Management Responses to Growth

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Introduction:

Growth is one of the primary objectives of an enterprise. Achieving growth is one thing and sustaining growth is another as also achieving sustainable growth is yet another thing. In this context, it is to be noted that growth is essentially a multidimensional concept as it can refer to many a factor such as : output, sales turnover, profits and its rate, product range and diversification, employment, capital, or it could also refer to the ratios like productivity, profitability and so on; or it could also be a combination of these elements since they are interrelated. In this paper, it is considered in a narrow sense, referring mainly to the physical output of an enterprise. This refers to the coal mining industry in A.P.

The major distinguishing feature of the mining sector is that growth contains decay. In other words, growth is ingrained in decay. Growth and decay are intertwined together in this sector because the enterprises deal with the depleting asset. Thus, extraction is nothing but depletion because a ton extracted is nothing but a ton depleted from the finite resource stock. Growth entails decay. In essence, this is the basic premise on the basis of which the present empirical investigations are carried out on the **"Management Responses to Growth".**

Growth can only be made compatible with decay only through exploration and conservation. There is no other way for achieving a sustainable growth in the mining sector. In other words, sustainable growth can be achieved only and only through undertaking exploration operations and conservational programmes on a continuing basis. Otherwise, the mining enterprises will have to face the ordeals of doomsday.

The present study is based on an expost facto analysis of growth and its major drivers. A long time series data on growth of output and its related aspects have been collected through field survey. Thus, it is essentially an empirical analysis of the past trends relating to the motors of growth. This exercise has been carried out with a belief that the study of history helps planning of the inherently unknowable future because **in change lies continuity.**

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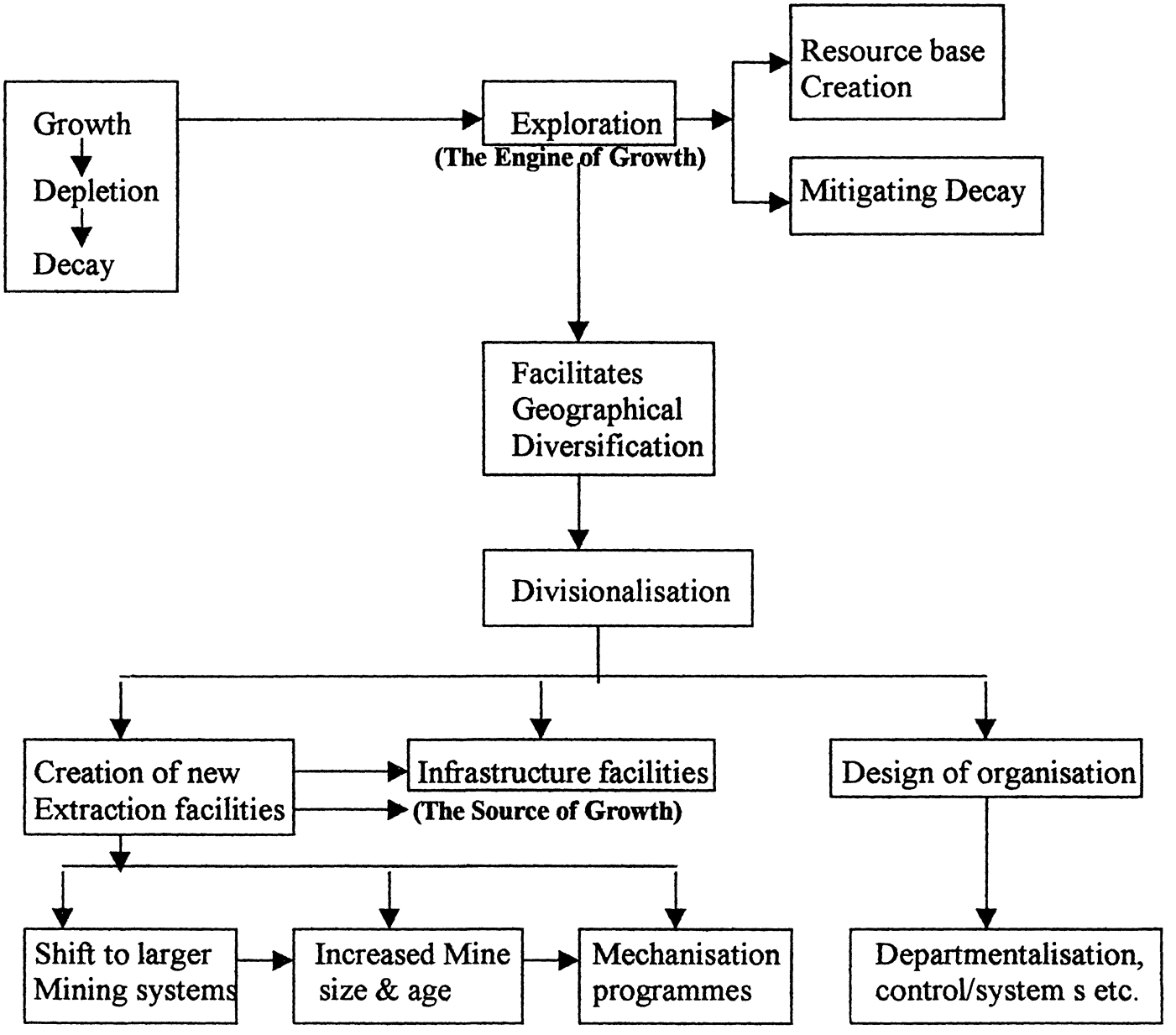
A Schematic Presentation of Managing Growth in the Mining Sector



MANAGEMENT RESPONSES TO GROWTH
(The Case of Coal Mining Industry in Andhrapradesh)

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The role of energy in the overall processes of development needs no emphasis. The positive high correlation between energy consumption and the GDP is widely known. Not only development, but also the quality of life depends on the energy consumption and its pattern. In one sense, it is often treated as one of the primary factors of production along with land, labour and capital. More importantly, it should be stressed that it is the energy resources that convert the rest of the natural resources into products with salability and utility. Thus, energy participates directly in the production of goods and services. This needs to be kept in mind while discussing the matters relating to energy policy and planning. Comparative studies across the countries reveal that the rate, level and pattern of economic development in the long run is guided by and adhere to the energy and other resources endowment. Even the international policies and politics are to a large extent influenced by the resource endowment (both fuel and non-fuel resources). This being the case, energy has international political dimensions.

In the present context, it is to be noted that the energy-intensities, for various reasons, are increasing in recent years at much faster rates than even before (see, Table - 1A) across various sectors (such as industry, agriculture, transport etc.) of the economy. Besides this, the life styles of the population as reflected in the percapita energy consumption are becoming more energy intensive. In the domestic sector, energy consumption is said to be habit-forming. All these macro level structural changes coupled together with population explosion, increasing levels of education, incomes and aspirations, developments in mass media, S & T and other factors of sort, have resulted in making enormous demands for energy in recent years. Trends in the patterns and rates of

energy consumption are both the cause and consequence of economic development. This is the peculiar nature of this sector.

There is ample empirical evidence to show that the demand for energy is increasing faster than the supply resulting in continuous energy shortages. Thus, the gap between the demand for and supply of energy is widening and the gap remains. Because, the known sources of energy are not able to cope with the ever increasing demands and that therefore, several countries are looking for non-conventional sources of energy like solar, wind etc. The management of various energy enterprises is not able to respond and cope with the expanding energy markets. Accordingly, the present paper attempts to analyse the management responses to the growth in energy demands with special reference to the coal mining. In other words, it tries to identify and analyse some of the major issues relating to the management of growth or managing growth or same as the management responses to growth. Though there are some subtle differences (conceptually significant but practically non-significant) among the three conceptual phrases, we have used them interchangeably or synonymously for the sake of convenience. Because, the sources of growth in the mining enterprises are same for the three conceptual phrases. In the process, an attempt is also made to identify the sources or the drivers of growth on the basis of which, some lessons can be drawn to formulate appropriate policies to cope with growth.

Growth is given exogenously to the enterprise either through the market surveys or market forces (or signals) or through the planning bodies. In either case, it has to be achieved to satisfy the market demands. Given the growth thus, the enterprise management has to respond appropriately to achieve the targeted growth in terms of output. Mere achieving growth is not enough. It has to be internalised and absorbed through developing appropriate organisational structures. Absorption of growth is a critical factor. It is as important as achieving it or perhaps more. There is yet one more aspect. When once growth is achieved and absorbed through proper organisational

structures, it has to be sustainable. This aspect of sustainability lies outside the scope of the present paper.[1]

The paper is broadly divided into four sections. Secion-1 delineates the global energy consumption trends bringing out the relative role of coal. Section-2 brings out the broad salient features of India's national energy policy highlighting the primacy of coal over the other fuels. Section-3 assesses the coal resource-base of Andhra Pradesh along with their distinguishing features. It also examines the extent of coal markets. Section-4 analyses the patterns of management responses to the growth of coal demands from the Southern region.

Data Sources: The present study is based mostly on the published data both by the coal mining industry and other agencies, and partly on the survey data.

SECTION - 1

In this section, an attempt is made to describe the relative resources endowment of fossil fuels at the global level. This is given in the table below.

Table 1 : World's Proven Reserves of Fossil Fuels (1991)

Sl.No.	Fuels	Proven Reserves
1	Oil (billion tonnes)	135.4
2	Natural Gas (TCF)	4378.1
3	Coal (billion tonnes)	1040.5

Notes: Proven reserves refer to those that are technically and economically recoverable under existing economic and operating conditions. As against these proven coal reserves, the extent of global geological coal occurrences or the indicated reserves are estimated to be 10,125 billion tonnes.

[1]See N Naganna, "Economic reforms and Sustainability : A Conceptual Analysis and Framework" (To be published in the forthcoming issue (January, 2000) of Indian Journal of Economics. The issue of sustainability is tackled in this paper.

Table 1A : Major Fuel Consumers in the Manufacturing Sector : 1973-74 and 1989-90

Fuels Cons./Val. Of Output (%)

Industry	1973-74	1989-90
Iron & steel	10.6	11.2
Cement, lime and plaster	25.1	33.6
Aluminum	14.2	22.4
Pulp, paper and paper board	10.1	17.6
Foundries for casting and forging of iron and steel	5.0	5.1
Ferro alloys	21.6	36.7
Glass and glass products	16.6	22.0
Structural clay products	15.1	21.0
Basic organic and inorganic chemicals	9.8	4.6
China-ware and porcelain-ware	15.3	20.1
Zinc	3.5	13.3
Copper	3.1	7.6
Ice	26.3	8.6
Synthetic resins, fibres, plastic materials, etc.	6.1	4.5
Fertilisers and pesticides	8.6	8.0
Cotton spinning and weaving	4.1	6.7
Starch	5.0	2.0
Common salt	5.2	8.2
Slaughtering, preparation of meat	3.2	4.7
Dyeing and bleaching of woolen textiles	9.7	29.9
Printing, dyeing and bleaching of silk textiles	4.6	13.0
Manufacturing		
Factories (Numbers)	60889	1,03,373
Fuels consumed (Rs. Lakhs)	73667	13,36,025
Fuels Cons./Val. Of output(%)	4.0	6.4

Source: CMIE, June 1994

1.1. World Coal Reserves: It is evident that the global fuel resources endowment goes in favour of coals. Energy resource experts opine that the coal reserves are much more plentifully endowed than the oil or the natural gas. World is richly endowed with coals. They are likely to last much longer than other fuels. The oils and natural gas are said to be relatively scarce when compared with coals. Consequently, oils have scarcity value. Most of the countries therefore prefer to depend heavily on coal as a primary source of their energy needs. But the fuel resources endowment is

extremely unevenly distributed across the countries as also their quality and mineability reflecting in large variations in unit costs. This aspect will have a significant influence on energy policy making of different countries.

1.2. Coal Policy Options: On the basis of their relative resources endowment, different countries are evolving different energy policies. The strategic policy options followed by different countries can be broadly divided as under:

a. Domestic coal production as a substitute for imported oil.
b. Domestic coal production by oil-exporting developing countries to FREE oil for exports.
c. Coal production for exports.
d. Coal imports to replace oil imports.
e. Coal as a direct fuel.

Relative fuel prices, unit costs, mining conditions, geographical factors like favourable coastal belt, political factors, infrastructure facilities, technology, inter-fuel substitution policy, relative resources endowment, transport and handling costs, etc., are some of the major factors that influence the crucial choice on the energy (coal) policy options keeping in view of the energy security needs. These issues have come to the fore in recent years because of the fact that India is also contemplating to increase its coal imports, which seem to be economically cheaper. Tamil Nadu is a case in point. Let us not, however, enter into the controversial issue of coal imports vs. domestic production.

1.3. World Energy Consumption Patterns and Trends: The purpose of presenting the world energy consumption patterns (fuel-wise) and their changing trends is to bring out the relative contribution of different fuels to the total global energy requirements. The relative share (%) of each fuel in meeting the world energy needs and their changing patterns is presented in Tables 2 & 3. The primacy of coal over other fuels is clearly reflected in the past. In 1929, coal alone contributed as high as 80% to the

total world energy consumption. Due to various techno-economic reasons and false hopes of energy planners, its relative share declined substantially from 80% in 1929 to a low of 26% in 1978. Thereafter, its relative share is again increasing. In the year 1995, the percentage share of coal in the global electricity generation is found to be 38%. Its recovery is indeed substantial (See Table-3). Thus, coal is gradually regaining its lost glory in recent years. The relative trends in the patterns of world energy consumption over time reveal the inter-fuel substitution and the broad structural changes that are taking place in the world economy. The main reasons for the decline in the relative share of coal are found to be:

- ➔ Oil cheaper; cleaner; and easier to handle.
- ➔ Oil transport cost less.
- ➔ Oil pollutes less; technology and equipments simpler.
- ➔ Energy planners expected unlimited oil supplies and at low prices.

Table-2 : World Energy Consumption (Commercial Fuels) :

(Orders of Magnitude)

Sl. No.	Fuels	1929	1937	1950	1960	1970	1978	1988	1991
1	Solid Fuels	80	75	62	51	42	26	30.1	31
2	Hydro-electricity	1	1	2	2	2	4.7	6.7	2.5
3	Natural gas	4	6	11	13	19	17	20.2	22.7
4	Oil	15	18	25	34	37	50	37.6	37.2
5	Nuclear Power	-	-	-	-	-	2.3	5.4	6.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Total in million tonnes of Coal equivalent	**1712**	**1826**	**2519**	**4433**	**7230**	-	-	-

Source: J.E. Hartshorn, **"Oil Companies & Governments"** (Faber And Faber, London, 1962, p 351) for the years 1929 to 1970. For other years, the sources are different.

Table-3 : Shifts in Electricity Generation - Fuelwise at Global Level

(Percentage share in total generation)

Sl.No.	Fuel	1980	1995
1	Coal	33	38
2	Petroleum	28	10
3	Hydropower	21	19
4	Natural gas	9	14
5	Nuclear Power	9	18
6	Others	-	1
	Total	**100**	**100**

Source: World Development Indicators, 1998

These are some of the major reasons for the replacement of coal by oil and natural gas in the past. However, in recent years, particularly after 1974, the events took a different turn due to the exercise of monopoly power in different forms and the scarcity value factor. The political uncertainties added to these two factors. Consequently, placing of hopes on oil proved to be false. The dwindling prospects for oil supplies at acceptable prices combined with the abundant coal resource-base gave rise to the increased importance and role for coal in meeting world energy needs. Of course, the issue of nuclear and hydel power pose different problems.

1.4. Prospects for Coal[2]: Many critical developments like technology, interfuel substitution, surprise finds (oil) etc., are specific to the energy sector and particularly the exercise of monopoly power whose nature and persistence are uncertain. Therefore, the energy prospects are especially hard to project. The following issues need to be considered while assessing the coal markets.

- ➔ Both producers and consumers are scattered over long distances. Coal is a bulky product. Handling and transport costs are high.
- ➔ On demand side, large differences exist in major end uses and locations.
- ➔ On supply side, the suppliers differ radically in their production costs; costs of delivery to key markets and the quality of coal produced.

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[2] Dr. Manmohan Singh. **"Towards An Integrated Energy Policy for India"** (Convocation address at Indian School of Mines. Dhanbad, on 5th April 2000).

Besides the above factors, there are many others which need to be considered in the analysis of future emerging coal markets both nationally and internationally as well. They are:

a. Coal competes with other fuels; and producers within the coal industry compete with each other.
b. Competition is affected by: the cost of equipments to burn coal; transport and handling costs; public policy; monopoly power in fuel markets etc.
c. The more ample the supply of competitive fuels, the more pressure will be on coal. Thus, the WORST CASE for coal is one in which ample supplies of oil and gas are available and nuclear power is cheap and politically accepted. The less these conditions prevail, the better the outlook for coal.

In this regard, the key issues that influence the future coal prospects both nationally and internationally are:

i. The true competitive position of different coal suppliers.
ii. How well coal can compete with other fuels.
iii. The political weightage given to energy security (nation-wise).
iv. Growth in electric power sector.
v. World steel output, where it occurs and the role coke will play.

The above are some of the critical factors that influence the extent of the emerging future coal markets both nationally and internationally. They are also equally important in analysing the domestic coal markets. In other words, they determine the extent of future coal prospects.

1.5. A Critical Review of Coal Prospects: The larger magnitudes of coal reserves/resources running into astronomical numbers are irrelevant. The main question is : How much coal can be sold PROFITABLY? The advantage of physical abundance is possibly an illusion. At what competitive price the coal will be supplied is more important.

A similar critical consideration is : How much of the coal supply can be mined cheaply enough to offset the substantially higher transportation, capital and non-fuel operating costs in utilisation as compared with those for oil and gas. Another factor in assessing future coal prospects is that the governments intervene effectively to control the environmental impacts of mining and using coals. Whether or not the coal industries thrive or languish, the environmental governance is bound to be stringent in future. Therefore, the coal prospects are constrained by environmental factors.

However, the coal prospects seem to be encouraging because of the fact that the true physical availabilities of alternative fuels (like biofuels, solar, wind etc.) are unclear. Till such time the alternative non-conventional fuels become technically and commercially viable and their use accepted, the growth of coal-use seems to be worldwide. No doubt, the coal industry is growing rapidly all over the world, but it may not reach the same preeminence as was seen in the past.

SECTION - 2

In this section, an attempt is made to bring out the salient features of India's energy policy. A critical examination of the policy (energy) statements from the GOI clearly reveals the primacy of coal over other fuels in meeting the country's energy needs. Our national energy policy is essentially guided by and adhere to the relative fuel resources endowment. The country is found to be richly endowed with coal reserves. Oil and natural gas are said to be relatively scarce in our country. The abundance of coal reserves prompted the energy planners to treat coal as a primary source of energy to the country. The Geological Survey of India has estimated that the coal reserves (as on March 1996) amount to 202 billion tonnes. Out of this, coking coal reserves are estimated to be 15% while 73% are inferior grade non-coking coals. This coal resource base is several times larger than other fuel sources. The primacy of coal over other fuels is brought out in several national energy policy statements made from time to time.

2.1. Primacy of Coal: After making a critical assessment of various energy sources in the country, the Fuel Policy Committee (1974) concludes with the policy statement as: **"Our analysis contained in the report establishes beyond any reasonable doubt that coal should be considered the primary source of energy to the country. The coal resources of India, inspite of their quality being poor and their unevenness in geographical dispersal, represent the most valuable and reliable source of energy to the economy".** This policy statement is obviously guided by the relative abundance of coal resources inspite of their problems in quality, ash content, mineability and wide geographical scatteration.

In the same vein, the Sixth Five Year Plan document reassures the policy by saying that: **"Coal is the most important source of commercial energy".** The Seventh Five Year Plan document also continue to lay the same stress on coal as the primary source of energy to the country. It says: **"Coal will continue to be the key source of energy".**

The Eighth Five Year Plan made a slight departure from the earlier ones. It broadened the base of economic planning by suggesting to include the **efficient use of resources and long term sustainability.** The Eighth plan says that any strategy for energy planning has to be consistent with these two broad objectives, viz., the efficient use of resources and the long term sustainability. The Eight plan also re-emphasises the role of coal by stating: **"while coal continues to be the main source of primary commercial energy not only for direct use in industry but also for indirect use through power generation....."**

From the above policy statements, it is clear that the national energy policy is primarily dictated by the relative abundance of resource endowment. This is the reason why coal is given a triple role to play in energy planning, viz.,

- as a direct fuel
- as a substitute fuel, and
- as a transitory fuel

2.2. Some quantitative Dimensions: The energy policy as given above by various official agencies has been broadly accepted and implemented by the GOI over a period of time. Its implementation is clearly reflected in the relative shares of different fuels in the total electricity generating capacities in recent years.

The source-wise installed power generating capacities is given in Table-4 below:

Table 4 : Source-wise Installed Power Generating Capacity (MW)

Year	Hydro	Nuclear	Thermal				Grand Total
			Coal Based	Oil Based	Gas Based	Total Thermal	
1970-71	6383.00	420.00	7508.00	230.00	168.00	7906.00	14709.0
% share	43.40	2.85	51.04	1.56	1.14	53.75	100.0
1974-75	7529.00	640.00	9753.00	229.00	166.00	10148.00	18317.0
% share	41.00	3.49	53.25	1.25	0.91	55.40	100.0
1979-80	11384.00	640.00	15991.00	165.00	268.00	16424.00	28448.0
% share	40.02	2.25	56.21	0.58	0.94	57.73	100.0
1984-85	14460.00	1095.00	26311.00	177.00	542.00	27030.00	42585.0
% share	33.96	2.57	61.78	0.42	1.27	63.47	100.0
1989-90	18308.00	1565.00	41237.00	183.00	2343.00	43763.00	63636.0
% share	28.77	2.46	64.80	0.29	3.68	68.77	100.0
1994-95	20833.00	2225.00	52139.00	343.00	5632.00	58114.00	81172.0
% share	25.67	2.74	64.23	0.42	6.94	71.59	100.0
1997-98	21891.00	2225.00	55969.00	1276.00	7805.00	65050.00	89166.0
% share	24.55	2.50	62.77	1.43	8.75	72.95	100.0

Source: Centre for Monitorning Indian economy, March 1999.

Among other things, the above table brings out clearly the primacy of coal over other fuels in the Indian economy. This is one of the characteristic features of the Indian economy. It is evident from the above table that the relative share of coal in the total power generation is found to be 51.04% in 1970-71 which registered a substantial increase to about 63% by 1997-98. Thus, the coal-based thermal power dominates India's energy scene. On the other hand, the relative contribution of hydel power declined substantially from a high of 43.4% in 1970-71 to a low of 24.5% in 1997-98. The relative contribution of nuclear power stagnates around 2.5% during the period under consideration

The notable feature of India's energy scene is that the relative contribution of gas-based thermal power generation is increasing at faster rates from a meager 1.1% in 1970-71 to about 9% in 1997-98.

The pre-eminence of coal in India's energy scene is clearly established in Table-4.

SECTION - 3

After examining the role and significance of coal and its future prospects both nationally and internationally, an attempt is made in this section to make a critical assessment of coal resources endowed in the state of Andhra Pradesh. Before going into this aspect, a few comments need to be made on the geographical distribution of coal resources in India. Most of the coal resources are located in a few states like West Bengal, Bihar, M.P., Maharashtra, Orissa and A.P., while the coal consuming centres lie far away from the coal belts. Obviously, this involves long hauls resulting in high transport and handling costs. High ash content aggravates the problem of unfavourable and uneconomic location. In the past around 1950's, roughly 80-85% of the total coal output used to come from only two states, viz., Bihar and West Bengal. To minimise the transport costs, to avoid or mitigate the transport bottlenecks, to minimise the delivered costs of coal to the consumers, etc., the Indian Coal Mining industry undertook the programme of geographical diversification and balanced regional development of the coal industry. Consequently, the excessive dependence on Bihar and West Bengal coal fields got reduced significantly by developing the other coalfields through exploration work in Orissa, M.P., Maharashtra and A.P. However, the large geographical scatteration and unfavourable (uneconomic) location coupled with high ash content and low quality are the main characteristic features of the Indian Coal Mining industry. To overcome this inherent disadvantage, the concept of super thermal (or the pit head) power stations came into being.

3.1. Coal Resources of A.P.: More or less, the same pattern exists in the case of coal resource endowment in A.P. They are not concentrated but scattered over large geographical areas in the Telengana region of A.P. This kind of scattered endowment pose severe problems in the development of organisational structures to exploit the coal resources. The coal resources in A.P. vary widely over different coal fields in terms of their quality, mineability, depth, gradients, seam thickness and other geological parameters. The resource base is thus highly heterogeneous. This aspect poses a number of complex problems in mine planning and development for exploitation. Besides these issues, the quality of coal is low with high ash content. In addition to these problems, it is reported that the mining conditions in A.P. coalfields with their highly disturbed and irregular seams, is more difficult and severe when compared with other states like Orissa, Bihar etc.

Coal Imports: Due to above unfavourable factors and other labour problems in the A.P. coal fields, the cost of coal production and its price is found to be so high that the coal imports turn out to be cheaper. In fact, some coal consumers shifted to the coal imports after economic reforms. But the imported coals have high sulphur content, which damage the boilers and create problems in maintenance. This is a blessing in disguise which is acting as a major deterrent to shift to the imported coals. This aside, the issue of energy security and self-sufficiency/reliance is likely to discourage the coal imports.

3.2. Coal Reserves in A.P. Coal Industry: In India, the coal reserves are normally classified in increasing order of their probability of extraction under existing economic and working conditions as under:

-Indicated,
-Inferred, and
-Proved

Depending upon the intensity with which the exploration is undertaken. Indicated reserves refer to all the geological occurrences with or without continuity of coal seams.

They are least certain for exploitation. Inferred reserves refer to those which have higher probability of getting proved for immediate exploitation. The proved ones refer to those that are technically and economically workable deposits. They are readily available for immediate extraction.

Keeping this classification in view, the coal reserves in A.P. are estimated to be 10,856 million tonnes, the breakup of which, is given below:

Table 5: Coal Reserves in A.P.

Sl.No.	Type	Amount (m.t)	%
1	Inferred	3543	32.6
2	Indicated	1112	10.3
3	Proved	6201	57.1
	Total	**10,856**	**100.0**

It is evident that the resource base for the coal industry in A.P. is quite comfortable and it is likely to last for more than a century with the current rates of extraction. In other words, the **"sustainability"** of the existing and known resource base is quite high with current rates of exploitation. Another noticeable observation is there. The fact that the "proved" reserves account for about 60% of the total deposits, shows that most of the likely coal-bearing areas are already explored fairly intensely and fully. In other words, the likely additions of new found deposits through exploration will soon reach the asymptotic limits. This has a serious implication in **sustainability.**[3]

Geographical Distribution of Proved Reserves: As said earlier, the reserves are not concentrated in one area but scattered widely over large tracts. The district-wise break up of proved reserves is given below:

[3] See, Naganna (2000), op.cit.

Table 6: District-wise Distribution of Coal Reserves (m.t.)

Sl.No.	District	Proved Reserves (m.t.)	%
1	Adilabad	2536	41.0
2	Khammam	1418	22.8
3	Warangal	453	7.3
4	Karimnagar	1794	28.9
	Total	**6201**	**100.0**

As against the above break-up by district-wise proved deposits, another break-up by coal-belt is given below:

Table 7 : Reserves by Coal-belts

Sl.No.	Coal Belt	Proved Reserves (m.t.)	%
1	Ramagundam	1794	28.9
2	Somagudem-Indaram	1388	22.4
3	Manuguru	685	11.0
4	Kothagudem	612	9.9
5	Dorli-Bellampalli	468	7.6
6	Mulung	433	7.0
7	Chinnur	334	5.4
8	Lingala-Koyagudem	219	3.5
9	Yellandu	209	3.4
10	Meripally-Kagaznagar	59	0.9
	Total	**6201**	**100.0**

The evidence as presented in Tables 6 & 7 brings out the fact that there is a wide geographical spread in resource endowment, ranging from 50 to about 600 kms distance between/among different coal fields. This kind of wide geographical dispersal pose severe problems in developing appropriate organisational structures for undertaking exploitation. In such a case, management also becomes really difficult and very complex. Similarly, the siting of coal-based industrial activities also becomes complex.

Depth-wise total Coal Reserves in A.P. Coal Fields: Depth refers to the vertical distance from the surface to the coal seam embedded in the underground. It is a very important parameter in deciding the choice of mining systems which in turn will have significant influence on cost structures, productivity, technology, environmental impacts,

mine capacities and so on. It is thus a crucial factor in the analysis on the assessment and evaluation of coal resources. It is a natural factor and one of the indestructible powers of the mine. As a matter of fact, the whole lot of decision-making processes with respect to the development and exploitation of coal reserves depend essentially on the depth at which the deposits are embedded. The depth-wise distribution of total coal reserves (i.e., indicated + inferred + proved) in A.P. is given in the below table.

Table 8 : Depth-wise Coal Reserves in A.P.

Sl.No.	Depth (mts.)	Total Reserves (m.t.)	%
1	0 - 300	4401	40.5
2	300 - 600	3942	36.3
3	600 - 1200	1717	15.8
4	> 1200	796	7.4
	Total	**10856**	**100.0**

As against the total reserves, the depth-wise distribution for the proved reserves is given in Table-9.

Table 9 : Depth-wise Proved Deposits

Sl.No.	Depth (mts.)	Reserves (m.t.)	%
1	0 - 300	3609	58.2
2	300 - 600	1796	28.9
3	Above 1000	796	12.9
	Total	**6201**	**100.0**

The above evidence on the depth-wise distribution of coal reserves indicates that there is a large potential for open-cast or the strip mining methods to extract coal. The strip mining systems are found to be more economical with lower unit costs and higher productivity than their counterparts, viz., the underground mining systems. Further, the mine-capacities to cope with the expanding coal markets are larger in this system. The A.P. coal industry has already shifted to this opencast system on a significant scale in recent years. But, the environmental damages are more severe in this case.

The reserve position with large tracts of virgin areas is quite comfortable by any standards and at the current rates of extraction. Consequently, the industry need not resort to the extraction of less furtile and high cost bearing marginal deposits in the near future. The real costs of coal mining is therefore likely to remain stable for quite some time to come. This gives credence to the present exercise because the historical perspective is an essential guide or a roap-map for planning theunknowable future.

The installed capacity of power generation in A.P. is given below:

Sl.No.	Source	Installed Capacity (000 kW)	%
1	Steam (coal based)	2703	46.9
2	Gas based	351	6.1
3	Diesel and wind	54	0.9
4	Hydel	2657	46.1
	Total	**5765**	**100.0**

It may be noted that the A.P. state gets its electric power both from hydro and thermal (coal) modes in equal propositions.

3.3. State-wise Distribution of Coal Reserves in India:

Table 10 : Coal Reserves by States (m.t.)

Sl.No.	State	Reserves (m.t.)	%
1	Bihar	64,601	32.8
2	Orissa	46,527	23.6
3	Madhya Pradesh	41,343	21.0
4	West Bengal	26,442	13.4
5	**Andhra Pradesh**	**10,856**	5.5
6	Maharashtra	6,276	3.2
7	North-Eastern States	866	0.5
	Total	**1,96,911**	**100.0**

Table 11 : Coal Reserves of India (m.t.)

Sl.No.	Type	Reserves (m.t.)	%
1	Indicated	86,079	43.7
2	Inferred	42,766	21.7
3	Proved	68,066	34.6
	Total	**1,96,911**	**100.0**

The above evidence suggest that there is an extreme unevenness in the geographical dispersal of coal resources in India. Four states, viz., Bihar, Orissa, Madhya Pradesh and West Bengal account for 91% of the total all-India coal reserves. This is highly unfavourable and uneconomic because most of the major coal consuming centres are far away from these states involving long hauls and high transport costs. The fact that the % of proved reserves to total reserves (See table 11) is only 34.6%, shows that there is a large scope for exploration work to be done. The same is found to be 57.1% in A.P.

3.4. The Unique Position of A.P. Coal Reserves: The coal fields in A.P. are also called the Godavari Valley Coal field. It is the only known source of hard coal in the entire South India. This is the unique position that the coal industry in A.P. enjoys. In a sense, this influences the nature and extent of coal markets for the industry. The exploration activity in these coal fields till now is the exclusive prerogative of the Singareni Collieires Company Ltd. (SCCL). It is estimated that 25% of the total all-India coal demand originates from the Southern states. Therefore, the attention of both the Central and A.P. State Government is concentrated on the Godavari valley coal fields and the SCCL for increasing the coal production to meet the ever expanding coal demands. The coal reserves of the SCCL constitutes about 5% of the all-India coal reserves while it contributes about 10% to the total all-India coal output.

3.5. A Historical Perspective: Historical records/evidence from the State Archives of AP show that the exploration (drilling) operations were taken up in October 1872 by an order from the HH, the Nizam Government to ascertain as accurately as possible the extent of the coal resources in the Singareni Coalfields of the Thelangana Region. In November 1872, the prospecting operations were commenced. In 1875, a report (Henan's Report, 1875) was submitted which estimated the total coal resources embedded in the Singareni Coalfields will be of the order of 46.5 million tons of which 19.5 million tons of coal was considered to be of first class quality and decidedly equal to, if not better than , any coal as yet discovered in India. On 7th January, 1886, the Government of Hyderabad granted a

mining concession to Mr. John Stewart and William Clarence Watson of London. A Limited Company called The Hyderabad (Deccan) Company Limited was duly registered and incorporated under the Company's Act of 1883 on the 29th July 1886. The company started raising coal from the Singareni Coalfields on the 7th August 1886. Thus the coal mining industry in Andhra Pradesh was started in 1886. Thereafter, the output has grown in astronomical figures despite the year to year mild fluctuations. In the year 1888, a couple of years after the start, the output was 13 thousand tons and it reached to little over 1 lakh tons by 1890. From this humble beginning, the SCCL at present is raising about 30 million tones of coal by operating 69 mines (including 11 opencast mines) with an employment of about 115,000 workers. The SCCL is one of the most progressive companies, constantly looking for modernisation and growth.

The above is the magnitude of growth from a meager annual output of about 10,000 tonnes to about 30 million tonnes per annum that took place in the A.P. coal mining industry over a period of 115 years or since its inception in 1886. The extent of growth is indeed remarkable. Then the issue before us is to identify and assess the management responses to growth of that magnitude or how the growth of that magnitude was achieved. This is addressed in the next section.

SECTION - 4

In the last section, we have seen that the coal industry (SCCL) in A.P. has grown phenomenally from a very modest beginning to the commendable heights in a span of a little over a century. Growth is observed to be not only remarkable but also sustainable. **This is the noteworthy feature.** In other words, the industry could achieve the sustainable growth and that too, in an industry, which is **inherently exhaustible or self-destructive.** Since the industry is engaged in a depletable asset, the closure/death is always at its doorsteps. Every rate of growth contains within it a rate of equal decay. Every growth curve harbours its own genetic code that predetermines its end point.

Decay is thus insidious in mining sector. The industry understudy could overcome this danger by proving that the sustainable-growth in the mining sector is possible and achievable.[4] This is the distinguishing feature of the A.P. coal industry because decay in this case had been overtaken by growth. This being the case, the issues that come to the fore for growth-analysis are identified as below:

- ➔ How could the management achieve such a phenomenal growth? What are the management-responses to growth? How could it manage the growth? Did they plan for growth or did they respond to growth?
- ➔ What is the art of managing growth that the industry adopted?
- ➔ What are the sources/drivers of growth at the industry level?
- ➔ Can other units learn some lessons from this success story? Can policy making be improved?

These are some of the critical issues that have been identified and addressed in this section.[5] It may be noted that growth is normally given exogenously to the enterprise either through the market signals (or market surveys including forecasting) or through the planning bodies. In either case, growth is given exogenously to the enterprise to which its management has to respond in time and adequately. Response is meant to achieve growth by creating production and other supportive facilities. When once growth is achieved, it has to be sustained. Growth is not a one-time affair. It needs to be fairly continuous over fairly long periods. Otherwise, there will not be growth but cycles or the notorious cyclical fluctuations which are normally condemned as counter productive. **Therefore, growth is its (enterprise) immediate goal while sustainable and stable growth is its long-term goal.** This kind of perspective on growth differs between the mining enterprises and the manufacturing ones because both diverge significantly with

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[4] See, Naganna (2000), op.cit. See also, **"The Corporate Imagination : How Big Companies Make Mistakes"** (M.E. Sharpe, Inc, Armont, New York, (1984). Also see, Wiseman J. (Ed.) **"Beyond Positive Economics"** (Macmillan, London, 1983).

[5] In fact, these issues need much more deeper study than what has been done here. Our paper may utmost provide some research leads. See, Robin Morris (1964), **"Economic Theory of Managerial Capitalism"**. (Macmillan, London). See also GLS Shackle, **"Imagination and the Nature of choice"** (Edinburgh University Press, 1979)

respect to markets, demands, production laws, input-output relations and so on. Keeping this distinction in view, an attempt is made here to carry out the **analysis of growth** on the A.P. coal mining industry.

Since the issue on hand is concerned solely with the mining enterprise, it is necessary to note broadly the divergent features between the manufacturing firms and the mining enterprises. They are tabulated below:

Table 11a : Divergent Features Between Mining & Manufacturing[6]

Sl.No.	Mining	Manufacturing
1	Derived demand	Direct demand
2	Limited markets	Large markets
3	Produce raw materials	Convert them into products
4	Depleting asset	No such thing
5	Resource base hidden and unknown	No such thing
6	Destructive use of land	No such thing
7	Environmental impacts	Different environmental impacts
8	Exploration (an addition activity)	No such activity
9	Risk and uncertainty high	Risk & uncertainty low
10	Inherently subject to diseconomies of scale	Opposite is seen
11	Input-output relation unstable	Input-output relations stable
12	Higher % of overheads; subject to overheads & extraction cycles	% of overhead low. No cycles
13	Life cycle trends : Age-cost and Age-size relations, etc.	No such life cycle trends
14	Labour intensive	Capital intensive
15	Mobile equipment (P & M)	Immobile equipments (P & M)
16	Capital phasing - gradual	Capital phasing - No.
17	S & T slow	S & T fast
18	No R & D	Significant R & D
19	No second hand markets	Second hand markets growing
20	Shifting activity spreading into different areas continuously	Not a shifting activity

[6] These divergent features between mining and manufacturing have been identified on the basis of our empirical investigations through several field visits. Although the two sectors radically differ from each other in various respects, one has to rely, in the absence of better alternative, on the frameworks/approaches developed for the manufacturing sector organisations to understand the problems of mining organisations.

The above is the list of some of the important differences between mining and manufacturing. This list is by no means exhaustive. These divergent features need to be kept in mind while conducting the analysis of growth on the coal industry.

4.1. Analysis, Extent and Magnitude of Growth of A.P. Coal Industry[7]: In this context, growth is restricted to the growth of coal output over a period of time. The period covers from the very inception of the coal industry to the present day. Output data for the period 1886 to 1998-99 are collected. For the sake of brevity, the data are presented only for one year in each of the decade. This data is presented in the table below:

Table 12 : Growth of Coal Output in A.P.

Year	Output (000 tonnes)	% variation over the previous year
1886	10	-
1888	13	30
1889	59	354
1899	401	580
1909	443	10
1919	642	45
1929	768	20
1939	1140	48
1949	1045	-8
1959	2230	113
1969-70	3700	66
1979-80	9403	154
1989-90	17805	89
1998-99	27325	53

It is evident from the above table that a phenomenal growth took place in A.P. coal industry from a mere 10 to 15 thousands tonnes of annual outputs in the initial years to about 30 million tonnes per annum in the latest years. This is an immensely impressive growth. The only decline during the entire period from 1886 to 1998-99 is in 1949 indicating that the industry suffered a severe set back due to the second world war. Growth is thus substantial over all the demarcated periods. It is consistent, stable and

[7] Mack Hannan, **"Fast-growth Strategies"** (McGraw-Hill Book Company, 1987). This book deals with how to grow big, grow fast and grow sure.

more importantly, sustainable. This is the remarkable feature. Since the A.P. coal industry registered much faster rates of growth than the all-India coal industry, its relative position or relative contribution to the total all-India coal output has increased substantially. This is shown below:

Table 13 : Percentage Share of SCCL Output in the All-India Coal Output

Year	% Share of SCCL Output
1964-65	5.0%
1973-74	6.8%
1978-79	8.8%
1988-89	9.6%
1993-94	10.2%
1997-98	9.8%

The percentage share of the SCCL output in the all-India coal output has been doubled from 5% in 1964-65 to 10.0% in the recent years. This reflects the objectives of national coal policy of reducing excessive dependence on Bihar and Bengal coal fields and thereby, to reduce the long hauls and transport costs.

In the same vein one more aspect is considered here on the fulfillment of output targets. The performance of the SCCL in terms of achieving its set targets is found to be quite impressive as shown below:

Extent of Performance by the A.P. Coal Industry[8]

Year	Target (lakh tonnes)	Actual production (lakhs)	Extent of performance (%)
1973-74	57.00	53.12	-6.8
1974-75	60.00	61.79	+2.98
1980-81	115.00	100.97	-13.90
1981-82	115.00	121.03	+5.24
1985-86	160.00	156.55	-2.1
1990-91	225.00	177.09	-21.29
1991-92	205.00	205.83	+0.40
1997-98	310.00	289.41	-6.64

Note: Extent of performance = (Target - Actual Production) ÷ Targets

[8] Robert S Kaplan and David P Norton, "The Balanced Score board - Measures that Drive Performance" **Harvard Business Review**, Jan - Feb 1992, pp 71-79.

It may be noted that the analysis of growth has been considered from three different view points, viz., (i) Growth in physical output, (ii) Relative position in all India coal industry, and (iii) Extent of performance in achieving targets. From all these angles, the A.P. coal industry could achieve impressive success.

It is evident that the industry's performance as judged by its fulfillment of output targets is fairly impressive. In fact, in some years there was over fulfillment of targets. The extent of under fulfillment is not very significant except in 1990-91. One of the underlying reasons for this success story is perhaps its comfortable resource-base and the easy availability of more fertile deposits. It is however difficult to say whether or not the same situation will continue in future if the more fertile deposits are exhausted.

4.2. Sources/Drivers of Growth: The issue is to identify the important factors that are responsible for achieving such an immensely impressive growth. On the basis of several field investigations, primary observations and the discussions with knowledgeable people, the following important sources/drivers of growth have been identified, viz.,

- ➔ Exploration
- ➔ Geographical diversification
- ➔ Technological change/Mechanisation programs
- ➔ Shift to higher capacity-oriented mining systems like the open cast and long wall mining.
- ➔ Increased mine size
- ➔ Organisational development/divisionalisation
- ➔ Training and education programmes
- ➔ Welfare measures.

The above are some of the very important factors or the sources through which the industry could achieve its impressive growth. No single factor works. It has to be a package of measures which need to be judiciously blended. This judicious blend has to be learnt by experience or by trial and error method. Thus, the above factors are all interdependent and that therefore, it is difficult to rank them by their importance and

contribution. Any one single factor can be effective only in combination with others. In isolation, they can not be effective. For instance, the geographical diversification can only be effective through exploration and vice versa.

In one sense, the above factors also reflect the nature of management responses to growth. In other words, the management responded to growth through undertaking the above programmes.[9] In this context, it is to be noted that "growth" is not examined in the cause-consequence framework because of its complex nature. For instance, the increased mine-size is both the cause and consequence of growth. In what follows is a brief explanation of the drivers of growth.

4.3. A Brief Explanation on the Management Responses to Growth: Management responses to growth are reflected, in effect, in the program of actions chosen through a decision-making process. This is essentially the managerial decision function. Due to various reasons, the growth in the general economy was there all around during the period under consideration. Since coal has a derived demand, the management took the responsibility of responding to the growth in the general economy. The unique geographical position of A.P. coal reserves adds to this responsibility. Mere verbal responses do not mean anything and hence, they took a series of actions that triggered the capacity expansion to achieve growth or meet the challenges of the market expansions. This is same as the managing growth through action plans.

An attempt is made here to give a brief explanation on the above identified sources of growth.

a. Exploration:

As a matter of fact, exploration is a precondition for growth. Exploitation centres around exploration. Its function is to discover and bring in the hitherto unknown and new deposits for extraction. It is a geo-technical activity designed to search for new mineral

[9] In fact, this needs a thorough study on the minutes of the Board Meetings and the decision-making processes and styles. This exercise is not undertaken in the present paper.

deposits. If exploration is not there, then the mining enterprises will have to close down their operations altogether due to exhaustion. [10] It gives life to the mining enterprises.

It is necessary to note that depletion is a corollary to extraction because a ton extracted is a ton depleted from the finite (known) stock of reserves under workings. Depletion is an inherent feature of all minerals including coal. Thus , growth entails decay. If extraction continues without the depleted reserves getting replaced/replenished by exploration through the discovery of new deposits/virgin-areas, then the mining enterprise (coal) will have to face the imminent doomsday, or in other words, it tends to cease to exist or even face extinction due to the inevitable danger of facing the total exhaustion of the deposit under workings. Therefore, for making the coal mining sector exist continuously for fairly long periods and save it from facing the doomsday sooner, there must be timely exploration operations with adequate investments to bring in new deposits/virgin areas through new discoveries. Since the main objective of exploration is to replace/replenish the depleted stock, it is to be considered as complementary to extraction or an integral part of extraction. It is essentially a precondition for a sustainable coal mining enterprise and equally so, for a sustainable growth. It is thus a precondition for a sustainable growth. **Thus, exploration is a driving force for a sustainable coal mining sector with a sustainable growth.**

The SCCL realised the role and significance of exploration. Accordingly, it started the Exploration Division some where in the mid-forties initially functioning with a single geologist. Later in the year 1974, the strength was increased to five. Only in the year 1980-81, with an ambitious plan to prove enormous reserves to meet the ever increasing coal targets of the SCCL under successive five year plans, the Exploration Division was expanded to a total strength of 80 executives with a multi-disciplinary approach, viz., geology, drilling, geo-physics, hydrology etc., to conduct systematic and scientific exploration as an integral part of its extraction operations and thereby, it could achieve the impressive sustained growth in coal output by continuously replenishing the

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[10] C Gopinath, "Turnaround : Recognising decline nd Initiating Intervention", **Long Range Planning**, Vol.24, No.6, 1991, pp 96-101.

depleted stocks/deposits. The empirical evidence as given here give ample credence to this proposition.

Table 14 : Trends in Exploration Operations at the SCCL

Year	Meterage drilled (mts.)	Reserves proved (mil.t.)
1973-74	27,904	263
1978-79	31,848	126
1990-91	1,00,895	432
1994-95	98,729	162
1998-99	86,575	251

It is evident that exploration could find its due space in the managerial decision making functions of the SCCL. The meterage drilled is consistently high and the replenishment rate is quite significant in the sense that the rate of extraction (or depletion) is much less than the rate of replacement and thus enhancing the life span of the resource base. There are broadly two implications in this context, viz.,

i. Sustained growth is made feasible through exploration. The onset of the Extraction-cycle[11] is mitigated.

ii. Geographical diversification is made possible and thereby, facilitating the SCCL to achieve those immensely impressive growth rates.

Thus, exploration is the major driving force behind the sustained growth. It is a primary source of growth through which the management is rightly responded. In its absence, the industry will have to face the ordeals of the doomsday. The mining industry generally needs to put exploration before extraction in matters of managerial decision making and thereafter, the response patterns to growth are to be adjusted.

[11] See, N Naganna, "Structural Composition of Costs in Coal Mining Industry : New Perspectives", **The Indian Economic Journal,** Vol 32, No.2, December 1984, pp 104-132.

b. Geographical Diversification:[12]

Besides exploration, the sustained growth has been achieved through geographical diversification. In this context, geographical diversification implies the opening of new coal fields (or extraction facilities) and divisions in different areas far away from each other instead of excessively concentrating and depending on a single coal field. Output growth is made possible through this mode. It may be noted that the coal mining activity is location-specific with no locational choices and thus, it is independent of the transport cost considerations.

As a matter of fact, growth lies in geographical diversification which also implies the subsequent divisionalisation and departmentalisation and thereafter,leading to the problems of organisational design. This is an inherent feature of the mining operations because of : (a) extraction cycle; and (b) age-size relationship[13]. Both (a) and (b) exhibit an inverted tub-shape relation. To overcome the adverse impacts of these cyclical relations, the industry needs to take up the geographical diversification. This implies the creation of extraction facilities in new coal fields because the existing capacities may not cope with the expanding coal markets as also due to depletion. This can only be achieved through exploration. Thus, the underlying forces of growth are both exploration and geographical diversification together.

The pattern of geographical diversification in the SCCL took place in the following sequence.

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[12] See Pradeep N Khandwalla, **"Design of Organisations"**, Harcourt Brace, Newyork, 1977. It has been observed that the consequence of diversification is divisionalisation. In divisionalisation, staff and facilities are grouped under executives responsible for the over all results of the units under their control. Each division is a profit centre. In this form of organisation, the area managers are responsible for the profitable production in their respective regions. In fact, this appears to be the broad pattern of organisational development that is followed by the SCCL. See also, Alfred D Chandler, **"Strategy and Structure"**, (The MIT Press, 1962). The field visits indicate that the SCCL appears to have taken the path of organisational design through geographical diversification. This is perhaps ingrained in the very nature of mining enterprises.

[13] See N Naganna (1984) op.cit. See also, N Naganna, "A Methodology of Materials Planning at the Corporate Level : Case of Coal Mining Industry", **Productivity,** July-September 1981, vol. xxii; No.2, pp 19-40. In this paper, a functional relation has been established between the mine-size and the number of working faces in the mines which, in effect, leads to the age-size relation.

Table 15 : Pattern of Geographical Diversification

Sl.No.	Name of Coal Field[14]	Year of Opening	Output in 1998-99 (ooo tonnes)	Percentage
1	Yellandu	1886	2787	10.2
2	Bellampalli	1928	773	2.8
3	Kothagudem	1937	2436	8.9
4	Manuguru	1975-76	4890	17.9
5	Mandamar	1961	1567	5.7
6	Ramakrishnapuram	1963-64	3535	12.9
7	Ramagundam	1961	10964	40.1
8	Bhoopalpalli	1991-92	374	1.4
	Total	-	**27326**	**100.0**

It is clear that the SCCL undertook geographical diversification into as many as eight coal fields or divisions out of which Ramagundam alone contributes 40.1% to the total SCCL output. Implicit in the sequence of opening the new coal fields is the fact that growth could be achieved through diversification into new areas by installing new extraction facilities. The geographical diversification and the consequent divisionalisation brought a profound change in the structure and culture of the organisation.

c. Mechanisation Programmes:

To achieve growth to meet the expanding coal markets, the SCCL undertook several mechanisation programmes by installing modern extraction machinery and equipments. Mechanisation was introduced both in the underground and opencast mining systems. Needless to say that it increases the mine capacities to extract more coal within a year. Growth lies in mechanisation and technology upgradation. The evidence below on the output from machine-mining sections of the underground mines with bord and pillar method would substantiate the case in point.

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[14] In this context, it may be noted that each coal field is a division with some amount of autonomy in decision-making. Each division is a profit centre by itself with its own staff, workers and executives. All the divisions are controlled and managed by the Head Office located in Kothagudem Coal Field. In a sense, the role of a divisional executive becomes one of a strategist rather than that of a coordination because he has to show the results in terms of output and profits. He is charged with the responsibility of the general run of the division on profitable lines.

Table 16 : Share of Output from Machine-mining Sections (Underground Mining)

Year	Output from M-m sections (in lakh tonnes)	% of total underground output
1973-74	3.71	7.0
1977-78	4.81	5.4
1981-82	6.59	6.0
1984-85	7.96	7.6
1989-90	8.07	6.7
1996-97	14.51	10.6
1997-98	13.96	10.2

Mechanisation achieves not only growth in output but also improves productivity as also reduces unit costs. It is evident from the above table that the extent of mechanisation is increasing in recent years.[15] It is widely known that technology/mechanisation is one of the major determinants of growth. Thus, the management responded to growth through mechanisation programmes.

d. Increased Mine-size:

It is both the cause and consequence of growth. It is in fact a facilitator of growth because small sized mines are not economically viable units to introduce mechanisation. Size is found to be one of the major determinants of the extent of mechanisation. Larger the size, higher will be scope for higher technology and mechanisation and thereby, higher will be the potential for growth. This is the reason why the all-India coal mining industry undertook the amalgamation of small contiguous mines to make them viable for mechansiation.[16]

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[15] See, N Naganna (1980), "Technical Change in India's Coal Mining Industry' in V Vyasulu (Ed.) book "Technological Choice in Indian Environment", Sterling pub., New Delhi, 1980, pp 175-279. See, Coase, R.H. (1937) "The Nature of the Firm", **Economica**, 4, (New Series), November, pp 386-405. It is a classic work to understand the concept of a mine and its operations.

[16] See, N Naganna (1980), op.cit

The over-all mine-size in the SCCL increased significantly in recent times. It is given below:

Table 17 : Trends in Mine-size at the SCCL

Year	Mine-size (lakh tonnes)	Index
1964-65	1.66	=100
1973-74	2.04	122.9
1981-82	2.37	142.8
1988-89	2.82	170.0
1993-94	3.71	223.5
1997-98	4.08	245.8
1998-99	3.96	238.6

The mine-size is more than doubled in 1999 over the base year 1964-65. Increased mine-size acts as a facilitator of growth by providing larger scope for better technology and higher levels of mechanisation.[17]

e. Shift to New Mining Systems:

The SCCL was solely dependent on the conventional "bord and pillar" method till recently. The B & P method is found to be less effective to meet the expanding coal requirements because it has the lowest mine-capacities with longer gestation periods to reach the stabilised state of production when compared with other mining systems.[18] It was effective when the coal markets were small. Now, it ceases to be effective to cope with the ever expanding coal markets. Therefore, the SCCL with its primary objective of

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[17] Besides this factor, the average age of mines has also increased from 9.5 years in 1964-65 to 18.0 years in 1989-90. This could have been contributed by a shift in mining systems and technology. Size induces and facilitates improvements in technology, organisation and performance. Both increased mine size and age have significant implications in terms of conservation and growth. Age has a different meaning in mining sector. On the basis of a critical examination of various drivers of growth like exploration and new additions to resource base, geographical expansion and so on, we are inclined to state that growth contains growth to achieve sustainable growth in the mining sector.
See , Mack Hannan, **Fast Growth strategies** (Mcgraw-Hill Book Company, 1987). See, N Naganna (1984), "Structural Composition of costs in Coal Industry : New Perspectives", **The Indian Economic Journal**, vol.32, October-December 1984, pp 104-132.

[18] For a brief description of different mining systems, see N Naganna (1980), op.cit. See also, Trist E.L. and KW Bamforth, "Some Social and Psychological Consequences of Longwall Method of Coal Mining; **Human Relations**, vol.4, 1952, pp 3-38.

achieving growth and modernisation shifted to those mining systems which have inherently larger mine-capacities and which are amenable for the introduction of better technology and mechanisation. They are long wall methods in underground mining and the surface/open cast mining methods. Both of them proved to be more effective in the context of expanding coal demands. They are also found to be more cost effective with better working conditions and with larger mine capacities as also with higher intensities of mining operations. Their distinguishing feature is that larger output can be extracted from smaller areas. This is called in mining parlance as the concentration-index which is higher in this case than the other mining systems, viz., B & P method. In view of the definite advantages in shifting to new mining methods, the SCCL started its first open cast mine in 1979-80 and the first long-wall face in 1983-84. This is a major source of growth. They are the major drivers of growth. The trends in output from these new mining systems is given below.

Table 18 : Trends in Output and Percentage Shares from the New Mining Methods

Year	Underground mining		Output from Surface Mining (lakh tonnes)	% of S. Mining output to total SCCL output
	Output from Long wall Method (lakh tonnes)	% to total U/G mining output		
1979-80	-	-	2.04	2.2
1983-84	1.33	1.2	17.64	13.9
1985-86	5.75	4.3	24.19	15.5
1989-90	4.64	3.9	57.73	32.4
1993-94	16.11	10.6	100.53	39.9
1996-97	22.93	16.7	150.01	52.2
1997-98	19.20	14.1	153.20	52.9

This is the most important structural change that took place in recent years at the SCCL. The percentage share of coal raisings from the surface mining to total SCCL output has increased substantially to 52.9% in 1997-98 from a low of 2.2% in 1979-80. Similarly, the percentage share of coal raisings from the long-wall faces to the total underground mining output has increased substantially to 19.20% in 1997-98 from a low of 1.33% in 1983-84. Both the mining methods are mechanised. In one sense, the

impressive growth in the A.P. coal industry could be achieved mainly through shifting to these more productive mining systems. This is how the management responded to growth.[19]

f. Organisational Development:[20]

Organisational responses to growth are very crucial in sustaining and maintaining the levels of growth that are attained. In turn, it also facilitates and promotes further growth. Organisations get evolved over time in response to growth and diversification (or divisionalisation) that the industry chooses to adopt. As the levels and rate of growth increase, the administration, coordination and control become increasingly complex. Growth induces the development of appropriate organisational structures to keep pace with the complexities of growth. More than theories, experience and practice play a significant role in this regard. In fact, it is the organisation that receives, absorbs and assimilates growth and thereafter, induces further growth and development. Thus, the organisational responses are very crucial.

It is the set of activities and their magnitudes that determine the organisational structures. As the activities grow, the organisation needs to grow in terms of size, departments, managerial personnel and so on. As the organisation grows to keep pace with the increased levels of activities and diversities, the managerial functions become increasingly complex as also the decision-making styles and the leadership patterns. In some sense, the organisational growth may lead to bureaucratisation, red tapism, primacy of procedures over performance, avoidable delays in decision-making and so on. In one sense, they become counter-productive due to too much expansion. Too much organisation and too little organisation need to be avoided by striking a balance in between the two on the basis of experience and practice.

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[19] The discussion on the environmental issues associated with this shift, is deliberately avoided.

[20] The present empirical investigations by and large tend to confirm the fact that as organisations grow older they learn to do their work more efficiently. This learning gets embodied in their structures particularly in their formalised procedures. The organisational structure, atleast in intent, will be evolved over time to make people more efficient.

The dynamics of organisational growth needs a deeper and more comprehensive study.[21] It is observed that the mining enterprises will have to cope not only with depletion and other formidable life cycle trends but also with the problems of organisational growth.[22] Thus, the mining enterprises are more complex than their counterparts in manufacturing sector.

To keep pace with the complexities of growth, the SCCL opened a number of new departments/divisions in recent years such as the Project Management, Research & Development, Training & Education, Planning & Coordination, Environmental Cell, Information Technology and Computers, and so on. The breakup of manpower at the SCCL would serve as an important parameter of organisation growth. It may be considered as a proxy parameter to organisational responses to growth. It is given below:

Table 19 : Breakup of Manpower at the SCCL

Year	Executives	Monthly rated staff	Daily rated workers	Piece rated workers	Badli fillers	Badli workers	Others	Total
1973-74	40	4299	18176	11451	-	2895	544	37767
1980-81	968	7860	32050	22421	-	-	4732	68031
1988-89	1753	11629	52589	22500	5092	7002	-	100565
1992-93	2213	13409	60224	20873	16827	1494	-	115040
1997-98	2426	13288	62911	27128	5621	775	-	112149

[21] See, the classic works by Larry E Greiner, "Evolution and Revolution as Organisations Grow", **Harvard Business Review**, July - August 1972. See also by the same author, "Revolution as Organisations grow", **Harvard Business Review**, May - June 1998. See also, Chandler (1962) and Pradeep N Khandwala, op.cit.

[22] Peter Benton and Bruce Lloyd, "Riding the Whirldwind : Managing Turbulence "**Long Range Planning**", vol..25, No.2, 1992, pp. 111-118. See also, William H Starbuck, "Why Orgsniations Run into Crises....", Chapter 1. See also, Starbuck WH and Paul C Nystrom (1981), "Designing and Understanding Organisations", in Paul C Nystrom and WH Starbuck (eds.), "**Handbook of Organisational Design**", Oxford University Press, Newyork, Vol.1, pp ix-xxii. These and other cited references in this paper are based mainly on and refers to the manufacturing organisations. However, some useful lessons can be drawn to understand the structure and design of the mining organisations. In the absence of better alternative, we have to rely on this approach of learning from the manufacturing sector.

The above evidence gives some idea about the complexities involved in the development of organisational structures to cope with the challenges of growth. Organisational responses though derived from growth itself, form part of the crucial sources of growth.

g. Training & Education:

It is widely recognised that the human resources development (HRD) is found to be an important source of growth because growth in one sense is not pruely inanimate. It is essentially people centred. It is the people who initiate, carry, improve and maintain growth. Therefore, human resources development assumes greater significance and role particularly when organisation grows in size and operations. This can take place through periodical training and education programmes to the employees. The recent newly emerging concepts like the learning-organisations, knowledge-based workers, organisational creativity, intellectual capital, delayering and empowerment etc. give ample credence to the need for training and education. Management development programmes in fact improve not only the quality of decision-making but also the overall organisational effectiveness. Having realised the importance of training, the SCCL gives a lot of support to the employees to get trained both in India and abroad. This would enable the management to get exposed to the latest developments in management theory and practice by which they can improve their organisational effectiveness.

Table 20 : Extent of executive Training[23]

Year	No. of Executives Trained			Total	Level of executives		
	In-com-pany	India	Foreign		Junior	Middle	Senior
1975-76	-	35	2	37	3	3	31
1978-79	96	51	4	151	49	55	47
1984-85	152	100	20	272	50	102	107
1989-90	727	163	32	922	400	388	134
1994-95	156	101	61	318	219	80	19
1998-99	283	90	2	373	201	159	15

[23] Noal B Zabriskie and Allan B Huellmantel, "Developing Strategic Thinking in Senior Management", **Long Range Planning**. Vol.24, Dec.1991, pp 25-32. See also, Barnard Taylor et.al, "Strategy and Leadership in Growth Companies", **Long Range Planning**, Vol.23, June 1990, pp 66-75.

Since training is expensive, the number of executives sent for training programmes depends on the profitability of the organisaion. The budgetary allocations will be less during the bad years and vice versa. Another noticeable feature is that there is a shift in the level of executives trained - from senior to middle or junior levels. In fact, the senior management needs to be given training inputs in the area of corporate strategy and policy through short duration (2 to 3 days) training programmes.

As the organisation (the SCCL) grew older in age and larger in size, it was realised that there is a dire necessity to improve the organisational effectiveness through imparting managerial inputs by sending their executives to various executive development programmes (EDPs) conducted both in India and abroad. This was also further necessitated by the fact that the organisation becomes increasingly complex due to departmentalisation, diversification and divisionalisation as it grows in age and size (See Table 19). On the basis of its size, age and complexities, we are opined that the present level (See Table 20) of training inputs are extremely inadequate to cope with the increasing organisational complexities.

h. Welfare Measures:

It is difficult to say whether or not the welfare measures (or amenities) constitute a source of growth. Though not directly, the welfare measures may contribute to growth indirectly by improving labour effectiveness, better industrial relations, satisfaction levels etc. Since the coal mining is generally located in forest areas where the civic amenities are conspicuous by their absence, the need for welfare measures is imperative. In recent years, there is a change in the attitudes of management towards labour. Now, labour is treated as more than a mere factor of production. Coal mining is essentially a labour-intensive industry. Therefore, growth depends on labour productivity. In view of this, the SCCL give a lot of importance to welfare measures which include the provision of : housing, hospitals, schools & colleges, roads, recreation, canteens etc. Accordingly, it is incurring significant amounts of expenditures on welfare measures.

Table 21 : Expenditure on Welfare Measures

Year	Expenditure (Rs. Lakhs)	Expenditure per tonne of coal raised	Expenditure per Employee (Rs.)	OMS (Tonne)
1973-74	97	1.82	256	0.62
1979-80	605	6.43	932	0.67
1984-85	1850	15.01	2126	0.70
1989-90	4337	24.35	3901	0.80
1995-96	13814	51.81	12135	1.00
1998-99	19274	70.74	17614	1.07

OMS = Output per man shift, a labour productivity index

The growth in expenditure on welfare measures reflects the changing attitudes of management towards labour. It is difficult to make any judgement on the trends presented in Table 21 because both welfare expenditure and labour productivity are guided by a different set of factors and institutional influences.

Since mining is a hazardous activity with its own specific occupational health hazards, safety, accidents etc., the welfare measures (or the social overheads) covering mainly medical, housing, education, canteens etc., have a different meaning and intent in mining sector. In one sense, they need to be treated as an integral part of the extraction system and its cost structure. Because these social overheads have a direct bearing on labour supply/labour markets, productivity and organisational morale as also they have a legal and institutional angle. This aside, the mineral (coal) resources are normally found in forest areas which are characterised by the conspicuous absence of minimum civic amenities. Hence, the need for laying the social overheads. It seems that there is a correlation between the age of the organisation and the extent of social overheads.[24]

[24] See Naganna (1984) op.cit.

Conclusion:

The primacy of coal over other fuels in the Indian economy is likely to continue for some more years to come mainly because of the fact that the other fuels are associated with more severe problems. The relative fuel resource-endowment is the guiding principle in India's energy policy.

The resource-base of the A.P. coal industry is assessed to be fairly comfortable. The unique geographical position of A.P. coal industry will enable it to retain its present high position in the Southern region. It could achieve immensely impressive growth since its inception in 1886. An ex-post facto analysis of growth was carried out after identifying some drivers/sources of growth. It is found that the management responses to growth were fairly adequate, systematic and timely. Behind this success story lies the comfortable resource base. The future will be constrained largely by the environmental factors.

EPILOGUE

The present paper attempts to bring out some underlying forces relating to the structural responses of management to growth. It deals primarily with the nature and content of management responses to growth. Achieving growth is one thing and sustaining it, is another. Therefore, sustainable growth is one of the most important objectives of an enterprise. In this regard, the coal mining industry in Andhra Pradesh is chosen as a case study since it has a significant place in India's energy policy. At the outset, it may be noted that both mining and manufacturing radically differ from each other in several economic and managerial respects (See Table 11a). However, in the absence of better alternative, it has been relied on the frameworks/approaches developed for the manufacturing organisations to study and understand the intricacies of the mining organisations.

The present study is mainly an expost facto analysis of growth of the coal mining industry in AP which is managed by a public sector company, viz., the Singareni Collieries Company Ltd. The said industry could achieve immensely impressive growth rates from a humble beginning in 1886 with an annual output of ten thousand tons to an astounding level of about 30 million tones a year by 2000. During the same period of 115 years, the resource-base of this industry increased substantially from a meagre 45 million tons estimated in 1886 to about 10,000 million tons by 2000. This could be achieved through extensive exploration work. In point of this fact, it has been observed earlier that **exploration is the underlying force** for achieving the impressive sustainable growth mainly through geographical diversification and mechanisation programmes with concomitant shift to larger-capacity oriented mining systems. In fact, growth necessitates diversification both geographically over different coal bearing areas and into more complex extraction systems. This is specially true in the case of mining sector.

Normally, growth is given exogenously to the enterprise to which the management has to respond to achieve it, on a sustainable basis. Response contains a managerial decision. Thus, response is a managerial decision function. On the basis of our study, the management responses to growth can be summarised in a tabular form as below:

Management Responses to Growth or the Drivers of Growth

Sl.No.	Nature of Response/ Drivers of Growth	Elements
1	Structural Responses	Age composition of mines, mine size, mining systems, technology, per tone energy consumption, geographical diversification.
2	Managerial Responses	Education and training programes, recruitment of professionals, number of managers/executives per 1000 workers.
3	Organisational Responses	Departmentalisation and divisionalisation, organisational design, labour force trends, and man power planning.
4	Performance Responses	OMS, target achievement, financial performance, welfare/social overheads, absenteeism.
5	User Responses	Coal quality, timely deliveries, adequate supplies, acceptable price levels.
6	Resource-base Responses	Exploration and new discoveries, mapping and mine development, conservation prograammes, infrastructure.

Management responses as tabulated above, can also be considered as the drivers or the sources of growth. They are classified under six broad categories. They are all interdependent and mutually inclusive. All these responses can be seen as a complex system in which exploration occupies a central place.

In mining sector, output growth implies essentially geographical dispersion of extraction facilities because larger outputs for fair long periods (or the sustainability) can not be obtained from a single area. Minerals are not concentrated in a single place; and they are spatially distributed over large tracts of mineral-bearing lands. Therefore, growth implies essentially geographical expansion/diversification to create more extraction capacities. **Growth thus entails geographical diversification for which the precondition is exploration.** This is an inherent feature of the mining sector. Thus, mining becomes a shifting activity unlike manufacturing. This inherent nature of the mining sector gives rise to several complex organisational problems to which the managements are to respond. In other words, divisionalisation is an integral part of growth in the mining sector and this gives rise to the creation of complex organisational structures, establishing the linkages between the parent office and the divisional offices, bureaucratization, creation of complex control systems and so on. Thus, growth is essentially a complex process and sustaining it, is more complex.

Geographical diversification implies the establishment of new organisational units in new places with different settings and structures. Therefore, the coal output expansion requires the development of appropriate **organisational designs** to suit to the specific

local conditions and cultures as also appropriate to the profiles of both the existing local labour markets and to the newly emerging work force whose educational levels are reported to be higher than the existing labour force.

In the mining sector, growth entails decay due to depletion. Therefore, the mining enterprise has to constantly cope with the inherent decay while at the same time achieve growth. This is the task. The accomplishment of this task is possible only through continuous exploration operations to replenish the depleted stocks to cope with decay as also to facilitate geographical diversification to achieve growth. Thus, sustainable growth is possible in depleting mineral industries through exploration. In other words, depletion and growth are made compatible through exploration. This is the central concern of the growth management. Rest of the concerns are promotional, facilitative and supportive in their nature and content, except the mechanisation programmes through which alone higher growth is achievable.

Although the present study is based on a single unit, the inferences drawn on the motors of grow have wider implications both in theory and practice. The outcomes of this empirical growth analysis will have significant applied usage in the formulation of corporate strategy and policy for achieving sustainable growth in the mining sector.

The whole exercise as carried out in this study is modeled in a schematic flow chart as below. At the back of this exercise lies both the national and international energy policies and that therefore, the outcomes have particular applied usage in energy policy and planning in relation to oil and coal resources. It has been carried out with a belief that the outcomes of the study of history is one of the major guiding principles for planning of the inherently unknowable future.

A Schematic Presentation of Managing Growth in the Mining Sector