CHAPTER-I
CHAPTER-I
INTRODUCTION

1.1 CEMENT INDUSTRY IN INDIA: SOME GENERAL OBSERVATIONS

Cement industry constitutes a very important segment of the modern industrial economy. In India the growth of cement industry is almost synonymous with the economic development. The industry is characterised by extensive use of minerals like calcareous and agrillaceous minerals such as lime stone, bauxite and gypsum and intensive use of energy such as coal, furnace oil and electricity. Cement is basically manufactured by using either the wet process in which a homogeneous mixture of various ingredients is converted into slurry and is characterised by high consumption of fuel or in the dry process in which various raw materials are blended in dry state, eliminating the fuel consumption needed to evaporate water as it is needed in the wet process. The main material required for producing one tonne of normal portland cement are: Limestone (1.6 Tonnes), Coal (0.2 - 0.3 Tonnes), and power 130 - 145 Kwh to 110 - 115 Kwh) depending upon the nature of the process. Gypsum constitutes 4.5 percent of total weight of the final product. The Cement production over the period (1950-51 to 1993-94) is satisfactorily high as evident by an average growth rate of approximately 8%. (Table 1.1).

The location of cement plant is determined by several factors like proximity to the sources of raw material, market conditions and availability of infrastructure such as power, fuel,
TABLE -1.1 PACE OF GROWTH OF INDIAN CEMENT INDUSTRY

PACE OF GROWTH (Including mini cement plants)

<table>
<thead>
<tr>
<th>FIVE YEAR PLAN</th>
<th>AT THE END OF</th>
<th>TOTAL INSTALLED CAPACITY</th>
<th>TOTAL PRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Target</td>
<td>Achievement</td>
</tr>
<tr>
<td>Pre Plan 50-51</td>
<td>00.00</td>
<td>03.28</td>
<td>00.00</td>
</tr>
<tr>
<td>I Plan 50-56</td>
<td>5.31</td>
<td>5.02</td>
<td>94.50</td>
</tr>
<tr>
<td>II Plan 60-61</td>
<td>16.00</td>
<td>9.30</td>
<td>58.10</td>
</tr>
<tr>
<td>III Plan 65-66</td>
<td>15.00</td>
<td>12.00</td>
<td>80.00</td>
</tr>
<tr>
<td></td>
<td>12.50</td>
<td>11.07</td>
<td>88.14</td>
</tr>
<tr>
<td></td>
<td>13.78</td>
<td>11.48</td>
<td>83.31</td>
</tr>
<tr>
<td></td>
<td>14.98</td>
<td>12.24</td>
<td>81.71</td>
</tr>
<tr>
<td>IV Plan 73-74</td>
<td>73.74</td>
<td>19.76</td>
<td>-</td>
</tr>
<tr>
<td>V Plan 78-79</td>
<td>23.50</td>
<td>22.58</td>
<td>96.10</td>
</tr>
<tr>
<td>VI Plan 80-81</td>
<td>27.50</td>
<td>26.99</td>
<td>98.10</td>
</tr>
<tr>
<td></td>
<td>30.00</td>
<td>29.25</td>
<td>97.50</td>
</tr>
<tr>
<td></td>
<td>36.00</td>
<td>33.51</td>
<td>93.10</td>
</tr>
<tr>
<td></td>
<td>38.00</td>
<td>36.00</td>
<td>94.70</td>
</tr>
<tr>
<td></td>
<td>43.00</td>
<td>42.00</td>
<td>97.70</td>
</tr>
<tr>
<td>VII Plan 85-86</td>
<td>-</td>
<td>44.00</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>52.00</td>
<td>54.40</td>
<td>104.62</td>
</tr>
<tr>
<td></td>
<td>57.47</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>55.97</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>61.55</td>
<td>99.27</td>
<td>-</td>
</tr>
<tr>
<td>Non Plan 90-91</td>
<td>-</td>
<td>64.36</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>66.59</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>VIII Plan (1991-93 to 1996-97)</td>
<td>92-93</td>
<td>-</td>
<td>70.09(P)</td>
</tr>
<tr>
<td></td>
<td>96-97</td>
<td>90.00</td>
<td>-</td>
</tr>
<tr>
<td>2000 AD</td>
<td>-</td>
<td>100.00</td>
<td>-</td>
</tr>
</tbody>
</table>

* P-PROVISIONAL

Source:
2. Cement Manufacturers' Association of India (1964), New Delhi.
water & man power. In general the nearness of raw material is more important than other factors; mainly because for every tonne of cement produced, 1.6 tonnes of limestone is required. Further limestone reserves should be adequate to last for at least 30 to 35 year to run the plant. Hence the plants are concentrated in a few states such as in MP 25, AP 17, Rajstan 11, Karnatak 10, Tamilnadu 10 and Gujrat 8 and they account for 81% the total production. Orissa accounts for nearly 3% of the total production in the country. Some of the significant details of the Indian Cement Industry are mentioned in Table (1.2).

**TABLE 1.2 HIGHLIGHTS OF INDIAN CEMENT INDUSTRY.**

<table>
<thead>
<tr>
<th></th>
<th>As on 31-3-93</th>
<th>As on 31-3-94</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cement Companies</td>
<td>53</td>
<td>54</td>
</tr>
<tr>
<td>2. (a) Large plants</td>
<td>99</td>
<td>110</td>
</tr>
<tr>
<td>(b) White &amp; Mini cement plants over</td>
<td>200</td>
<td>N.A.</td>
</tr>
<tr>
<td>3. Installed Capacity (Lakh tonnes)</td>
<td>700.9</td>
<td>N.A</td>
</tr>
<tr>
<td>(a) Large Plants</td>
<td>648.35</td>
<td>693.91</td>
</tr>
<tr>
<td>(i) Private Sector</td>
<td>553.95</td>
<td>598.91</td>
</tr>
<tr>
<td>(ii) Public Sector</td>
<td>95.00</td>
<td>95.00</td>
</tr>
<tr>
<td>(b) White &amp; Mini Plants</td>
<td>52.5</td>
<td>N.A</td>
</tr>
<tr>
<td>4. Production (Lakh tonnes)</td>
<td>537.2</td>
<td>N.A</td>
</tr>
<tr>
<td>(a) Large Plants</td>
<td>507.2</td>
<td>575.94</td>
</tr>
<tr>
<td>(b) White &amp; Mini Plants</td>
<td>30.0</td>
<td>N.A</td>
</tr>
<tr>
<td>5. Total Investment (In crores Approx.)</td>
<td>Rs. 15,000</td>
<td>Rs.17,000</td>
</tr>
<tr>
<td>6. Man power (Lakhs)</td>
<td>Over 1.5</td>
<td>N.A</td>
</tr>
</tbody>
</table>
FIG. 1.1   TOTAL PRODUCTION OF CEMENT IN VARIOUS GRADE

Source.
1. Cement Manufacturers' Association of India (1996), N. Delhi
In the order of production capacity, the Indian cement industry is the fourth largest in the world and by 2010, it is expected to be next to China. The technological development in the recent years has enabled high cost reduction and large volume production. The wet process plants have been replaced by dry process kilns that have helped in reducing fuel costs by 30 percent. Further improvement in thermal efficiency has been obtained by installation of preheaters and addition of precalciners. Finally, computerisation and quality control of raw material have resulted in optimal usage of fuel and power.

India produced 70 million tonnes of cement during 1995-96. However, due to partial decontrol in 1982 and full decontrol in 1989, cement production capacity has increased from 30 million tonnes in 1982 to 100 million tonnes in 1996. This increase of 70 million tonnes in 14 years includes the production of mini cement plants and white cement plants. The experiment in liberalisation proved a success putting the whole industry on the path of vibrant growth. The growth of cement industry is depicted in FIG. 1.2.

The average world per capita consumption of cement in 1995 was 240 kg while India's was 71 kg. This is much lower than many other developing countries. Hence, there is a good scope for improvement of the production of cement in India.

The per capita consumption is expected to touch 85 kg by 2002 and possibly it can reach 130 kg in 2010 provided the present trend of growth continues. In order to achieve at least 75 percent of the world average an investment of Rs.40,000 crores on plants is necessary. Besides, additional investment of the same order on adequate infrastructure is required spreading over
FIG. 1.2. GROWTH OF CEMENT INDUSTRY

X Axis - Years
Y Axis - Million Tonnes.

Source:
Cement Manufacturers' Association of India (1996), New Delhi
10 to 15 years. The demand of cement by 2010 is placed at 140 million tonnes in the wake of the industrial and economic growth, unleashed by the liberalisation process. Thus growth prospects of the industry are assured.

In order to exploit smaller deposits of limestone scattered all over the country and in remote areas including hilly terrain's and other inaccessible areas, the Government originated the concept of mini plants in 1979. This concept was supported by incentives such as 50 percent reduction in excise duty. The major advantages of mini cement plants are generating employment opportunities in rural areas and also dispersal of production capacity, reducing strain on the transportation infrastructure.

There are, at present, more than 350 mini cement plants with an aggregate capacity close to 9 million tonnes and a production of over 5 million tonnes. China is the world’s largest producer of has 70 percent of its production in the mini cement plants. However, these plants are not energy efficient. Hence, it is necessary now that both in China and India, energy efficient large dry process plants be set up. The target capacity and production during the 8th plan period are 90 million tonnes and 70 million tonnes respectively. This includes an export target of 5 million tonnes and the rest for meeting the domestic needs. The industry today is well on the way in achieving this target. The estimated region wise demand for a period of five years starting from 1997-98 is shown in the Table 1.3.
According to The Hindu Survey of Indian Industry (1996) it has been forecasted that by 2001-02 the minimum demand will be 84.81 million tonnes and the maximum demand will be 107.50 million tonnes. The corresponding figures as forecasted by the National Council of Applied Economic Research (1996) are 93.89 million tonnes and 111.35 million tonnes respectively. The demand estimates for the Ninth Plan period have been updated as 72 million tonnes for 1996-97, 79 million tonnes for 1997-98, 86 million tonnes for 1998-99, 94 million tonnes for 1999-2000 and 102 million tonnes for 2000-01. (Table 1.3.)

If economic growth shows further acceleration, the demand for cement could be even higher than the projected levels. Huge coast-based plants are being constructed in Gujarat where large deposits of limestone are available. Modern gigantic plants are being setup with their own jetty for the specific purpose of export and also for movement by sea to other coastal areas of India.

The cement and clinker market of India suddenly rose as the neighbouring countries such as Sri Lanka, Bangladesh, Burma
and Maldives imported as they have no limestone deposits. India can also meet the additional requirement of Pakistan and West Asia. It entered the world cement scenario by exporting cement and cement clinker in 1989. A meager export of 1.6 lakh tonnes in 1989-90, increase to 3.17 million tonnes in 1994-95. Export are growing but at a slow pace on account of infrastructural constraints.

The quality of Indian cement is comparable with the best product in the world. With increased production and the urge to go global, quality assumes paramount importance. The physical and chemical characteristics of 15 standards of Indian cement are equivalent to most of the international specifications.

The industry is continuously striving to improve productivity by adopting the latest developed technology. The main areas of emphasis of the industry are energy saving, pollution control, quality improvement and cost reduction. At present, many plants are using new technologies such as on-line bulk analyser, pre-blending of coal, vertical roller mills for raw material grinding and cement grinding, high efficiency separators, 5 to 6 stage pre-heaters, mechanical conveying systems and total computerised control of operations.

By installing energy efficient equipment, the industry, has achieved considerable improvement in consumption of both electrical and thermal energies. It has setup its own training schools, conducting training programmes at plants to create the required skills.

Most of the plants have technical development cells and quality circles to improve quality and productivity. Some plants
have also achieved thermal efficiency of 800 k.cal per kg and
electrical energy consumption of below 90 units that are
considered as the best in the international level. A number of
plants have adopted total quality management and have already
obtained ISO 9002 certification and many more plants are in the
pipe line to receive. More than 70 percent of the cost of
production of cement comes under the purview of Government
controls like coal price, power tariffs, railway freight, royalty and
cess payments of limestone.

In terms of input, about 1.6 tonnes of limestone are required
to produce one tonne of cement. Hence, location of the plant is
based on the limestone deposits. The major cash outflows comes
by way of royalty and cess payments. India's estimated total
reserve of cement grinding limestone is about 90 billion tonnes.

Power is used in grinding raw materials, clinkerisation of
limestone in the kiln operation and clinker grinding along with
gypsum to form finally cement. The older plants used to require
120 to 130 units of power per tonne of cement produced but
energy efficient plants need 80 to 90 units per tonne.

Since cement manufacturing is a continuous process, any
disturbance of power supply affects the production. Hence most
plants have to setup either their own captive power plants or
make provision for DG sets to meet a major portion of their power
requirement. This however involves large investment and
increased production cost.

Coal is another major input and with electricity it forms 40
percent of the total cost. Coal is used as fuel in the kiln and
also to burn the limestone. The ash of the burnt coal chemically
combines with the limestone and form clinker. On an average 250 kg of coal is required to produce one tonne of cement.

Coal is transported in India over a long distance of 1,000 to 1,200 km to plants located in the North, South and West regions. There is a severe coal shortage for the industry. The quality of coal supplied by Coal India and Singereni Collieries are such that consumption is higher as compared to world standards. This has resulted in installing some coastal based companies in Tamil Nadu and Gujarat where imported high quality coal is used.

Again, cement being a low value bulk material, its transportation over long distances involves huge costs. Non-availability of adequate number of railway wagons over the years has resulted in a major portion of cement being despatched by road and this has increased the cost of freight. The cost of movement by rail has also gone up sharply.

Cement is a major contributor to the Ex-chequer. The excise revenue during 1996-97 is placed at Rs.2,500 crores. Duty on integrated plants is Rs.350 a tonne while it is Rs.200 for mini plants.

The construction material is packed and sold in 50 kg bags. The use of jute bags till the mid-Nineties created a lot of pollution and dust in various stages of handling and also wastage of cement upto 3 kg per bag. Today cement is packed in HDPE/Polypropylene and paper bags. Less than one percent is transported in bulk. India is far behind the world practice where a major portion of cement is sold in bulk to bulk terminals and to ready mix concrete plants. In US and European countries around 90 percent of the cement is sold in bulk and in South East Asian
countries more than 50 percent is sold in bulk. Handling of bags is costly in comparison since it involves additional cost of packing material and loss in handling.

Eighty percent of the cement production depends on limestone deposits that are not found in all the states. This is concentrated in six states of India. This involves transportation over a long distance where the cement plants are located far from limestone deposits.

1.2. NEEDS FOR PRODUCTIVITY OPTIMISATION STUDIES IN CEMENT INDUSTRY:

Today, India is the fifth largest cement producing country and China is the first. The other countries in order are Russia (former U.S.S.R), Japan, and USA. But in terms of per capita consumption of cement India's position is very low (71 kgs) even when compared to countries like, Brazil, Argentina, Turkey, Thailand and Malaysia. Whereas the world per capita cement consumption is 240 kgs.

With a total production of 70 million tonnes in 1995-1996 from both large and mini cement plants, the cement consumption in India is equal to that of wheat. This makes cement the third largest consumed commodity in the country after rice and wheat. Study regarding the demand for cement shows that there will be a total demand of 80 million tonnes by the end of 8th plan and 105 million tonnes by the end of 9th plan Period, assuming an annual growth rate of 8.8%. But the production is estimated to be around 70 million tonnes by the end of 8th plan and 104 million tonnes by the end of 9th plan period. This report by Ministry of Industry, Government of India (1996) shows that the production is not surplus. The growing demand can only be met by judicious
utilisation of the available resources and maintaining high productivity level.

India is on the threshold of industrial development. Therefore Indian economy is undergoing a basic transformation through the process of liberalisation, privatisation and globalisation. Cement sector being the predominant and crucial industry in building the infrastructure of the nation, there is an urgent need for understanding the impending problems of this industry to make the cement industry highly productive and profitable. As mentioned earlier the industry will experience phenomenal growth in the years to come. Hence we have attempted to study the problems of productivity management of the cement industry in this thesis.

Cement industry is directly linked with the growth of a nation and it is quite true to say that "Build the Cement industry and you build the nation". Hence, for the successful monitoring of economic growth it is important to make scientific appraisal of the trends in the productivity, the efficiency with which the resources are converted into goods and services. The reasons are obvious. Since cement industry is one of the highly capital intensive industries, the productivity analysis plays a vital role in forecasting trends and making policy decisions for the successful monitoring of firm's economic progress.

The productivity measurement and analysis in the firm level is important since each cement plant is an integral part of the Industry i.e. (the sum total of the units that are presently working). The individual productivity analysis is therefore, quite important to compare its performance with the industry average
and take suitable measures to effect improvements whenever possible.

The cost breakup of the industry is shown in FIG. 1.3. It is quite clear from the FIG. 1.3 that cement is a highly taxed commodity. Excise and sales tax account for the main cost. Transport, fuel and power are other main costs that are to be controlled to lower the cost of production. Raw materials constitute 8% of the total cost. Limestone and coal are major inputs. Coal costs have increased steeply in the last two years. Calorific value of the domestic coal is poor. Hence efficiency in coal consumption holds the key to reduce cost of production. To achieve high operational efficiency low coal and power consumption is imperative. Since the efficiency with which the resources are converted to output mitigates volatility of profit, productivity analysis is imperative.

1.3 OBJECTIVES OF THE RESEARCH:

Managing productivity is important for all types of organisation, whether manufacturing or services, large or small. This also contributes towards better national economic health and the standard of living. Sumanth (1984) says "If countries have to improve their national productivity levels and growth rate, efforts must begin at the organisational level".

Managing productivity at the enterprise level has four formal cyclic phases. Sumanth (1984) describes them as productivity measurement, evaluation, planning and improvements. While a lot of research works are reported in literature for the productivity measurement and evaluation (which of course are very important phases of the management cycle) there is relatively a paucity of
FIG. 1.3 COST BREAKUP OF THE CEMENT INDUSTRY
research related to productivity planning and improvement in cement industry in India.

The specific objectives of this research are as follows:

(A) To understand the problems of Indian cement industry and depict the critical dimensions affecting productivity management.

(B) To review in general the literature on productivity management as applied to industry sectors and identify models and methods which may be specifically applicable to cement industry.

(C) To construct and validate some productivity optimisation models through two real life examples.

(D) To suggest implementation of instruments for productivity improvement in cement industry.

1.4 ORGANISATION OF THE THESIS:

With the broad objectives mentioned in the earlier section the research studies have been organised in ten chapters.

In chapter-I, which is this chapter, we have described some general problems of Indian cement industry and have identified the significance of productivity optimisation studies.
Chapter-II describes the evolution of cement industry in India. The historical evolution has been depicted in three distinct periods such as:

(I) The period of conditional free trade (1904-41).

(II) The period of control (1942-82) and

(III) The period of Decontrol (1983 - to date).

In each of the period a critical assessment has been made with reference to the following aspects such as (i) Technology, (ii) Capital, (iii) Labour, (iv) Raw material and energy, (v) Commodity.

The review of literature relating to productivity management is presented in chapter-III. The deficiencies in contemporary literature have been identified and focus of the present research has been explained in this chapter.

In chapter-IV, a detail description and comparison of two major cement plants of the state of Orissa in India is brought about. It explains the existing operating principles and practices and the problems involved in productivity management.

Chapter-V is devoted to measure and evaluate the productivity of said plants. The productivity measurement is given an accounting approach and suitable partial productivity like Man power, Material, Overhead & Power are measured for both the cement industries and also compared. Suitable recommendations are made to overcome the difficulties in productivity management. Finally a total productivity measurement is done to find out the combined affect of the inputs over the total output of these
plants. The chapter identifies the factors which leads to better productivity performance of the companies through total productivity measures and partial productivity measures.

Chapter-VI, undertakes an investigation relating to the various factors that can affect productivity. A set of data have been generated by such survey in this chapter, which is used to analyse relationship between multiple facets of productivity and also for assessing the context and dynamics of group behaviour in an industry. It is concluded in this chapter that productivity culture can only bring about a total productivity improvement in an organisation. Productivity culture is the key to the formulation and implementation of a successful strategy in any organisation.

Chapter-VII establishes the production functions for the two plants taken in this study by using multiple regression analysis. Two types of production functions namely linear and Cobb-Douglas are considered in this analysis and finally a statistically most significant production function is recommended for each plant. The development of such production functions enables the management to understand the influence of different inputs over the output of the enterprise.

Chapter-VIII, aims at developing some productivity optimisation models and applying them to cement plants in order to derive some meaningful conclusions. To maximise the total productivity of the plants two strategies are postulated namely, the input minimisation oriented and output maximisation oriented. Two linear programming models have been formulated for the strategies mentioned above. In this chapter, the experience and results of applying the strategies to cement manufacturing plants have been discussed.
The theories of time-based total productivity management strategies and their practices have been narrated in chapter-IX. The way the strategic time based total productivity management can be implemented in cement plants has also been described in this chapter.

Chapter-X is the concluding chapter which gives a general overview including summary, significant conclusions, specific contribution, limitations and scope for further work.