Competition' and the responses of the organizations to survive and grow.

Later chapters speak of two basic strategies for energizing performance improvement. One,a 'push' strategy propelled through measurement and the other, a 'pull' strategy that involves developing a shared vision of a desired future organization. The authors claim that implementing vision requires new paradigms. They examine some of the dysfunctional paradigms about measurement which have created roadblocks to performance improvement. These, according to them, include, overemphasis on labour productivity sloppiness of subjective measures etc.

The key elements of the strategies for the future organization, the authors stress, are going to be increasing organizational flexibility, product and process innovation, cost reduction, and quality improvement. Organisation structures will shift from pyramidal to flatter, lattice structures. Organizations wll be market driven and process technologies will be geared towards increased quality, lower cost, and reduced flow times. Modern technologies will also revolutionize white collar jobs. Management systems must institutionalize organisational strategy, vision and core values.

The authors divided the planning process into four types; Long range, Strategic, Tactical, and Opertional. Various 'terms' are discussed to break semantic barriers. Then a detailed discussion is made on an innovative planning process which the authors call the Performance Improvement Planning Process.

The book also reveals the myopic views on measurement which prevail in present day organisations. Citing personal experiences and Deming's ideas, the authors suggest that measurement should help not only in controlling but also in performance improvement, the second role being more important than the first.

Later in the book the authors comprehensively deal with the design and development of measurement systems. The authors have developed a five-step technique called management systems analysis (MSA). They argue that in selecting a target, a top down strategy be followed and performance measures be developed for a process rather than a function. They also recommend the development of measurement masters. These masters are very few. They have to be developed by forming a team of individuals drawn from a variety of disciplines.

The authors further suggest eleven performance/productivity measurement tools and techniques. They range from multi-factor producitivity measurement model to variance analysis. Borrowing ideas from others, the authors have suggested a contingency theory approach, a decision tree approach, and a decision contour map approach to select appropriate techniques for measurement. They suggest the force-field analysis, originally forwarded by Lewin, to develop the implementation plan. Implementation should be a reverse process compared to design and development.

The authors have given a five phase methodology of general measurement : (1) What to measure, (2) Develop the measurement process, (3) Collect the required data, (4) Process output validation, and (5) Link to improvement. This is then followed by a review of conventional measurement aproaches stressing on how they fit in the general measurement methodology. These approaches are work measurement, cost accounting, corporate finance, management by objectives, and gainsharing. The authors then discuss the state-of-the-art measurement approaches in the context of the general measurement methodology. The approaches are total factor productivity measurement, family of measures, statistical performance control, and common staffing study approaches.

The underlying theme of the authors is that status quo is not favourable to maintaining excellence, that staying a leader is more difficult than becoming one, and that we should change our paradigm of looking at and thinking about things. The authors have reviewed Grayson and O'Dell's ten lessons from history, the factors that caused leaders to decline and challengers to rise to take their place. The book maintains that the levels of performance in The New Competition, in some cases, are orders of magnitude greater than traditional preceptions and standards, that it demands at least an introspective examination of, and whole-brain thinking during, management processes and practices.

In spite of minor printing errors, the book is very well-written and should be read by every manager and the planning and measurement schemes suggested by the authors should be implemented in every progressive organization. The book provides an excellent source of new ideas and case materials with which management courses in business schools could be enriched and revamped.

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Organization Stress and Executive Behaviour, *by Shailendra Singh, Shri Ram Centre for Industrial Relations & Human Resources, New Delhi, 1990, pp. 154, Rs.150/-*

This book endeavours to show the effect of organizational stress on the behaviour of executives. It examines key issues like work ethics, need for achievement, organizational climate, leadership styles, job performance, job satisfaction, job related strain, and organizational commitment. The writer identifies several factors which result in stress situations, and offers suggestions towards preventing it.

The book is based on a study of 250 junior and middle level executives from seven private and three public sector organizations of north India, belonging to a wide range of functional areas. The data was collected through structured interviews, and processed through multi-variate analysis.

After a comprehensive survey of literature, the author gives his own definition of organization stress. 'Stress phenomenon' is deemed to be associated with a 'process' which includes stressor, stress and strain, in a sequence. *Stressors* imply persons, and organizations related antecedent variables which predispose stress conditions. Person related variables comprise age, experience, education, need for achievement, and work ethics. Organization related variables comprise different aspects of structure such as formalization, standardization, centralization; processes like leadership and modes of information sharing; and management policies and practices. *Stress* represents perceived forces, stimuli, or cognition, which create threats to the individual. *Strain* refers to the maladjustive responses of the individual, both at the psychological and physiological levels. A state of strain "would only appear if threats or demands (created by stressful congnitions) are beyond person's coping capabilities". Job strain is manifested in the form of job anxiety, job tension, physical tension, depression, dissatisfaction, and alienation. Its behavioural indicators are unpunctuality, absenteeism, and a lack of indiscipline.

The author also provides a diagrammatic model (p.8). The model shows that Personal Factors, and Organizational Factors, together produce Organizational Stress, and also separately produce the Outcomes. The Outcomes may be negative (i.e., job strain) or positive (i.e., job satisfaction). Organization Stress in turn also produces the Outcomes. The dynamic reciprocal link (No. 6) between factors and Outcomes, perhaps the most important part of the model, remains however, completely undiscussed. If this link is taken into account, the model becomes a multi-feedback loop representation. The writer is however, unable to formulate his model in terms of cybernetic analysis.

The model also appears to suffer from conceptual obfuscation, personal Factors, and Organizations Fractors, produce Outcomes both directly, and indirectly i.e., through Organizational Stress. The latter being a 'central construct' also produces Outcomes directly. The justification for this redundancy and overlap remains unclear. A more serious problem arises with 'positive' Outcomes. In so far as organization stress has been defined in terms of 'stressor', 'stress' (as perceived), and 'strain' (i.e., anxiety, tension, depression, etc;), how can it ever produce outcomes like 'job satisfaction' and 'organization commitment'? The author is seen to be contradicting himself, or is unclear about the semantic implications of the concepts employed by him.

Another basic weakness of the author's model is its lack of explanatory content. Organization stress is defined by him in terms of the executives' perceptions of threat or danger to them in their work environment. This stress in turn, generates indicators of job strain in executives' behaviour. The crucial explanatory issue here is: What determines such perceptions, or how do such perceptions emerge? The author fails to tackle this issue.

According to the author, junior executives' generally experience more (a) lack of group cohesiveness, (b) role conflict, (c) experience of inequity, (d) role ambiguity, (e) role overload, (f) lack of leadership support, and (g) inadequacy of role authority (p. 100). These are 'stress dimensions'. His agenda for action (p. 98) is :

(1) Decrease experience of inequity, (2) Increase nurturant task leadership, (3) Increase status, (4) Increase professional help, (5) Decrease role overload, (6) Decrease role ambiguity, (7) Decrease lack of leadership support, (8) Increase expressive work ethics, (9) Decrease constraints of change, and (10) Decrease formal communication. The trouble with this agenda is its piecemeal and disjointed approach. It lacks an overall focus and integrative rationale.

In 'excellent' and 'change - master' companies, distinguished by their strongly shared belief systems and vision, organization stress, and job strain, are largely absent. They are supplanted by a pervasive sense of shared purposes and perceptions on the one hand, and an ethos of innovation, achievement, and team work, on the other.

The author would do well to take cognisance of the existing literature on organization culture, something, which seems to be lacking in this book.

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Infrastructure and Economic Development in India. *By B.M. Joshi, Ashish, New Delhi, 1990. pp. 247+xvi Rs. 200-*

Economic development, howsoever defined, remains a function of a large number of factors. Neither economic development can be captured by any single indicator without causing serious misconceptions nor can the contribution of any single factor to economic development be specified in an operationally meaningful and theoretically convincing manner. Appropriate apportioning of the contribution of various individual factors is, at the present stage of knowledge, a nearly impossible task. Development, as evident is a composite, organic phenomenon. As a result of the influence of simplistic economic development theories which became popular during the 1950s, a number of exercises regarding the role of various single factors to economic development, defined in terms of growth of output, came into vogue. But now not only quantifiable factors but a large number of qualitative factors have also been analysed with a view to explore their contribution to economic development. These include entrepreneurship, size of the country, motivation, religion, ethics, various forms of family system, caste system, democracy etc. There is no doubt that such studies highlight some aspects of the complex phenomenon of economic development. These include entrepreneurship, size of the country, motivation, religion, ethics, various forms of family system, caste system, democracy etc. There is no doubt that such studies highlight some aspects of the complex phenomenon of economic development.

The present study on the role of infrastructure in economic development in the context of India in general and the state of UP in particular, can be taken to belong to this category of studies. The study is a revised and updated version of the author's Ph.D. thesis on the subject of "infrastructure, regional imbalances and economic development: a case study of UP."

The study manifests both the advantages as well as disadvantages of converting a Ph.D. thesis into a book. However, the present study retains its readability and cannot be considered overly pedantic, which is generally true of other such thesis.

The author makes good use of available literature to clarify the concept of infrastructure, its different varieties and various possible ways in which economic development and infrastructure can be related. The range of studies covered by the author is fairly impressive. However, in an attempt to weave together the ideas advanced in many different studies, possibly undertaken in a different context, the author tends to make his formulations an amalgam of disparate ideas, not necessarily pulling in the same direction. For instance; in a long list of 42 activities included under infrastrucutre, one would find a number of intermediate goods whose production is largely taken to belong to the manufacturing sector; the examples being machinery and machine tools, fertilizers and pesticides, basic chemicals and metals. The author goes on to debate whether such intermediate goods, which can also be imported, should be included in the category of infrastructure. The author takes a stand on these issues by distinguishing between the narrow and the broader concept of infrastructure.

Similar conceptual difficulties face the author in dealing with the concept of economic development. Here, the discussion is neither very clear nor seems to show familiarity with the recent advances in development studies. The presentation of economic development, capital formation and infrastructural relationship in the form of a chart (p.23) seems to be fairly confusing; e.g., inclusion of "investment climate" as a factor on the demand side of capital or inclusion of "incentives to save and tax concessions" on the side of supply of capital appear to be ambiguous. In any case, to equate economic development with high per capita income and "higher productivity and modern technology" is rather misleading. It seems to show lack of awareness of recent advances and well-known critiques of the earlier views on economic development.

The determination of the relationship between economic development and infrastructure is a rather difficult task indeed. In development studies, machine age reductionist methodology of causal analysis is increasingly being supplemented by resorting to systems analysis and synthetic methods of analysis, and political economy approaches. It becomes difficult to get clarity on the question whether developed infrastructure is the cause or the effect of economic development because of the manner in which the question is asked and the methodology of enquiry. Afterall, there are vastly different varieties of infrastructure and it would be difficult to get clearcut evidence and justification on either theoretical or empirical grounds on the nature and direction of the relationship between the two. Similarly, the problem needs different framework, depending on whether one is discussing the case of early or late developing countries. It is well-known that the balanced growth vs. unbalanced growth debate did not succeed in providing any meaningful guidance to development planners. The debate over the question whether infrastructure is a precondition of economic development or economic development creates advanced infrastructure seems to be similarly, a formal one and does not seem to be capable of coming to grips with the logic of development as a multi-faceted, historical process.

The chapters on the development of infrastructure under the five year plans in India, inter state disparities in the development of infrastructure and intra-regional (or state) disparities in this respect in UP are useful. A good deal of factual material has been coherently brought together. However, attempts to deal with paradoxes like underutilisation of various infrastructural facilities in a poor country, ill-equiped with such facilities, (like irrigation, power, etc.) may throw some light on the role of infrastructure in economic development. As far as social infrastructure is concerned, there has been a lot of debate regarding role of health, education, cultural facilities etc. and their, multi faceted contribution to broader development which, in a sense, goes beyond per capita incomes. I wonder whether a composite discussion under the title of infrastructure can do justice to such important factors like education, culture and health. The same consideration will apply to the institutional infrastructure whether administrative, financial, marketing, etc. All these problems arise basically on account of the fact that it is very difficult to understand a complex phenomenon like development, even economic development, in terms of the contribution of a single factor. Taking an overall view, one would find that this is an interesting study which embodies a lot of serious effort and would certainly make a perceptive reader ask herself or himself a number of questions.

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Industrial Productivity : A Psychological Approach; *By A.P. Singh, Sage Publications; London; pp158 Price £ 8 or Rs. 145/-*

Productivity is always considered as one of the important facets of industrialisation. Of late, This concept has been emerging as the most vital facet of economic growth not only in the developed countries but in developing economies also.

The term productivity has been studied largely in the context of inputs such as raw materials, energy, technology and work environment. However, very little has been studied in the context of human element which still dominates the process of economic growth. It is an undisputed fact that productivity can not be studied and understood without taking into account the human element.

The central theme of the book is to testify the notion that "no organisation can afford to over look the importance of human resources in productivity". It is observed that, there has not been much awarness on the part of the organisations to link productivity with the individual's attitudinal and personality characteristics which are certainly the main pillars for today's industrialisation. The study in question revolves around this hypothesis.

The book under review consists of two parts, which are running into 158 pages. Part I deals with the theoretical orientation on the subject which includes introduction, conceptual framework and review of the literature. Part II discusses the subject matter related to the problem under discussion. It provides discussion on the statement of the problem, deging, methodology, results, discussion and summary and conclusions. The study also has a foreword on the book written by Mr. Pestonjee, D.M. of Indian Institute of Management, Ahmedabad.

Under the conceptual framework, the author examines the important psychological issues such as alienation, anxiety and job involvement and their very existing relationship with the term productivity.

Part II of the study gives field data to support the hypothesis and also examines the relationship between the personality characteristics and productivity in a comprehensive manner. The study further points out that 'performance is negatively co-related with alienation and anxiety while it is positively cor-related with job involvement". This inter-action of the said facets makes the study worth reading.

One of the important findings of this study is that "though every employee in an organisation works with similar tools, machines and materials, yet individual differences in their levels of performance are quite often evident. It indicates some sort of cause and effect relationship between a work performance and his individual build up". Hence, it is imperative for every organisation to take into account the role, contribution and significance of human element while efforts are made to enhance productivity.

According to the author "casual relationship that might exist between a number of personality and attitudinal variables and productivity have not received proper attention in Indian studies or elsewhere". Hence, the need of the hour is that Indian business organisations and research Institutes come forward and undertake such studies in which due importance is given to the human factor.

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Productivity Abstracts

NPC Documentation Section

Chatterjee Anjana : Need for fresh thinking on Environmental issues, *Yojana, Vol 34(10), June 1-15, 1990, p 23-26.*

The author makes an impassioned plea in the article for a balanced evaluation of the environmental issue and not being carried away by the outcry of developed nations. There is need for stopping harassment of people and project proposals in the name of environmental protection. The author feels that there should be sensible environment policies based on our own resources and technology ensuring hygienic living and working conditions, safety against industrial hazards, afforestation and authentic information to the masses on environment.

Clark. L. Robert and Anker Richard : Labour force participation rates of older persons: An international comparison, *International Labour Review, Vol. 129(2), 1990/2, p.255-271*

This article investigates the labour force participation rates of older men and women around the world on the basis of data covering 151 countries. It analyses how these rates are related to a number of economic, demographic and policy variables. The authors find that the well-known decline in participation rates of older persons that accompanies economic development can be traced, to a large extent, to increasing income levels and structural changes in employment associated with increasing urbanization and non-farm activity. Also found to be important in reducing participation rates of older persons are social security programmes and (for older men only) the ratio of older persons to persons of standard working age.

Crume V. Richard, Ryan M. William, Peters A. Thomas, Bryan J. Robert : Risk analysis on air emissions from ground water aeration, *Research Journal of the water pollution control federation, Vol 62(2), March/April 1990, p-119-123.*

An air quality analysis and health risk assessment was performed by the authors to determine the potential inhalation risk associated with a proposed ground water aeration tower located in the Los Angles Basin. The tower was used to "strip" contaminants from polluted groundwater, resulting in the discharge of the contaminants to the ambient air. Emissions of trichoroethylene, perchloroethylene, benzene, chloroform, and methylene chloride were included in the study, based on the potential for these compounds to cause cancer in humans. A health risk assessment for each compound was conducted by the authors in a manner that the potential impact of these compounds on the surrounding community could be evaluated. Both carcinogenic as well as noncarcinogenic effects were examined.

Deo Mangal Jai : Towards a taxonomy of voluntary organisations, *Abhigyan, Spring 89, p. 44-53.*

In the present paper an attempt has been made to present a typology of voluntary organisations employing the concepts of 'charter' and 'structure', as they relate to the functioning and management of voluntary organisations. The usefulness of this scheme for researchers, working in the area of Organisational Behavior, in general, and that of voluntary organization, in particular, as well as for the policy-makers has been indicated.

Deotale Y.D. & Singh V.C. : Some aspects of environmental impact assessment of Mansar Manganese mines, Maharashtra, *Indian Journal of environmental protection, Vol. 10(1), Jan 1990, p. 14-19.*

The paper deals with the detailed study of some aspects of environmental impact assessment (EIA) for Mansar manganese mine Manganese Ore India Limited (MOIL) falling in district Nagpur, Maharashtra. The authors in their investigation have studied, various impacts on land and soil, agriculture, water regime and society and have suggested measures for mitigation/protection. The base line data regarding the impact of mining activity on the various mentioned environmental elements has been collected/generated by the authors in the field and interpreted.

Freedman, H David : Special employment programmes in developed and developing countries, *International Labour Review, Vol. 129(2), 1990/2, p. 165-185.*

Special employment programmes (SEPs) have a long history as an instrument of policy but the economic crisis and high unemployment of the 1980s have increased their prominence in developed and developing countries alike. This article begins by examining changes over time in the economic conditions and policy environment which have brought SEPs into existence and influenced their role. The changing nature of public works activity is highlighted in particular and the article then reviews and assesses four additional broad categories of present-day SEPs. It concludes by critically discussing two issues which are at the core of SEP activity: targeting and programme duration.

Herriot Peter and Fletcher Clive : 'Candidate-friendly' selection for the 1990s, *Personnel Management, Vol. 22(2), Feb 1990, p. 32-35.*

In the jobs climate of the 1990s recruiters can no longer call all the shots; applicants may well be choosing employers rather than vice versa. This trend towards a 'seller's market' for jobs means that recruiters in the 1990s must look at how they can make the selection process more 'candidate-friendly'. Peter Herriot argues that the procedure can no longer be designed as if the organization is the only one doing the selecting. Clive Fletcher adds his comments to the selection debate.

Maghaddam M.B and Reddy C Subba Rami : The existence of value added function in Iranian food, beverages and tobacco industries, *Prajnan, Vol. XVIII (3), July-Sept. 1989, p. 265-275.*

The paper tries to discover whether or not a value-added (through a double deflation procedure) function exists for some of the Iranian industries during the period 1963-64 to 1984-85 and tries to find out whether or not the measure of output of the sub-sector of the economy, in terms of real value-added, is proper. If capital and labour are weakly separable from intermediate inputs, the linear homogeneous production function gives the measure of real value-added through double deflation procedure which is valid only under the assumption of additive separability.

Assuming constant returns to scale and permitting technical change a translog production function is derived and associated share equations are derived from producer equilibrium conditions. Using iterative Zellner efficient function, the above hypotheses (symmetry CRTs and Hicks neutral technical change) are examined.

Mall I.D., Singh A.R., & Upadhyay S.N. : Biotechnology applications in pulp and paper industry, *IPPTA, Vol. 2(1), March 1990, p. 1-14.*

Biotechnology has aroused wide interest due to its diverse applications in various fields. It is likely to gain prominent position in pulp and paper sector also. This article highlights the various aspects of biochemical processes used in pulp and paper industry. Forest agriculture, biopulping and bio-bleaching, pollution abatement and colour removal, production of chemicals and bio-energy generation from lignocellulosic wastes of the industry are the areas where biotechnology is likely to play a major role in coming decades. Various pretreatment methods used to enhance enzymatic and microbiological attack on ignocellulosic wastes are also examined. The micro-organism responsible for deterioration of raw materials and products are also discussed.

Means K.H. and Gerhard C : Prediction of seal life in an abrasive environment under high pressures using finite elements, *Tribiology International, Vol. 23(1), Feb. 1990, p. 3-10.*

The authors consider the method of performing coal injection using the dry-feed system in this study. According to them the most critical parts of the piston coal feeder assembly are the dry lubricated gas energized seals. Here bronze filled PTFE seals are considered and the wear, primarily adhesive and abrasive wear, are associated with them. The authors have used a Nastran finite element programme to simulate the seal stresses, a wear equation has also been used. Comparison with test data reveals radial wear rates of the finite element model are of the same order of magnitude as the Ingersoll Rand wear rates.

Miranda Robert : Computer training widening gap, *Business Computer, April 30, 1990, p. 46-50.*

With interest in computers on the high, computer training courses are rampant, but still not enough. The Indian computer industry is facing a massive gap between demand and supply of skilled manpower. The author delves deeper into the problems faced by the industry and talks about the increasing number of computer training courses.

Pack S. Robert : The foundations of dissent, *The American Review, Vol. 34(2), 2/1990, p. 29-32.*

"Freedom of expression is the indispensable condition, of nearly every other form of freedom", Supreme

Court Justice Benjamin Cardozo wrote in 1937. Free speech has long been accepted in the United States as a fundamental right, but it did not originate with the constitution. In this article, legal scholar Robert S. Peck traces the concept of freedom of expression to its source in English history. He also examines how the Supreme Court's interpretation of the First Amendment has evolved during the last 200 years and summarizes earlier decisions in which the court has defined the limits of free speech, limits that were tested again by the case of Texas V. Johnson.

Ram Babu : Primary energy demand in India by 2000 A.D versus new technologies, *Urja, Vol 27(6), June 1990, p. 15-18.*

This paper presents projections of total primary energy demand in 2000 A.D. in the case of India. Assessment has also been made regarding its availability in the same year. Based upon this, energy shortfall has been estimated. Potential shortfall of 1.25 million barrel a day of oil equivalent is expected by 2000 A.D. To meet this shortfall by 40 percent, new technologies such as coal gasification, MHD, nuclear breeder, micro hydel, wind and solar have been suggested.

Rodriguez P & Mannan SL : Development of special steels for fast breeder reactors, *Indian Journal of Technology, Vol. 28, July-Aug, 1990, p. 281-295.*

The liquid sodium coolant, the high neutron flux and the elevated temperatures at which fast breeder reactors (FBR) operate present a very hostile and demanding environment for materials. Starting with a brief review of the world trend in the selection of materials for FBR, the authors highlight the research and development activities at the Indira Gandhi Centre for Atomic Research on the development of fast reactor materials for structural, core and steam generator applications. Austenitic stainless steels are the major structural and core component materials for the currently operating and planned FBR. In order to increase burn up and to reduce fuel cycle cost, ferritic/ martensitic steels are being considered for sub-assembly wrapper applications because of their good resistance to radiation swelling. 2 1/4 Cr 1 Mo and 9 Cr-1Mo steels are the current favourites for the steam generator applications. The indigenous efforts towards developing these materials for the prototype fast breeder reactor (PFBR) now under design are described in detail. The authors also discuss areas for further research like materials testing in sodium, use of fast breeder test reactor as an irradiation facility to study materials behavior, and development of ferritic/martensitic alloys for the next generation FBR.

Sarin Rahul : Evaluation of the Science and Technology policy of a developing country, *Management in Government, Vol. 21(1-3), April-Dec. 1989, p. 57-69.*

In developing a procedure for evaluation of a science and technology policy the basic features of a developing country must be given the central importance. If the goals of society are rapid national development and modernization, then the policy must be integrated with the overall national development programme. While, in the broader sense, evaluation is related to the national development effort, in the narrower sense, the viability and effectiveness of the policy is considered by examining some of the relevant factors and criteria. The paper attempts to focus attention on the process of evaluations and not on the methodological techniques and also seeks to bring out the importance of the political setting in which the policy will operate, succeed or fail.

Sen K.K, Reddy SS & Sen S.K : Sugars from jute stick, *Research and Industry, Vol 35, June 1990, p. 94-95.*

The authors have investigated the suitability of jute stick as a potential source for sugar production using concentrated H_2SO_4 as hydrolysing agent. Various parameters like acid strength, solid-liquid ratio, temperature and time have been optimised. The yield of reducing sugars from untreated jute stick is 59.8 per cent and from delignified jute stick is 64.7 percent comparatively favourable with that obtained from hardwoods.

Shukla Madhukar: Creativity Techniques-II : Lateral thinking and forced relationship, *Excellence in Supervision, Vol. 6(4), March-April 1990, p. 165-171.*

In this article the author discusses two creativity techniques-Lateral thinking and forced relationship. The author feels that these two techniques can be very effectively used by supervisors in their problem-solving efforts. These techniques rely heavily on the basic principles underlying the Brainstorming technique. Thus according to the author one has the option of using these techniques both individually as well as in groups.

Singh Y.P. & Gupta Chandra Prakash : Soft mode approach to Cost-Volume-Profit analysis, *Decision, Vol. 16(4), Oct-Dec. 1989, p 281-287.*

To handle the complexities arising out of a multi-product multi-resource C-V-P problem a hard mode

approach using a number of optimization techniques is conventionally applied. But, because of the crisp data demand of such techniques, they fail to provide desired decisions. To overcome this limitation, a new approach, Soft-Model approach, is developed and applied to C-V-P Planning Model, in this paper, Fuzzy Optimization Technique is used to ensure optimum results of Soft C-V-P Model.

Smith Sheila & Sender JB : Poverty, gender and wage labour in rural Tanzania, *Economic and Political Weekly, Vol. 25(24&25), June 16-23, 1990, p. 1334-1342.*

Based on data from the Usambaras region the paper attempts to analyse the constraints on the supply of manual agricultural wage labour in Tanzania. The authors argue that the constraints on the expansion of agricultural wage labour have retarded the process of accumulation and have, therefore, had negative consequences for the welfare of the rural population as a whole. In particular, the analyses focuses on the welfare implications for women on restrictions on their ability to derive cash income from wage labour.

Wickramasekara Piyasiri : Rural employment generation schemes: Review of Asian experiences, *Indian Journal of Industrial Relations, Vol. 25(4), April 1990, p. 354-369.*

In the context of increasing poverty and landlessness of rural poor households, many Asian governments have launched special employment creation programmes. These programmes primarily relate to wage employment generation and self-employment creation. This paper undertakes a review of experience of several countries in the region with special employment creation programmes. The emerging picture is compared briefly with the Indian situation. Several controversial issues relating to the role of NGOs, sustainability of projects, wage versus self-employment programmes and institutional arrangements are discussed. The author concludes that the special employment-oriented programmes by themselves cannot have much impact on the employment and poverty problem.

Woodworth Bruce M & Thakur Manab : Strategic decision making: How project management can help, *Decision, Vol. 16(4), Oct-Dec. 1989, p. 235-248.*

The study explores how project management can be utilized at the senior levels of an organization to improve the strategic decision making process. The salient feature of strategy formulation, and project management are discussed with particular emphasis on the issues of uncertainty and the need for flexibility at this level. The conclusion is that project management can help avoid the phenomenon of decisional quicksand.

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Books-in-Brief

NPC Documentation Section

Building Productive Teams : *Glenn H. Varney. San Francisco, Jossey-Bass, 1989, 150 p, $ 20.95*

Offers practical, first-hand information in the systematic building of productive teams. The book also provides checklists, questionnaires and surveys that can be used in skills inventory, team profiling, problem solving, and decision making.

Collection and Analysis of Market Information for Farm Products in Asia. *Tokyo, Asian Productivity Organisation, 1990, 204p.*

This publication is the report of the APO Seminar on "Collection and Analysis of Market Information for Products" organised in Japan in 1988. The report consists of two major parts. First part consists of the resource papers on designated topics presented by the experts at the seminar, among which three papers provided detailed analysis on Japan's experience in such areas. The other resource papers include a regional analysis on agricultural marketing system, the approach to utilise agricultural statistics for sound economic decision-making, and the relevant experience of the United States Deptt. of Agriculture. The second part comprises of eleven country papers.

Effective Business Psychology : *Andrew J. Zabrior. New Jersey, Prentice Hall, 1990, 434p, $ 44.00*

This book is based on empirical studies and established psychological concepts and theories. At several places, the reader is given the opportunity to add to their self-insight by competing questionnaires. The text is useful for students of psychology and human relations. It is also a helpful guide to practising managers.

Executives in Crisis : *Jeffrey Lynn Speller. San Francisco, Jossey-Bass, 1989. 164 p, $ 19.95*

Case studies of executives suffering from alcoholism, drug addiction, and mental illness are used to highlight techniques for indentifying and managing personnel with these problems. A plan for the systematic collection, review, and evaluation of data on job performance, and the communication of these findings to the executive in question is outlined.

Fundamentals of Database System : *R A Elmasri and S.B. Navathe, New Delhi, Springer Book, 1990, Rs 375*

Database systems are rapidly becoming one of the most widely used types of software in computer systems. They are used in wide variety of applications, including business, engineering, science, medicine and design. This text provides a blanced coverage of theory and implementation, logical and physical design, and the major data models, it is unique and exactly on target.

Implementing Japanese AI Techniques—*Turning the Tables for a Winning Strategy* : *Richard Tabor Greene. New York, McGraw-Hill, 1990, 266p, $ 19.95.*

Different methods for introducting and using artificial intelligence by American and Japanese firms are explored. American businesses are shown how to use Japanese techniques with a built-in competitive advantage, while exploring business strengths unique to the West. The development of kanban, just-in-time, quality circles, and "no-man" automation is explained.

Japaness Management-The Indian Context : *AV Srinivasan, New Delhi, Tata McGraw-Hill, 1990, 206p.*

This publication gives a detailed exposition of the organisation functions and industrial personnel in Japan and how they can be applied to the Indian context. It presents the factors responsible for reconstructing the Japanese industry from the ravages of World War II and putting it on the industrial map of the world. It also provides an overview of Japanese industrial development, along with their marketing, production and finance functions in management. It compares Indian Management practices and points to the weakness of the Indian system of management, providing guidance for its betterment.

Leadership Skills for Every Manager : *Jim Clemmer and Art McNeil. London, Judy Piatkus, 1990, 280p, $ 9.50*

In this book, authors outline exactly what leadership skills are required in a business and explain how they can be achieved. First, they examine four leadership elements-vision, values, environment/culture and behaviour-that exist in every organisation. Then, they explain how, to be successful, a manager must improve his ability to align organisational culture, build powerful team and train people towards high personal performance. Finally, they describe how certain individuals and organisations have developed their own particular organisational skills.

Management and Society : *M.K. Singh and Anant Mahadevan (Eds). New Delhi, Discovery Publishing House, 1990, 276p, Rs 300.*

This book is a compilation of articles; extracts and reports by eminent management thinkers like Peter Drucker, Samwel Paul, Michol Maccoby etc. It provides a cross-sectional view of the many interfaces of modern management and the social environment in which it functions.

Management of International Trade Promotion : *Edger P. Hibbert, Routledge, Chapman & Hall Ltd., 1990 287p, $ 40*

This book provides a comprehensive analysis of trade promotion and stresses the need for an integrated approach to the development of effective international promotion strategies. Throughout the book useful guidelines, checklists and references are given. A list of international trade promotion organisations is provided in the appendix.

On Leadership : *John W. Gardner. New York, Free Press, 1990, 220 p, $ 19.95*

The practice of leadership in America today is examined through the use of interviews and field studies of organizations. Key chapters include discussion of community, renewal, and leaderships between leaders and followers are analyzed in the context of shared values and beliefs and their ability to contribute to effective action.

Pollution : Causes, Effects and Control : *R.M. Harrison (Ed). Cambridge, Royal Society of Chemistry, 1990, 394p, £ 29.50*

This is the second edition of the book which has been considerably updated and expanded, reflecting the great changes that have taken place since the first edition was published in 1983. It contains two new chapters dealing with radioactive pollution and the chemistry and pollution of the stratosphere, reflecting the importance now attached to these areas.

Poverty Alleviation and Rural Development : *J.S. Sodhi, New Delhi, Criterion Publication, 1990, 184p, Rs. 200.*

Integraed Rural Development Programme was launched in each and every district of the country and during the last nine years, a little more than nine-thousand crores have already been invested. Programme of this magnitude and nature need to be carefully monitored and studied to know the impact and the shortcomings, so that it is possible to apply mid-course corrections. This book is an attempt in this direction. It attempts to achieve three basic strands. First, it investigates the reality of IRDP in district, second, it provides an exhaustive survey of literature. Third, using the first two as spring boards, it offers suggestions and presents a debate on the crucial issues of IRDP and the development of rural poor in the country.

Power Systems And Power Plants - Selected Papers from IFAC Symposium, Seoul, Korea 22-25 August 1989 : *U. Ahn (Ed.). New York, Pergamon Press, 1990, 560p, £ 87.50*

The control of power systems and power plants is a subject of growing interest which continues to sustain a high level of research, development and application in many diverse yet complementary areas, such as maintaining a high quality but economical service and coping with environmental constraints. The papers included within this voume provide the most up to date developments in this field of research.

Quality Costs : Ideas and Applications, Volume 2 : *Jack Companella. Quality Press, 1989. 495 p. $ 35.95*

This is a compilation of papers representing current thinking on quality costs, including the application of these costs to service as well as manufacturing industries. It updates the first volume, which appeared in 1984.

Renewing the Earth : Development for a Sustainable Future : *Seamus Cleary. London, CAFOD, 1989, 147p, $ 3.*

This booklet forming a part of the development series of CAFOD is an analysis of the pattern of development and environmental degradation. It begins with a description of

several disasters such as floods in Brazil and disease in Nigeria caused by environmental degradation of waste disposal policies. From there it describes some of the consequences such as land degradation by industrial agricultural practices. The rest of the book is an analysis of the causes and search for solution.

Reinventing the Factory : Productivity Breakthroughts in Manufacturing Today : *Roy L. Harmon & Leroy D. Peterson, New York, Free Press, 1990. 303 Pages. $ 35.*

More than one hundred real-life productivity improvement applications are documented here. The principle of organizing a plant along the lines of multiple subplants that are designed to ensure maximum productivity is detailed. The physical and organizational changes needed to achieve a focused factory also are described.

Riding the Waves of Change : *Gareth Morgan & San Francisco, Jossey-Brass Publications, 1989, 214 p. $ 20.95*

In this book, the author shows how managers can deal effectively with waves of change-in the form of advanced technologies, new management styles, market fluctuations, changing employee values, and the like-and flourish in a business world marked by constant flux.

Rubber Technology Handbook : *Werner Hofman. Munich, Carl Hansar Verlag, 1989, 651p. $ 46.56*

The handbook concisely and most comprehensively described the "State of the Art" of modern rubber technology. All important fields on rubber technology are covered in this work : natural rubber, synthetic rubber, rubber chemicals and additives, processing of elastomers as well as rubber testing and analysis. Rubber properties compounding, processing technologies, applications and rubber testing are equally well treated.

Software Maintenance and Computer : *David H. Longstreet. Washington, IEEE Computer Society, 1990, 304p, $ 58.30*

This publication is intended for managers of information systems, programmes and researchers. Software maintenance is critical; code that is not maintained or tested can- and has - brought organizations to their knees. The information in this text is provided to prevent such an occurrence. Topics covered include: managerial issues, personnel issues, controlling costs, outside help, and solution through configuration management.

System and Software Requirements Engineering : *Richard H Thayar and Merlin Dorfman. Washington, IEEE Computer Society, 1990, 744 p, $ 105.60*

This publication assembles under one cover a sufficient body of knowledge about systems and software engineering. Emphasis is on software requirements analysis and specifications and on system engineering and its interface with software engineering. Information is presented on subjects that are impacted by system and software requirements such as verification and validation, management, costs, and configuration managements.

The Art of Becoming an Executive : *Philip B. Crosby New York, McGraw-Hill, 1990, 214 p.*

This work describes the three functional areas in which a manager must develop to skills in order to become a leader. A story telling style is used by the author to present information on growth in relationships, quality, and finance.

The Decision Makers : *Robert Beller. New York, Truman Talley Books, 1989, 385 pages, $ 22.50*

Six different types of decision makers, who typically make the best decisions in business, are defined. The book also analyzes the processes behind the decisions, identifies the causes of backfires, and assesses the abilities of the current top decision-makers.

The Indian Economy-Resources, Planning Development and Problems : *Ishwar C. Dingra. New Delhi, Sultan Chand & Sons, 1990, 67p, Rs. 85*

This is the sixth revised edition of the book. In this edition, the author attempted to make the subject matters more easily intelligible although a more rigorous analysis of the Indian economy has been presented.

New diagrams have been introduced to facilitate the understanding of theoretical underplannings of the various arguments.

The Information-Based Corporation : *David R. Vincent. Homewood, Jones, Irwin, 1989, 298 p, $ 24.95*

This book provides practical, common-sense solutions to the problems faced by corporations that are planning to invest in information technology, and relates the success stories of a number of companies. It also gives suggestions for realizing the potential of information technology by redesigning a corporation from the bottom up.

The Photofit Manager : *Marion Devine. London, Unwin Hyonan, 1990, 192p, £ 18.00*

This book is based on the extensive work which is taking place to prepare managers to cross the threshold of a new decade. Industry and education are currently grappling with the problem of how to help managers to adjust to the changing features of this era, which include new organizational structures, demographic changes and a fresh definition of internationalization. It builds on the work presented at a conference organized by the Association of Management Education and Development (AMED) and Ashridge Management Research Group.

The Risk Ranking Techniques in Decision Making : *John C. Chucken and Micheal R. Hayna. Oxford, Pergamon Press, 1989, 123p. $ 27.*

This book gives a comprehensive approach known as the 'Ranking Technique' for the assessment of decision options. The aim being to provide a way of presenting a decision maker with a consistent way of making a comprehensive assessment of all the factors associated with complex decisions. Appendices to the book, describe the essential features of the Ranking Technique, definition of the terms used, a review of some technical acceptability criteria that have been used and an outline of the essential steps in reactor licensing procedure.

Training for Development : *Relief P. Lynten & Udai Pareek, New Delhi, Vistaar Publications, 1990 364p, Rs. 95*

This publication focuses on training not primarily as a source of new formation, but rather as a means for changing behaviour for lasting improvement on the job. Training is most effective when viewed as a system of interactions between trainers and trainees and between work organisations and institutions providing training.

Transactional Analysis Counselling in Action : *Ian Stewaral. New Delhi, Sage Publications, 1989, 192p. £ 19.95*

This book emphasizes the powerful new techniques and concepts in TA that have been developed in the last two decades. The author described the systematic process of counselling in TA by means of an actual case-history, it traces the clients progress from first contact and intake, through diagnosis and treatment planning, to contract making and the implementation of the planned treatment sequence. Each phase of the treatment is explained clearly and accessibly.

Up and Running : Integrating Information Technology and the Organization : *Richard E. Walton, Boston, Harvard Business School Press, 1989. 231 p, $ 22.95*

The ways in which information technology and organizational dynamics impinge on each other, both positively and negatively, are examined through the use of case studies. Information technology features of particular importance to planners and researchers are emphasized.

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"Suppressing the unions may give relief at a particular moment from what might appear to be an unbearable pain; but the relief will be obtained at the price of marking the disease incurable."

—Peter F. Drucker

"If the values of organisation culture and the conceptual inputs of management education are not in harmony, learning may occur but will not move in the desired direction."

—Douglas Mcgregor