Financial Performance Appraisal of a Steel Plant: A SD Model

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Abstract

Proper analysis of the financial statements of any company is necessary to assess the financial health of the company, as it provides valuable insights into its financial performance. The principal tool of financial analysis is the financial ratio analysis. Financial ratios reflect company's ability to raise external financing and the cost of external financing. In the present work detailed System Dynamics (SD) modeling and analysis of the financial performance of a local integrated steel plant is undertaken. The key financial ratios taken up for simulation and analysis are (i) Liquidity ratios (ii) Turnover ratios and (iii) Profitability ratios over a period of 20 years from 1994. SD model has been successfully applied to portray the dynamic behaviour of the financial system of the plant.

Keywords: Financial Performance, Leverage Ratio, Leverage ratios, Liquidity ratios, Turnover ratios, Profitability ratios, System Dynamics, Steel Plants, India.

INTRODUCTION

In the fast changing economic scenario world over, the management of any company has to play a dynamic role in managing its finances. To make rational decisions in tune with the objectives of the firm, the management must analyze (i) the fund needs (ii) the financial status and profitability and (iii) the business risk of the company (Van Horne 2000). In view of the economic policies in vogue, it has become imperative for the company under study to become self-reliant and generate resources on its own and facilitate modernization and expansion.

As there is an increasing competition from other global players, the management has to initiate appropriate steps to lower the cost of production and generation of additional revenues through cost competitiveness. For this purpose, certain production areas have been identified for cost reduction. The management can aim at increasing the profit through the following methods:

- Optimization of the product mix with a view to enhance the sales revenue and thus, the profitability of the company
- Conversion of semi- finished products into value added products
- Increased production of value added steels
- Continuous reduction of inventory levels of spares and raw materials at the rate of atleast 5% per annum
- Implementation of expansion plans as per the fixed schedule with an eye on capturing the expanding market

In the light of the above, proper analysis of the financial statements of the company is necessary to assess the financial health of the company, as it provides valuable insights into its financial performance. The principal tool of financial analysis is the financial ratio analysis. Financial ratios reflect company's ability to raise external financing and the cost of external financing. They are also useful for the company to monitor the financial performance and take corrective action with a view to improve the same. Keeping this point in view, a detailed SD modelling and analysis of the financial performance of the company is undertaken. The financial ratios considered for simulation and analysis are (i) Leverage ratios (ii) Liquidity ratios (iii) Turnover ratios, and (iv) Profitability ratios over a period of 20 years from 1994. The results are validated. Further, the model is utilized to explore alternative policies which have been compared for their relative effectiveness.

1. BACKGROUND

The Company under consideration was setup at a project cost of Rs.85950 millions including the estimated cost of Rs.660 millions in Captive Mines. Burdened with high capital related charges, the company sought for restructuring of its capital base and the same was approved by the Government of India (GOI), which provided for the conversion of part of the loans made available by it into equity and balance into preferential shares in two stages.

Because of the problems already mentioned, at one stage the company was under the potential threat of being declared as a sick industry and was being referred to Board for Industrial Restructure, GOI. However, dramatically it could overcome these difficulties because of outstanding production performance coupled with a sudden spurt in demand for steel from the year 2000 onwards resulting in steep hike in prices of steel products. Thus it started earning net profits from the year 2002-03 onwards. At the same time, it was able to bring down the interest burden from a peak level of Rs. 43 millions in 1996-97 to around Rs. 5.1 millions during the year 2003-04. Simultaneously, it became a debt free company in the same year and became financially self-sustained company. At this stage, the company carried out SWOT analysis and realized the importance of capacity addition for sustained growth.

2. DETAILED DESCRIPTION OF THE MODEL

Fig.1 presents the causal loop diagram for the financial sub-sector and shows the causal-relationships among various financial parameters. The flow diagram is developed using causal relations. The flow diagram presented in Figs.2 (a) and 2(b) has been discussed with the executives of the Steel Plant and it is found that the sequential steps in the diagrams are in line with the practices in the steel plant under study.

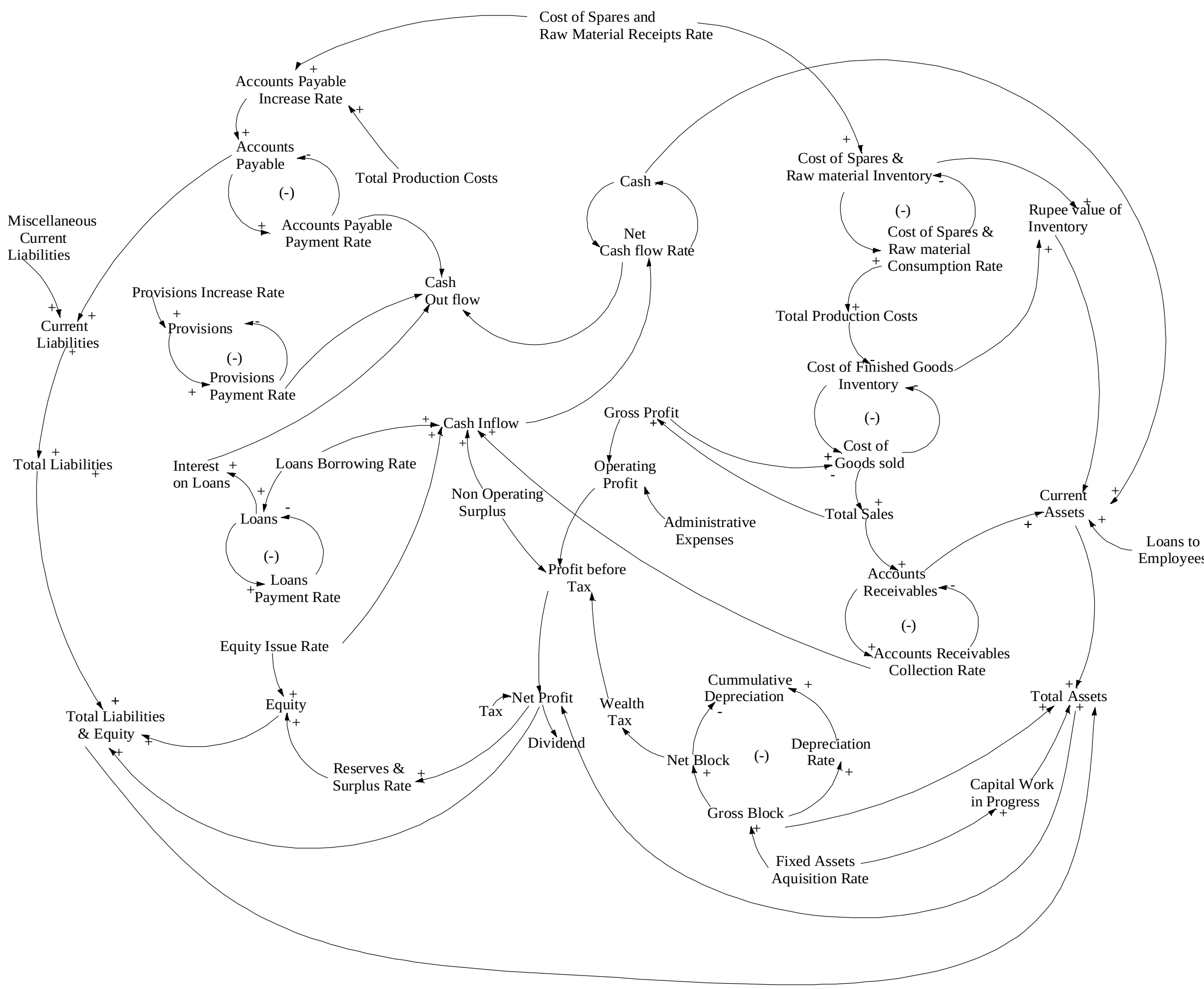

Fig.1 Causal loop diagram of the Financial Model

The financial information helps in predicting, comparing and evaluating the earning ability of the company. It also helps in economic decision making- investment and financial decisions. Any company provides financial information through financial statements and reports.

Two basic financial statements prepared for providing information to its owners, investors and creditors are: (i) balance sheet, which reflects the financial status of the company at a given point of time and (ii) income statement or profit and loss account. Balance sheet provides information about assets, liabilities and owner's equity as on a specified date. The earning capacity or potential of the company is reflected in the profit and loss account.

The contents of the balance sheet can be broadly classified into two categories- namely assets and liabilities. Assets are valuable possessions of the company and can be categorized as current assets, fixed assets and other assets. Current assets are liquid assets which include cash, inventories, accounts receivables, prepaid expenses, accrued income and loan advances. Fixed assets can be classified as tangible and intangible. Land, buildings, equipment and machinery are considered to be tangible where as patents, copyrights are considered as intangible assets. The sum of current assets and fixed assets is called total assets. Besides, investments in other companies are called other assets.

Liabilities consist of current liabilities, permanent liabilities, equity, debts payable in future, borrowings from banks, interest, taxes, bonds, debentures etc. Current liabilities are debts that are received to be paid within an accounting period. They are accounts payable to suppliers, bills to be paid on a specified date, bank borrowings- both long term and short term, provisions for payment of dividend, tax etc., expenses payable like wages and salaries, rent, commissions etc. Equity consists of paid- up share capital, owners claim against business entity and reserves and surplus.

The equations of the SD modeling of the financial sub-sector are described in this section and serve as the base model for portraying the financial performance of the organization. Though equity is static for some time, it has been taken as a level variable as it would be subjected to the changes in the money market. Accounts payable, accounts receivable, cash, cumulative gross block, cumulative depreciation, excise duty, inventory of spares, raw materials and finished goods, various loans and provisions are also considered as level variables as they have the accumulating behaviour over a period of time.

1. a) Accounts payable (ACCPAY) is the amount to be paid for procuring spare parts and raw materials, for paying salaries and wages, expenditure incurred for power and fuel and also for repairs and maintenance. It is defined as a level variable and is expressed as:

$$ACCPAY = ACCPAY + DT * (ACPICR - ACPAPR)$$

where ACPICR = Accounts payable increase rate

ACPAPR = Accounts payable payment rate

b) Accounts payable increase rate (ACPICR) is defined as a rate equation and is given by the sum of Direct labour cost (DIRLBC), Power and fuel expenditure (POWRFE), Repair and maintenance expenditure (REPMAE), Average cost of spare parts arrival rate (ACSPAR) and Average cost of raw material arrival rate (ACRMAR) multiplied by Accounts payable increase rate factor (ACPICF), a constant. It is given by the following equation.

ACPICR= (DIRLBC+ POWRFE+ REPMAE+ ACSPAR+ ACRMAR)*ACPICF

c) Accounts payable payment rate (ACPAPR) is obtained from the following Call Delay function.

CALL DELAY (ACPICI, ACPICR, AP1, AP2, ACPAPR, TACPAR)

where ACPICI = Accounts payable payment rate, initial AP1 and AP2 are constants

TACPAR= Time to adjust accounts payable payment rate

2 a) Provisions (PROVSN) is the amount set aside by the company for the unsettled claims which are due to be paid during the relevant financial year. It is the amount earmarked to pay provident fund, gratuity and other benefits when an employee retires. It is defined as a level variable and is given below:

PROVSN = PROVSN + DT *(PROVIR – PROVPR)

where PROVIR = Provisions increase rate

PROVPR = Provisions payment rate

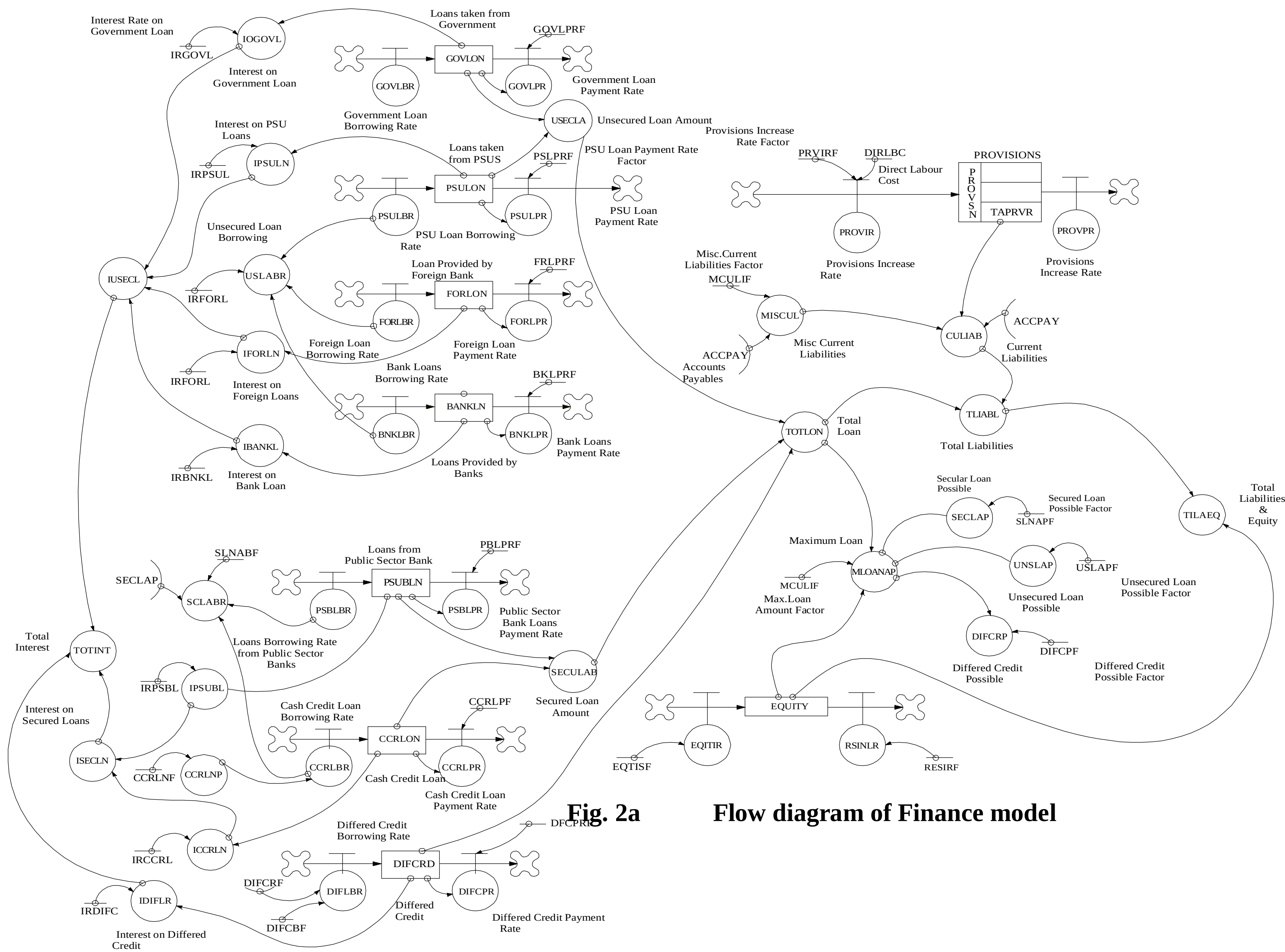

Fig. 2a Flow diagram of Finance model

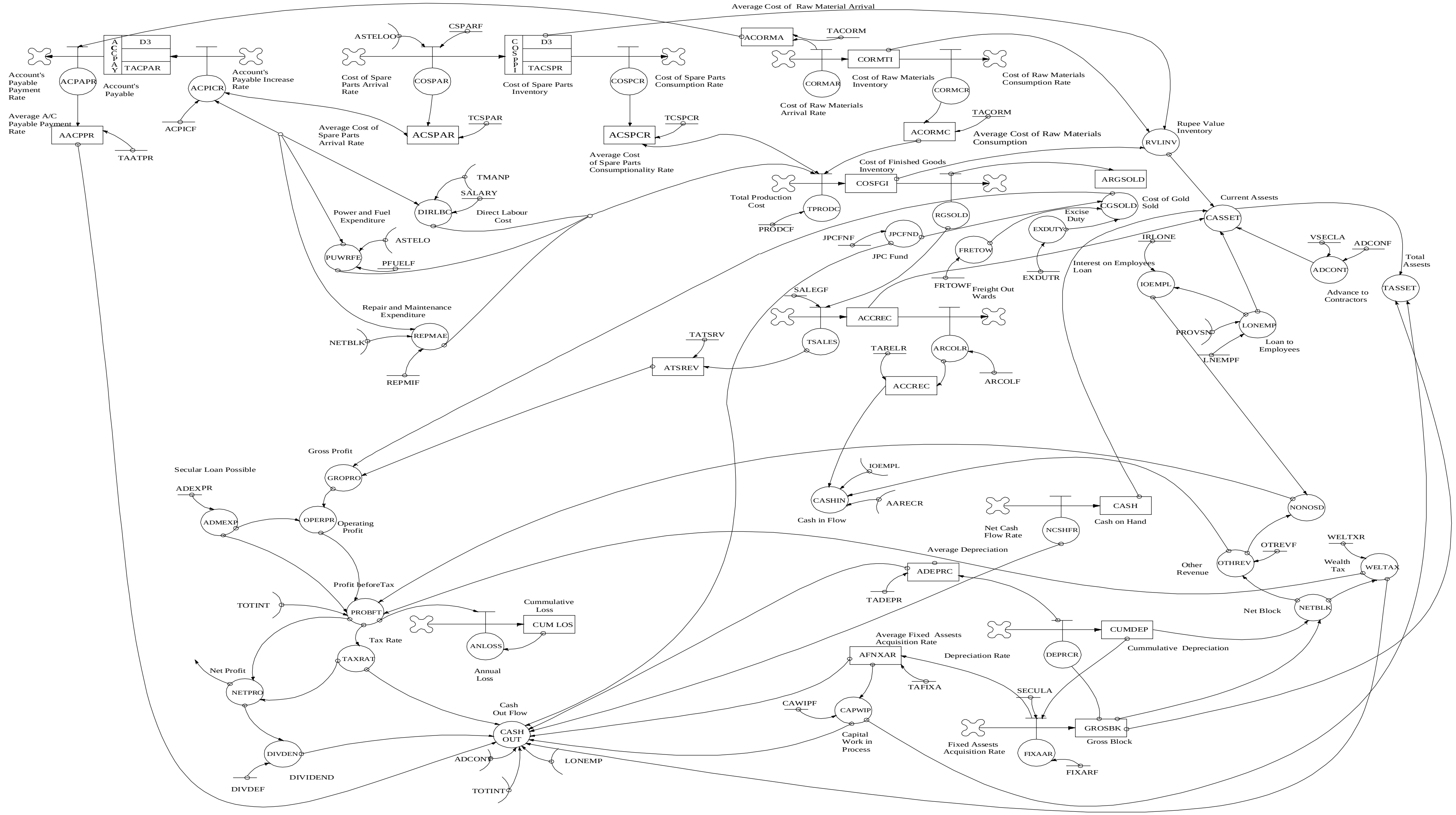

Fig. 2b Flow diagram of Finance model (continued)

b) Provisions increase rate (PROVIR) is defined as a rate variable and is given by the product of direct labour cost (DIRLBC) and provisions increase rate factor (PRVIRF) and is given below:

PROVIR = DIRLBC * PRVIRF

c) Provisions payment rate (PROVPR) is defined as a rate variable and is given by the product of Provisions (PROVSN) and Provisions payment rate factor (PRVPRF) and is given below:

PROVPR = PROVSN * PRVPRF

3) Any company borrows funds from various funding agencies to carryout its business activities and this company is not an exception to it. In the present case, the company has borrowed funds from various sources like Government of India, Public Sector Undertakings, foreign banks as well as domestic banks. The interest rates on these loans vary from one funding agency to the other. The loans that are borrowed by the company are categorised as (i) secured loans and (ii) unsecured loans. Funds raised through secured loans are utilized to meet capital expenditure like procuring capital equipment, construction of factory buildings and procurement of lands where as unsecured loans are utilized to meet day to day requirements.

a) The loan provided by the Government (GOVLON) is modelled as a level variable and is given below:

GOVLON = GOVLON + DT*(GOVLBR – GOVLPR)

where GOVLBR = Government loan borrowing rate

GOVLPR = Government loan payment rate

b) The Government has provided loans only twice during the period of base run and therefore, the equation for Government of India Loan borrowing is defined as given below:

IF (TIME. EQ. 1994. 0) GOVLBR=GOVLNI-GOVLON

IF (TIME. EQ. 1995. 0) GOVLBR=130000-GOVLNI

where GOVLNI=Government of India loan, initial

c) Government of India loan payment rate (GOVLPR) is defined as a rate variable and is given by the product of government loan (GOVLON) and Government loan payment rate factor (GOLPRF), a constant. It is given below:

GOVLPR=GOVLON*GOLPRF

4 a) Loans borrowed from public sectors undertakings (PSULON) are modeled as a level equation.

PSULON = PSULON + DT*(PSULBR – PSULPR)

where PSULON = PSU loan

PSULBR = PSU loan borrowing rate

PSULPR = PSU loan payment rate

b) Both PSU loan (PSULBR) borrowing rate and payment rate (PSULPR)are modeled as rate equations.

PSULBR = PSUBRI

where PSUBRI = PSU loan borrowed rate, initial

PSULPR = PSULON * PSLPRF

where PSULON = PSU loan

PSLPRF = PSU loan payment rate factor, a constant

Similarly the loans borrowed from foreign banks (FORLON), loans provided by domestic banks (BANKLN), Public sector bank loan (PSUBLN), Cash credit loan (CCRLON), Foreign bank loans (FRGNLN), Differed credit (DIFCRD) are modeled as level equations. And their borrowing rates and payments rates are also defined as rate equations and are similar to the rate variables explained above.

5 a) The financial interests of owners are called equity which reflects the excess of the company's assets over liabilities. Equity (EQUITY) is modeled as a level equation and is given below:

EQUITY = EQUITY + DT*(EQITIR + RSINCR)

where EQITIR = Equity issue rate

RSINCR = Reserves and surplus increase rate

b) Equity issue rate (EQITIR) is defined as rate equation and is given by the product of Equity (EQUITY) and Equity issue rate factor (EQTISF), a constant and is given below:

EQITIR = EQUITY * EQTISF

Certain percentage of Net Profit is set aside as Reserves and surplus. In the present case, Reserves and surplus increase rate (RSINCR) is defined as a rate variable and is given by the product of Net Profit (NETPRO) and Reserves and surplus increase rate factor (RESIRF), a constant and is given below:

RSINCR = NETPRO * RESIRF

6 a) Cumulative depreciation (CUMDEP) or accumulated depreciation is defined as a level variable and is given below:

CUMDEP = CUMDEP + DT*DEPRCR

where DEPRCR = Annual Depreciation rate

b) Annual Depreciation rate (DEPRCR) is expressed as the product of gross block and depreciation rate factor, a constant and is given below:

DEPRCR = GROSBK * DEPRCF

where DEPRCF = Depreciation rate factor, a constant

7. a) Cost of spare parts inventory (COSPPI) is defined as a level variable and is given below:

COSPPI = COSPPI + DT*(COSPAR – COSPCR)

where COSPAR = Cost of spare parts arrival rate

COSPCR = Cost of spare parts consumption rate

b) Cost of spare parts arrival rate (COSPAR) is modeled as the product of Average liquid steel produced (ASTELO) and cost of spare parts arrival rate factor (CSPARF), a constant and is given below:

COSPAR = ASTELO * CSPARF

c) Cost of spare parts consumption rate (COSPCR) is obtained from the following Call Delay function.

CALL DELAY (COSPRI, COSPAR, SP1, SP2, COSPCR, TACSPR)

where COSPRI = Cost of spare parts consumption rate, initial

SP1, SP2 = delay constants

TACSPR = Time to adjust cost of spare parts consumption rate, a constant

8 a) Cost of raw material inventory (CORMTI) is defined as a level equation and is given below:

CORMTI = CORMTI + DT*(CORMAR – CORMCR)

where CORMAR = Cost of raw material arrival rate

CORMCR = Cost of raw material consumption rate

b) Cost of each raw material received is defined as a product of quantity of raw material received and the unit cost of each raw material. For the purpose of eastimating, the cost of each raw material received is assumed to be a rate variable in this sectoral analysis. Cost of raw material arrival rate (CORMAR) is given by sum of cost of various raw materials received multiplied by Cost of raw material arrival rate factor (CRMARF), a constant. It is defined as a rate variable and is given below:

CORMAR= (CCOLOR + CMNFAR + CIFNAR + CSQFAR + CBFDAR + CIRNAR + CBFLAR + CQRZAR + CMNGAR + CSLSAR + CSDLAR + CFALAR) * CRMARF

c) Cost of each raw material consumed is also estimated by multiplying quantity of raw material consumed with unit cost of each raw material Thus the Cost of raw material consumption rate (CORMCR) is given by sum of cost of various raw materials consumed during production and is defined as rate variable. It is given by the following equation.

CORMCR = COLCR + CIRBFR + CLSBFR + CLSBMR + CMNFBR + CIFBMR + CSQFBR + CDOLBR + CQRTBR + CMGOBR + CSLSCR + CFALCR + CSDLCR

9 a) Cost of finished goods inventory (COSFGI) is defined as a level variable and is given below:

COSFGI=COSFGI+DT*(TPRODC-RGSOLD)

where TPRODC= Total Production costs

RGSOLD= Rate of goods sold

b) Total production costs (TPRODC) is defined as a rate variable and is given by the sum of costs of spare parts consumed, direct labour costs, repair and maintenance costs, power and fuel costs, and sum of cost of various raw materials consumed multiplied by the production costs factor (PRODCF), a constant. The relevant equation is given below:

TPRODC = (ACSPCR + DIRLBC + REPMAE + POWRFE + CCOLCR + CIRBFR + CLSBFR + CLSBMR + CMNFBR + CIFBMR + CSQFBR + CDOLBR + CQRTBR + CMGOBR + CSLSCR + CFALCR + CSDLCR)*PRODCF

c) Rate of goods sold (RGSOLD) is defined as a rate variable and is given below:

RGSOLD=COFGI/RSOLDF

where RSOLDF=Rate of goods sold factor, a constant

10 a) Accounts receivables (ACCREC) is the amount due to the company from the debtors and is modeled as a level variable.

ACCREC = ACCREC + DT*(TSALES – ARCOLR)

where TSALES = Total sales revenue

ARCOLR = A/c receivables collection rate

b) Total sales revenue (TSALES) is given by the sum of sales of semi-finished and finished products like Granulated Slag, Pig castings, Prime Blooms, MMSM Products, Billets, LMMM products and Wire rod mill products multiplied by Sales growth factor (SALEGF), a constant. It is defined as a rate equation and is given below:

TSALES = (SLAGS + CPIGCS + CBLOMS + CMMMPS + CBILTS + CLMMPS + CWIRDS)*SALEGF

c) Accounts receivable collection rate (ARCOLR) is defined as a rate variable and is given by the product of Accounts receivable and Accounts receivable collection rate factor (ARCOLF), a constant and is given below:

ARCOLR=ACCREC*ARCOLF

11 a) Gross Block (GROSBK) is the book value of fixed assets and is defined as a level variable. Its value depends upon the acquisition of fixed assets. It is expressed as:

GROSBK=GROSBK+DT*FIXAAR

where FIXAAR= Fixed assets acquisition rate

b) Fixed assets acquisition rate (FIXAAR) is defined as a rate variable and is given by the following equation.

FIXAAR=SECULA*FIXARF

where SECULA=Secured loan available

FIXARF= Fixed assets acquisition rate factor, a constant

c) Secured loan aamount (SECULA) is taken as the sum of the loans taken from Public sector under takings (PSUBLN) and under cash credit loan (CCRLON) and is given by the following equation.

SECULA=PSUBLN+CCRLON

d) Average depreciation (ADEPRC) is given by the following Smoothed equation.

ADEPRC=SMOOTH (DEPRCR, ADEPRC, TADEPR)

where DEPRCR=Depreciation rate, a rate variable

TADEPR= Time to average depreciation rate, a constant

e) Depreciation rate (DEPRCR) is defined as a rate variable and is given by the following equation. It is expressed as product of Gross Block (GROSBK) and depreciation rate factor (DEPRCF), a constant.

DEPRCR=GROSBK*DEPRCF

12 a) Cash on hand (CASH) is defined as a level variable and is given by the following equation.

CASH = CASH + DT * NCASHF

where NCASHF = Net cash flow

b) Net cash flow (NCASHF) is the difference between the cash in flow from various sources (CASHIN) and cash out flow in the form of various expenses (CASHOT) and is defined as a rate variable. It is given by the following equation.

NCASHF = CASHIN – CASHOT

where CASHIN = Cash in flow

CASHOT = Cash out flow

c) Cash in flow (CASHIN) is the sum of amount is received from various sources such as interest on loans given to employees, revenue from other sources like rents on buildings, by selling of scrap etc., loans borrowed from different sources, funds raised through equity issue, accounts receivables and other revenue. It is defined as an auxiliary equation and is given by the following equation.

CASHIN = IOEMPL + OTHREV + AGOVLB + APSULB + AFORLB + ABNKLB + APSBLB + ACCRLB + ADIFCB + EQITIR + AARECR

d) Cash outflow (CASHOT) is the sum of amount paid towards repayment of loans and interest on loans, production costs, advances to contractors, loans to employees, capital work in progress, for procuring fixed assets, cost of depreciation, wealth tax and joint plant committee fund. It is defined as an auxiliary equation and is given below:

CASHOT = AACPPR + AGOVLP + APSULP + AFORLP + ABNKLP + APSBLP + ACCRLP + TOTINT + ADIFCP + ADCONT + LONEMP + CAPWIP + AFIXAR + ADEPRC + WELTAX + JPCFND + DIVDEN

13 a) Cumulative loss incurred (CUMLOS) by the company is modeled as a level variable and is given by the following equation.

CUMLOS=CUMLOS+DT*ANLOSS

b) Annual loss (ANLOSS) is defined as a rate variable and is given by the following equation.

ANLOSS= (-) PROFBT

If the Profit before tax is zero or negative during the financial year under consideration, then it is taken as Annual loss.

14) Average Accounts payable payment rate (AACPPR) is defined as a smoothe equation and is given below:

AACPPR = SMOOTH (ACPAPR, AACPPR, TAAPPR)

where ACPAPR = A/c payable payment rate

AACPPR = Average A/c payable payment rate

TAAPPR = Time to average A/c payable payment rate

15) Average cost of spare parts consumption rate (ACSPCR) is defined as a smoothed equation and is given below:

ACSPCR = SMOOTH (COSPCR, ACSPCR, TCSPCR)

where COSPCR = Cost of spare parts consumption rate

ACSPCR = Average cost of spare parts consumption rate

TCSPCR = Time to average cost of spare parts consumption rate

16) Average Accounts receivables collection rate (AARECR) is defined as a smoothed eqution and is given below

AARECR = SMOOTH (ARCOLR, AARECR, TARECR)

where ARCOLR = A/c receivables collection rate

AARECR = Average rate of A/c receivables collection rate

TARECR = Time to average A/c receivables collection rate

17) Average total sales revenue (ATSREV) is defined as a smoothed equation and is given by the following equation.

ATSREV = SMOOTH (TSREVN, ATSREV, TATSRV)

where TSREVN = Total sales revenue

ATSREV = Average total sales revenue

TATSRV = Time to average total sales revenue

18) Average depreciation (AVEDEP) is defined as a smooth equation and is given by the following equation

AVEDEP = SMOOTH (DEPREC, AVEDEP, TADEPR)

where DEPREC = Depreciation

AVEDEP = Average depreciation

TADEPR = Time to average depreciation

19) In any company, there is a limitation for borrowing funds from different lending agencies. In the present case, maximum loan amount (MLOANA) that can be taken is limited to 60% of the equity and is defined as an auxiliary equation. It is obtained from the product of equity and maximum loan factor, a constant and is given below:

MLOANA = EQUITY * MLOANF

where EQUITY = Equity

MLOANF = Maximum loan amount factor, a constant

20) Total outstanding loan (TOTLON) is the sum of secured loan, unsecured loan and differed credit and is defined as an auxiliary equation. It is given below:

TOTLON = USECLA + SECULA + DIFCRD

21) Current liabilities (CULIAB) is given by the sum of provisions, accounts payable and miscellaneous current liabilities. It is defined as auxiliary equation and is given below:

CULIAB = PROVSN + ACCPAY + MISCUL

22) The sum of current liabilities and total loan outstanding gives Total liabilities (TLIABL). It is defined as an auxiliary equation and is given below:

TLIABL = CULIAB + TOTLON

23) Total liabilities and equity (TOLNEQ) is the sum of total liabilities and equity and is defined as an auxiliary variable. It is given by the following equation.

TOLNEQ = TLIABL + EQUITY

24) Interest on Government loan (IOGOVL) is given by the product of government loan and interest rate on government loan and is defined as an auxiliary equation. It is given below:

IOGOVL = IRGOVL * GOVLON

where IRGOVL = Interest rate on Government loan, a constant

Interest on PSU loan (IPSULN), interest on foreign bank loan (IFORLN), interest on domestic bank loan (IBANKL), total interest on unsecured loan (IUSECL), interest on PSU bank loan (IPSUBL), interest on cash credit loan (ICCRLN), interest on foreign bank loan (IFRGBL), interest on differed credit (IDIFCR) are defined as auxiliary equations:

25) Total interest (TOTINT) on the loan amount outstanding is given by the sum of interest on secured loans (ISECLN), interest on unsered loans (ISECLN) and interest on differed credit (IDIFCR). It is defined as an auxulliaty equation and relevant equation is given below:

TOTINT = IUSECL + ISECLN + IDIFCR

26) Rupee value of inventory (RVLINV) is the sum of costs of finished goods inventory, spare parts inventory and raw material inventory. It is defined as an auxiliary variable and is given by the following equation.

RVLINV = COSFGI + COSPPI + COSRMI

25) Total assets (TASSET) are given by the sum of current assets (CASSET), capital work in progress (CAPWIP) and gross block (GROSBK). It is defined as an auxilliary variable and is given by the following equation.

TASSET = CASSET + CAPWIP + GROSBK

Gross profit (GROPRO) is defined as an auxiliary equation and is given by the difference between Average Total sales revenue (ATSREV) and Average cost of goods sold (ACGSLD) and is given below:

Gross profit is given by the difference between average total sales and average cost of goods sold. It is defined as an auxilliaty equation and is given below:

GROPRO = ATSREV – ACGSLD

29) Operating profit (OPERPR) is defined as an auxiliary equation and is given by the difference between gross profit and operating expenditure. It is given below:

OPERPR = GROPRO – (ADEPRC+ADMEXP)

30) Profit before tax is given by the sum of operating profit and non-operating surplus/deficit. and defined as an auxiliary equation as given below:

PROFBT = OPERPR + NONOSD

31) Tax has to be calculated as a percentage on the profit obtained and is given by the auxillary equation.

TAX = PROFBT * TAXRAT

where TAXRAT = Tax rate, a constant

32) Net profit (NETPRO) is the profit remaining after payment of tax. It is defined as an auxiliary equation and is given below:

NETPRO = PROFBT – TAX

33) Dividend (DIVDEN) has to be paid to the shareholders from the net profit earned. It is defined as an auxiliary equation and is given below:

DIVDEN = NETPRO *DIVDEF

where DIVDEF = Dividend fraction, a constant

34) Net block (NETBLK) is the difference between gross block and depreciation. It is defined as an auxiliary variable and is given below:

NETBLK = GROSBK – CUMDEP

2.1 FINANCIAL RATIOS

Financial Ratio analysis helps in assessing the financial performance of the company and thus throws light on the financial health of it. The various ratios that are used for financial analysis in the present study can be grouped into:

(i) Liquidity ratios

(ii) Leverage ratios

(iii) Activity ratios/ Turnover ratios and

(iv) Profitability ratios.

Liquidity ratios measure the ability of the company to meet its current obligations. It provides a quick measure of liquidity. Leverage ratios are useful to judge the long term financial position of the company. Activity ratios or Turnover ratios are used to evaluate the efficiency with which the company manages and utilizes its assets. Profitability ratios help in assessing the operating efficiency of the company. In the present study the following ratios are included in the model.

1. Current ratio (CR) is one of the Liquidity ratios and is defined as the ratio between current assets and current liabilities and is given below:

   CR = CASSET/CULIAB

2. Inventory turnover ratio (ITOR) is one of the Activity ratios and is defined as the ratio between average total sales revenue and rupee value of inventory and is given below:

   ITOR = ACGSLD/RVLINV

3. Fixed assets turnover ratio (FATR) or Net assets turnover ratio is the ratio between total sales revenue and net block and is expressed as:

   FATR=ATSREV/NETBLK

4. Gross profit margin ratio (GPMR) is the ratio between gross profit and sum of average total sales revenue and non-operating surplus/deficit and is given below:

   GPMR = GROPRO/ (ATSREV + NONOSD)

5. Return on investment (ROI) is one of the Profitability ratios and is defined as the ratio between profit before tax and sum of net block and current assets and is:

   ROI = OPERPR/TASSET

2.2 COMPUTER SIMULATION OF THE MODEL

This model consists of a total of 236 equations having 18 level equations, 30 rate equations, 4 third order call delay functions, 128 auxilliary variables and 56 smooth functions. The model is simulated for a period of 20 years from 1994 using DYMOSIM Software package. Simulation is carried out with the assumption that the problem description would remain valid for this period. All together six policies are tested and the results are verified with the available published data.

2.3 VALIDATION OF THE MODEL

The model is calibrated and validated at every stage of its development. As suggested by Forrester (1968), Coyle (1977), Forrester and Senge (1980), Mohapatra et al (1994), validation has been treated as a continuous process.

In this financial sector, the following parameters have been chosen for model validation. (1) Current Assets (2) Current Liabilities (3) Total assets (4) Cost of Goods sold (5) Total sales revenue (6) Rupee value of inventory (7) Gross profit and (8) Net block.

The values of the parameters generated by the SD model are compared with the actual plant data over a period of 10 years from 1994-2003 and are presented in Figs. 3 to 10. From these graphs, it can be concluded that these selected variables of the model almost replicate the behaviour of the actual values thus enhancing the confidence in the model. Thus the SD model adopted in the study adequately represents the dynamic behaviour of the company in as much as the results of the model and actual plant data are in good agreement

2.4 TESTS OF MODEL STRUCTURE

i) Structure verification test:

The structure of the model was thoroughly validated such that it clearly resembles the structure of the real life system. The physical flows of the important level variablessuch as equity, accounts payable, accounts receivabes, cash, gross block, cumulative depreciation, loans, provisions, cumulative loss, inventory of spares, raw materials and finished products are considered in this model. Both the causal loop and flow diagrams consist of variables which can be easily identified in the real life system and they are also consistent with the real life system.

ii) Parameter verification test:

All the parameters considered in the model are present in the real life system both conceptually and numerically. All these parameters can be identified easily in the real life system and they are consistent with the real life system.

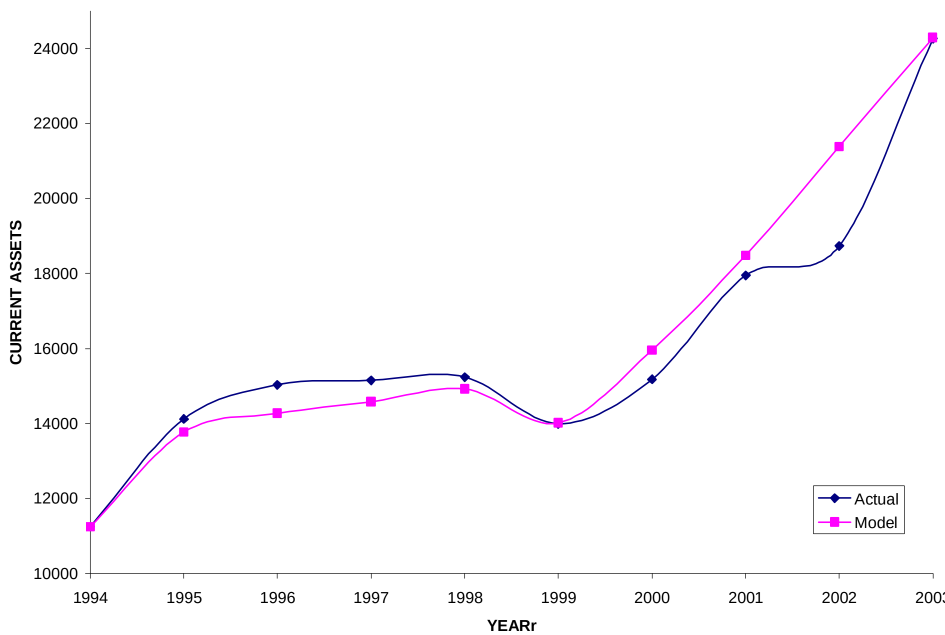

Fig. 3 Current Assets- Base run

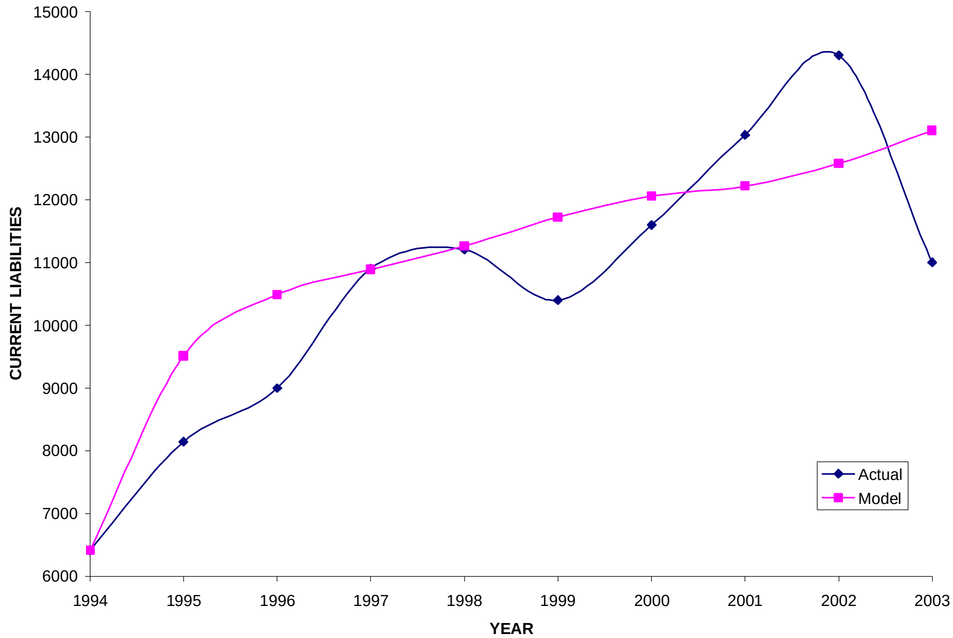

Fig. 4 Current liabilities- Base run

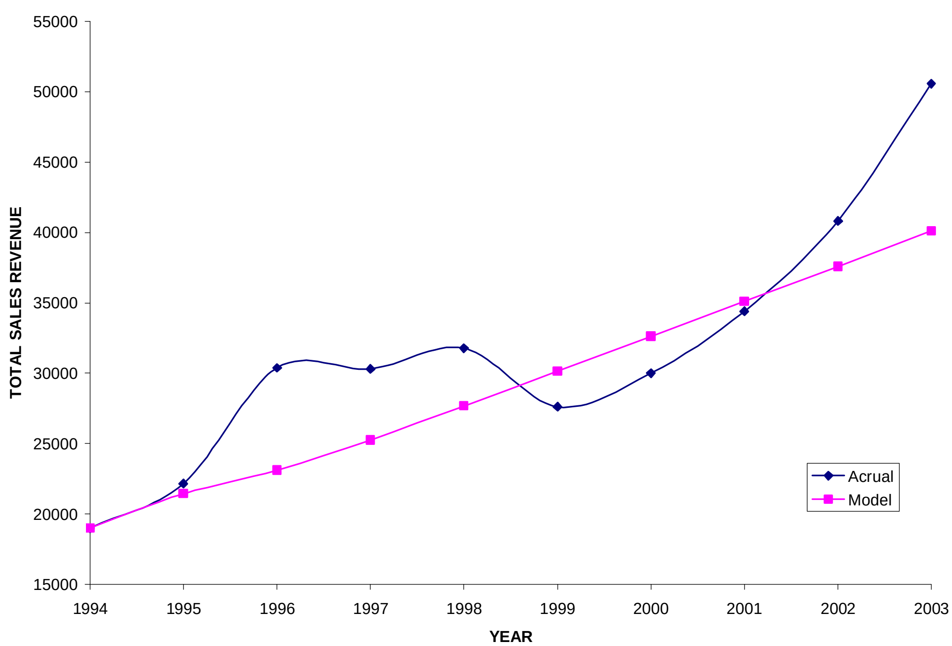

Fig. 5 Total sales revenue- Base run

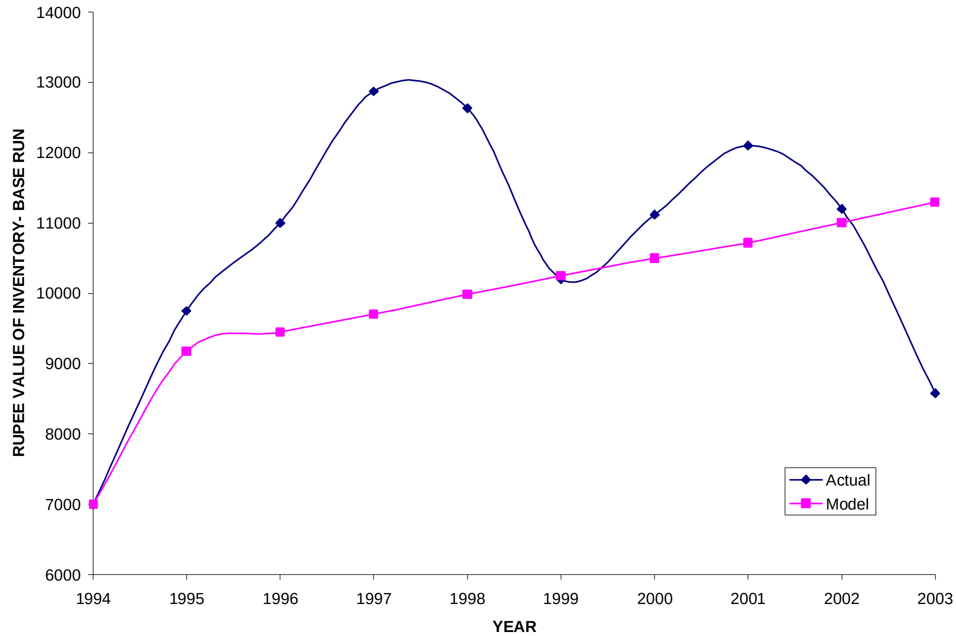

Fig. 6 Rupee value of inventory- Base run

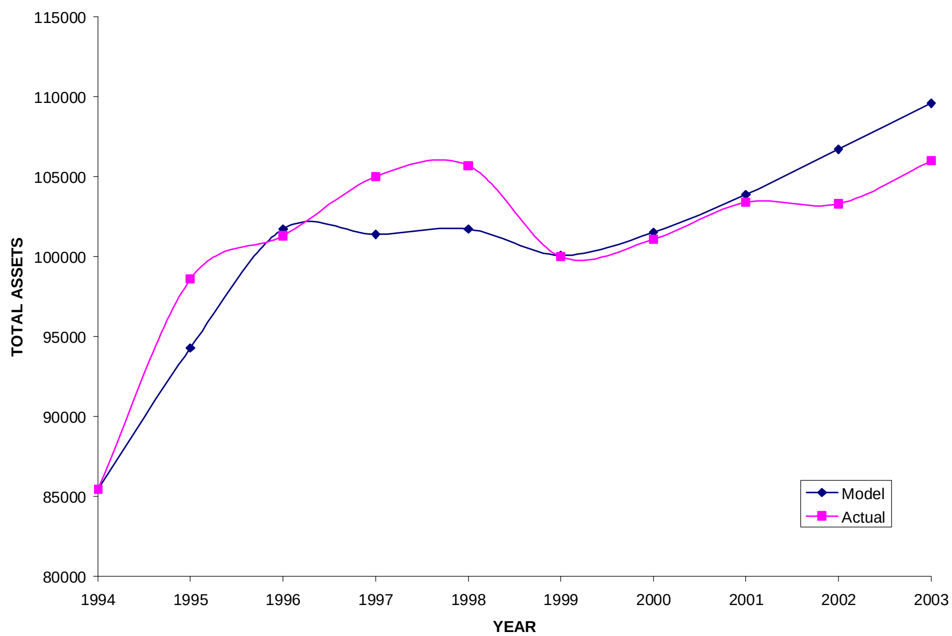

Fig. 7 Total Assets- Base run

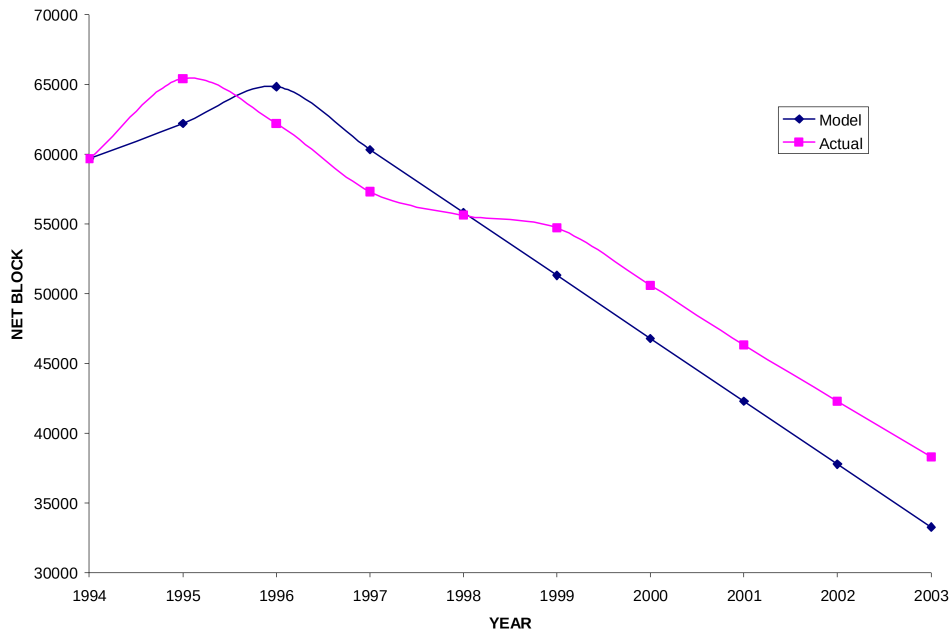

Fig. 8 Net Block – Base run

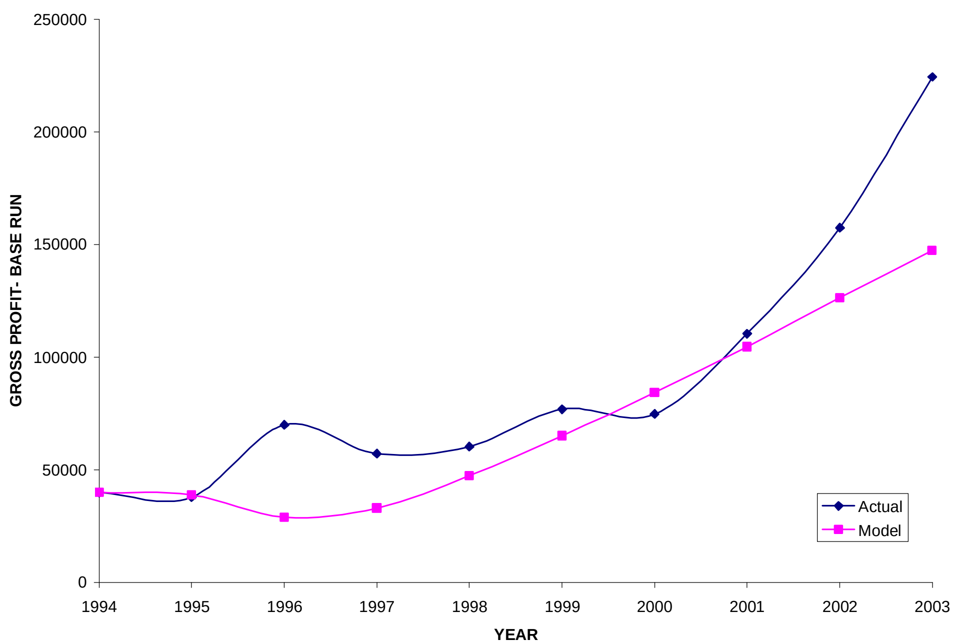

Fig. 9 Gross Profit with base run

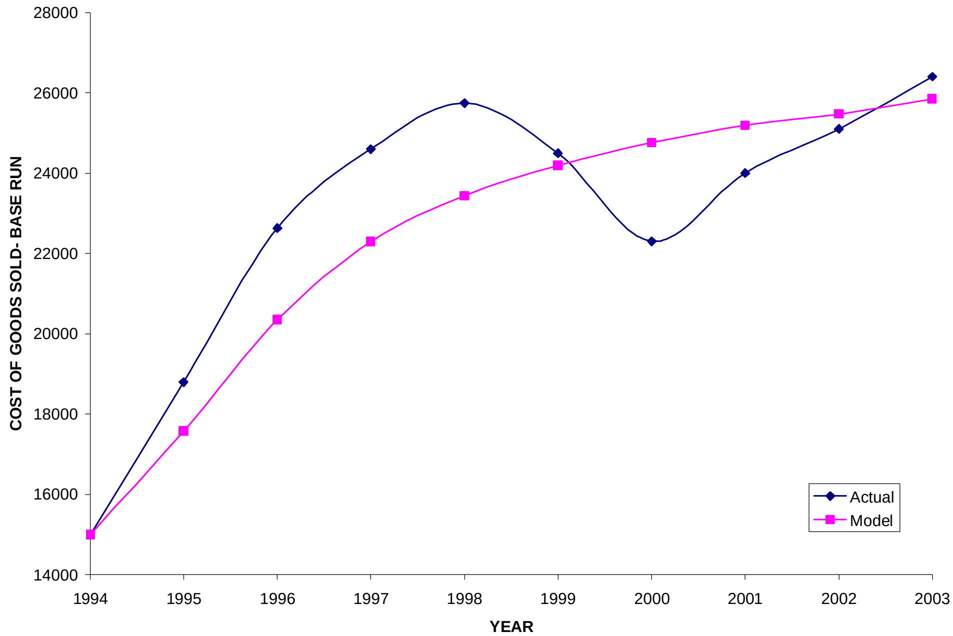

Fig. 10 Cost of goods sold- Base run

iii) Dimensional consistency test:

The model altoghether consists of 236 equations. All these equations are written and thoroughly checked for dimensional consistency between the influencing variables and resultant variables. Thus the model is found to be dimensionally consistent.

iv) Boundary adequacy (structure) test:

As indicated by causal loop and flow diagrams, the factors considered in model have been adequate in addressing the various issues related to real life system. The model boundary defined in this study, therefore, is considered adequate for the objectives with which the model is developed.

2.5 TESTS OF MODEL BEHAVIOUR

i) The base run and the Behavioral reproduction test:

The simulated data along with the actual production data for the select parameters are presented in Table 1. It can be seen that they are in agreement. To enhance the confidence in the model further, t-test and F-test are conducted. The results of the tests are presented in the Table 2 and test statistics are well within the 95% confidence limits. Therefore, it can be said that the model represents the dynamic behavior of the system very well and it can be extended to generate future scenarios which form the basis for formulating policies for the growth of the company.

It can be observed from the results of the t-test that the t-values are much below the standard t-value of 2.26 at 95% confidence level which establishes the adequacy of the model. Similarly, from the results of F-test, it can be observed that all F-values are much smaller than the standard F-value of 3.18 at 95%confidence level.

ii) Behaviour prediction test:

Valid prediction of the real system behaviour can be made only if the model structure, the managerial policies and time variation of exogeneous variables could be predicted (Mohapatra 1994). The model is run for a further period from 2004 to 2013 and observed that the results of the model are identical with the values acheived for the period 1994-2004.

iii) Behaviour anamoly test:

The model did not produce any behaviour anamolous to that of the real system.

iv) Family member test:

Eventhough the model has been developed for a shore based integrated steel plant located in Visakhapatnam, it is generic in nature. With appropriate modifications in the initial values of the level variables and parameters, it can be applied to any other steel plant either in India or elsewhere globally.

v) Surprise behaviour test:

The model did not produce any surprise or counter intuitive behaviour.

vi) Boundary adequacy (behaviour) test:

This test was intended to check whether the model boundary can be expanded to include other related aspects like domestic sales, export sales separately and owning captive mines. However, at aggregate level inclusion of these factors is not expected to produce significance changes in the model results.

vii) Behaviour sensitivity test:

The model was tested for changed values of various parameters. Qualitatively the model retains its behaviour for all the variables.

Table 1: Comparison of Actual and Model generated values for selected variables (Values in Millions of Rupees)

Year	Current Assets		Current Liability		Total Assets		Cost of goods Sold		Total Sales Revenue		Rupee value of Inventory		Gross Profit		Net Block	
	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model
1994	11249	11249	6410	6410	85449	85449	15000	15000	19000	19000	7000	7000	4000	4000	59650	59650
1995	14115	13770	8146	9514	98600	94293	18800	17575	22160	21441	9750	9174	3565	3881	65400	62187
1996	15027	14271	9000	10487	101300	101744	22630	20349	30390	23117	11000	9445	2339	2899	62200	64832
1997	15149	14577	10900	10889	105000	101399	24600	22291	30300	25256	12870	9705	2451	3305	57300	60321
1998	15232	14923	11211	11267	105700	101735	25750	23437	31780	27668	12630	9982	3643	4722	55600	55811
1999	13987	14012	10400	11720	100000	100085	24500	24191	27620	30139	10200	10247	5290	6503	54700	51300
2000	15173	15952	11600	12057	101100	101533	22300	24758	30000	32619	11120	10497	7136	8427	50600	46789
2001	17944	18481	13035	12222	103400	103891	24000	25184	34400	35099	12100	10714	9123	10465	46300	42278
2002	18736	21371	14304	12582	103300	106722	25100	25472	40810	37577	11200	11006	11247	12627	42300	37768
2003	24267	24286	11000	13103	106000	109592	26400	25852	50580	40105	8580	11295	13328	14742	38300	33257

Table 2: t-test and F-test results for selected variables

S. No.	Variable	Actual		Model		t- Values	F-Values
		Mean	Standard deviation	Mean	Standard deviation	[t_9(0. 05) = 2.26]	[$F_{9,9}$(0.05) = 3.18]
1	Current Assets	16087.9	3537.936	16289.2	3951.063	0.653202	1.247176
2	Current Liabilities	10600.6	2296.141	11025. 1	1934.225	1.149026	0.709605
3	Total Assets	1030278.0	73619.83	1030749.	78431.06	(-)0.0597	1.134976
4	Cost of Goods Sold	230100.0	35003.02	233984.3	33937.92	0.914778	0.940069
5	Total Sales Revenue	31704	8958.279	321443.6	29202.1	(-)1.83646	0.630814
6	Rupee value of Inventory	108450.0	21144.17	99063.8	12245. 52	(-)1.51999	0.335408
7	Gross Profit	7831.8	6640.818	7157.1	4216.807	(-)0.76331	0.403203
8	Net Block	532350.0	87650.84	51009.7	112172.1	(-)2.10725	1.637789

3. POLICY OPTIONS

Having established the adequacy and effectiveness of the System Dynamics approach in understanding the behaviour of the actual system, it is now necessary to extend the model to next 10 years in order to generate future scenarios and design effective policies for the financial growth of the company with if-so-then analysis. Altogether ten policies are tested. Among these policies tested, Policies- 1 to 7 are pure policies and Policies 8, 9 and 10 are mixed policies. Broadly these policies can be grouped into:

(i) implications of reduction in inventory

(ii) implications of reduction in production costs

(iii) implications of increase in production costs and

(iv) effect of increase in sales price and

(v) a combination of above

The policies tested to improve the financial performance of the company are:

Policy- 1: Base run

In this policy, it is assumed that the present trend with reference to capacities and that of demand persists in future also and there will not be any significant changes in the scenerio.

Policy- 2:

As any management intends to reduce the inventory of spare parts and raw materials, this policy is designed to test the implications of reduction in inventory of same. It is assumed that there is no change in the values of other parameters.

Policy- 3:

As there is a sudden demand for steel products internationally, its prices are increasing dramatically. In tune with the present trend in steel prices, the impact of hike in steel product prices by 50% on the profitability of the company is tested, keeping the values of other parameters unchanged.

Policy- 4:

In this policy, the increase in the prices of steel products is assumed to be 100%, keeping the values of other parameters unchanged.

Policy- 5:

In this policy, the price increase in the steel products is assumed to be 100% and there is no change in the values of other parameters.

Policy- 6:

The company is contemplating to introduce cost effective measures so as to reduce the production costs. In view of the same, this policy is designed to study the impact of the same on the production costs of various end products by assuming a 10% decrease in the production costs, assuming that there is no change in the values of other parameters.

Policy- 7:

At present the production costs are showing an increasing trend because of increase in input costs. In view of the prevailing situation, this policy is designed to test the impact of increasing production costs on the profitability of the company. In this case, a 10% increase in the production costs is assumed where as other parameters remain unchanged.

Policy- 8*:*

In this policy, it is assumed that there is a 10% reduction in inventory of spares and raw materials, 10% decrease in production costs and 50% increase in unit sales price of end products.

This is a mixed policy and is designed to check the implications if there is a reduction in inventory of spare parts and raw materials coupled with decrease in production costs and increase in the unit sales price of each semi- finished and finished products.

Policy- 9:

In this policy, it is assumed that there is a 100% increase in the unit sales price of the end products and a 10% increase in the production costs. Again this is a mixed policy designed to test the implications on the financial performance of the system under study.

Policy- 10:

In this policy, it is assumed that there is a 10% decrease in inventory of spare parts and raw materials, 100% increase in the unit sales price of end products and 10% decrease in production costs. This is a mixed policy aiming at studying the implications on the financial performance of the system.

The impact of each of these policies is examined in a systematic manner by assessing their effect on the financial ratios. An analysis of the ratios helps in understanding not only the future trend but also the impact of each policy on the financial performance.

4. RESULTS OF MODEL SIMULATION

After simulating the model for different policy options listed above, the behaviour of key variables was examined in detail. The base run (Policy-1) results have also been compared with the available historical data. A comparative study of various policies has been made.

The results of the base run for the selected variables are presented in Table 3.

Table 3: Base run results of financial sub- system

S. No	Variable	1994	1997	2000	2003	2006	2009	2013
1	Current Assets	11249	14577	15952	24286	38078	46921	53554
2	Current liabilities	6410	10889	12057	13103	16111	19355	26315
3	Total assets	85449	101399	101533	109592	123201	131836	138287
4	Sales revenue	19000	25256	32619	40105	54386	60067	69246
5	Cost of goods sold	15000	22291	24758	25852	28372	31499	37875
6	Rupee value of inventory	7000	9705	10497	11295	12713	13715	15763
7	Net block	59650	60321	46789	33257	19725	17349	17349
8	Gross Profit	4000	3305	8427	14742	26397	28770	31513

5. POLICY ANALYSIS

The results generated by the model under different policy options for select variables have been depicted in Figs.11 to 19 and comparison of results under different policy options is given in Table 4. The objective of policy analysis is to evaluate different policies and rank them considering the long term interests of the company. The best policy is the one for which the profitability is the maximum.

5.1 TOTAL SALES REVENUE

In Fig.11, the variation in Sales revenue under different policy options is indicated. Any one of the Policies-5, 9 and 10 would be contributing the same Sales revenue of Rs.688028. 6 million in 2004 and it increases gradually to Rs.124064.0 million in 2013. In the case of these three policies, the increase in sales price of end products is assumed to be 100% even though the actual sales price increase is much more than the assumed values. These three policies are exhibiting a distinct pattern and can be singled out when compared with the rest of the policies because of the parity in the expected sales revenue. Policies- 4 and 8 will contribute the same amount followed by Policy- 3. This is followed by Policies- 2, 6 and 7 which contribute the same sales revenue as that of Policy- 1 (Base Run).

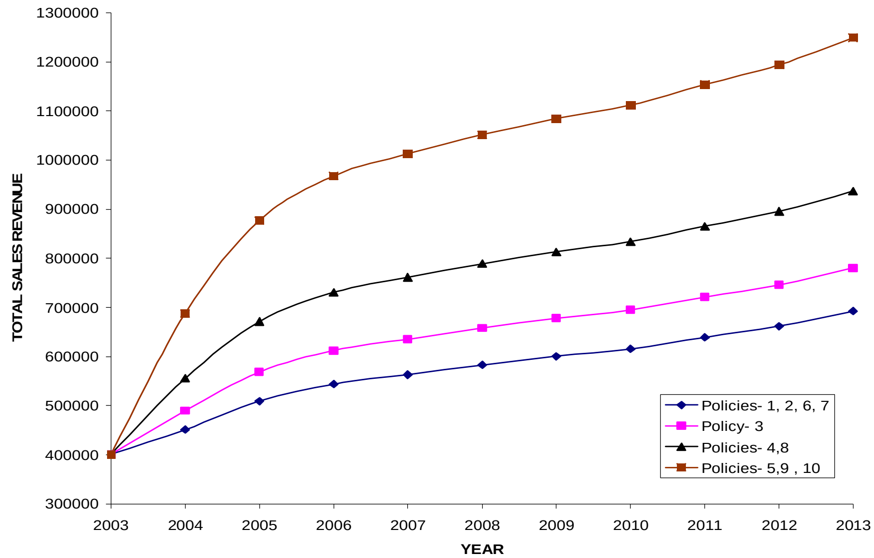

Fig.11 Total sales revenue with policy changes

5.2 RUPEE VALUE OF INVENTORY

Fig.12 shows the policies concerning the rupee value of inventory. Of all the policies, Policies-8 and 10 give the same and the lowest inventory levels followed by Policies-2 and 6. Policies-3, 4 and 5 also result in same level of inventory as that of Policy-1 (base run) and higher than the earlier ones. Policies-7 and 9 result in the same value and lead to higher inventory levels.

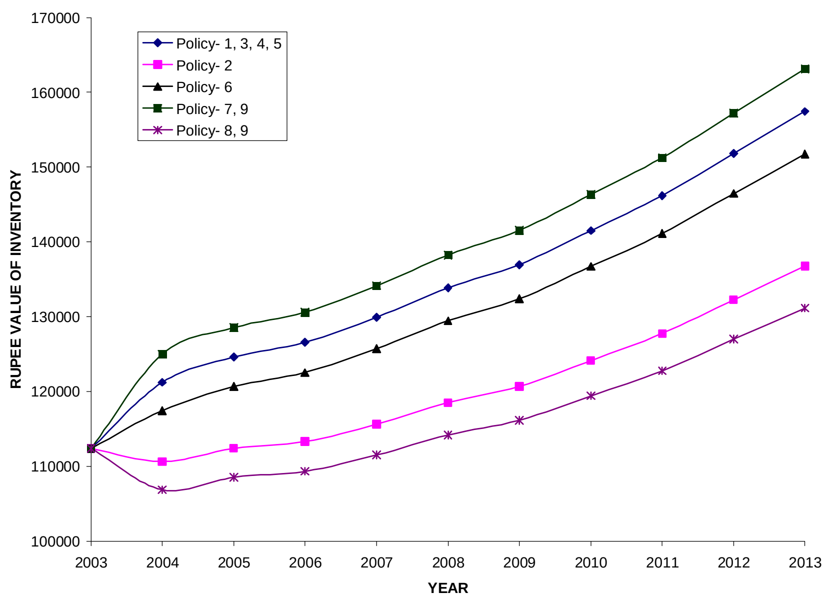

Fig.12 Rupee value of inventory with policy changes

5.3 GROSS PROFIT

The gross profit over the years with different policy options is presented in Table 4 and Fig.13. Policy-10 yields highest gross profit of Rs.432350.8 million in 2004 and increases gradually to Rs.915038 million in 2013 followed by Policies -5, 9, 8, 4, 3, 6, 2, 1 and 7 in that order. Policy- 7 results in the lowest profits which is less than Policy- 1 (Base Run), indicating that an increase of 10% in production costs will offset the profit margins. This is also reflected by Policy-8. In Policy-8, a 100% increase in the sales price of the semi-finished/ finished products is assumed. In the case of each policy, there is a sudden jump in value between 2004 and 2007 and later there is a steady growth in Gross profit. Even though all the policy options are exhibiting similar pattern, they can be grouped in to three, considering the expected Gross profit by following each of the policy options. In Figs.14 and 15, the contribution of Operating profit and Net profit are shown. They are all exhibiting similar trends as that of Gross profit. But, in reality these two variables are bound to vary due to various reasons. The value of operating profit depends upon depreciation and administrative expenses where as Net profit depends upon the total interest to be paid on various loans borrowed and quantum of various taxes to be paid to the Government. Therefore, it is not possible to discuss the implications of these two variables.

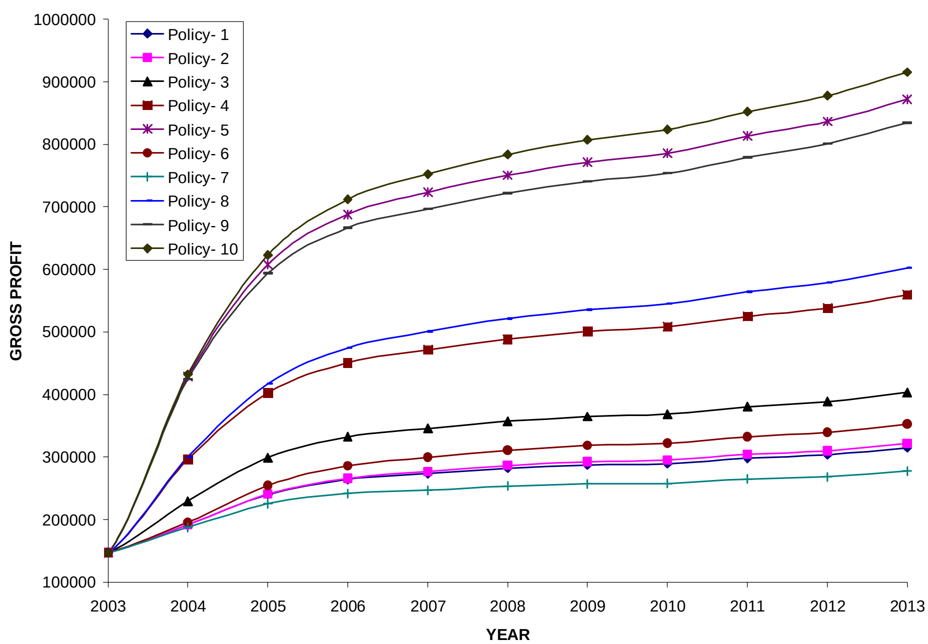

Fig 13 Gross profit with policy changes

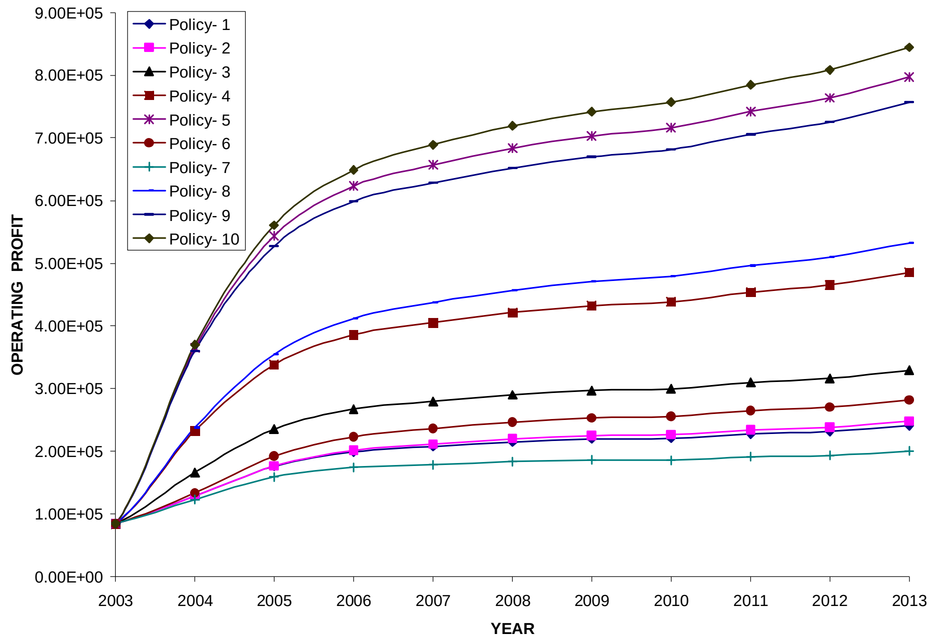

Fig 14 Operating profit with policy changes

Table 4 Comparison of values for different policies

No.	Variables	Year	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
1.	Total Sales Revenue	2004	451053.5	451053.5	489562.3	555717.8	688028.6	451053.5	451053.5	555717.8	688028.6	688028.6
		2007	563277.3	563277.3	635405.5	761198.2	1012784	563277.3	563277.3	761198.2	1012784	1012784
		2010	615793.4	615793.4	694951.1	833889	1111765	615793.4	615793.4	833889	1111765	1111765
		2013	692459.2	692459.2	780668.7	936800.3	1249064	692459.2	692459.2	936800.3	1249064	1249064
2.	Rupee Value of Inventory	2004	121220.6	110619.3	121220.6	121220.6	121220.6	117450.6	124990.6	106863.5	124990.6	106863.5
		2007	129938.9	115647.3	129938.9	129938.9	129938.9	125735	134142.7	111516	134142.7	111516
		2010	141525.4	124154.5	141525.4	141525.4	141525.4	136723.3	146327.6	119434.3	146327.6	119434.3
		2013	157438.6	136762.7	157438.6	157438.6	157438.6	151750.3	163127	131167.9	163127	131167.9
3.	Gross Profit	2004	191332.6	191351.4	229841.5	295996.9	428307.7	195358.8	187306.5	300039.9	424281.5	432350.8
		2007	273328.4	276678.8	345456.6	471249.4	722834.9	299624.6	247032.2	500560.8	696538.8	752146.4
		2010	289770.8	295273.2	368928.4	507866.3	785742.2	322102.8	257438.6	545150.6	753410.1	823026.4
		2013	315128.8	321450.3	403338.2	559469.9	871733.2	352744.4	277513.2	602774.8	834117.6	915038
4.	Operating Profit	2004	128028.8	128062.3	166537.7	232693.1	365003.9	133239.2	122818.5	237933.5	359793.5	370244.4
		2007	207376.8	211105.5	279505	405297.8	656883.4	236106.6	178647.1	437383.3	628153.6	688968.8
		2010	220543.3	226529.1	299701	438638.9	716514.8	255676.5	185410	479159.3	681381.5	757035.2
		2013	241081.9	247948.8	329291.3	485422.9	797686.2	281982.2	200181.6	532503.4	756786	844766.6
5.	Net Profit	2004	83722.06	83747.13	112603.7	162220.3	261453	87629.85	79814.28	166150.6	257545.2	265383.3
		2007	157099.8	159896.3	211195.9	305540.5	494229.7	178647.2	135552.5	329604.6	472682.3	518293.8
		2010	167204.3	171693.7	226572.6	330776	539182.9	193554.2	140854.3	361166.3	512832.9	569573.2
		2013	182764.8	187915	248921.9	366020.7	600218.1	213440.1	152089.6	401330.9	569542.9	635528.4
6.	Current Ratio	2004	1.90	1.99	2.03	2.25	2.69	1.88	1.93	2.33	2.71	2.81
		2007	2.48	2.72	2.88	3.58	4.99	2.45	2.52	3.90	5.02	5.45
		2010	2.34	2.54	2.73	3.41	4.76	2.31	2.38	3.66	4.79	5.13
		2013	2.04	2.16	2.37	2.96	4.14	2.00	2.07	3.12	4.18	4.39
7	Inventory turnover ratio	2004	2.21	2.42	2.21	2.21	2.21	2.16	2.26	2.37	2.26	2.37
		2007	2.31	2.56	2.31	2.31	2.31	2.15	2.46	2.39	2.46	2.39
		2010	2.40	2.69	2.40	2.40	2.40	2.24	2.55	2.52	2.55	2.52
		2013	2.53	2.86	2.53	2.53	2.53	2.36	2.68	2.69	2.68	2.69
8	Return on investment Ratio	2004	0.12	0.12	0.15	0.21	0.31	0.13	0.11	0.22	0.30	0.32
		2007	0.17	0.17	0.22	0.29	0.40	0.20	0.15	0.31	0.38	0.42
		2010	0.17	0.18	0.22	0.29	0.40	0.20	0.14	0.32	0.38	0.43
		2013	0.18	0.19	0.23	0.31	0.42	0.21	0.15	0.34	0.40	0.45
9	Gross profit margin Ratio	2004	0.42	0.42	0.47	0.53	0.62	0.43	0.41	0.54	0.61	0.63
		2007	0.48	0.49	0.54	0.62	0.71	0.53	0.44	0.66	0.69	0.74
		2010	0.47	0.48	0.53	0.61	0.71	0.52	0.42	0.65	0.68	0.74
		2013	0.45	0.46	0.51	0.60	0.70	0.51	0.40	0.64	0.67	0.73
10	Fixed Assets turnover Ratio	2004	1.83	1.83	1.98	2.25	2.78	1.83	1.83	2.25	2.78	2.78
		2007	3.55	3.55	4.01	4.80	6.39	3.55	3.55	4.80	6.39	6.39
		2010	3.89	3.89	4.39	5.26	7.02	3.89	3.89	5.26	7.02	7.02
		2013	4.37	4.37	4.93	5.91	7.88	4.37	4.37	5.91	7.88	7.88

5.4 RATIO ANALYSIS

Whenever financial health of a company has to be assessed invariably one has to depend on financial ratio analysis. Therefore, various policy options are considered in the present study to carryout financial analysis of the company. However, in this model Leverage ratios such as Debt- equity ratio, Interest coverage ratio and Debt- asset ratios are not considered for Policy analysis as the company declared that it became debt free in 2004 and having sufficient surplus funds to run the company. The financial ratios considered for this purpose are as follows:

(i) Current ratio(CR)

(ii) Inventory Turnover ratio(ITOR)

(iii) Return on Investment ratio (ROIR)

(iv) Gross Profit Margin ratio (GPMR) and

(v) Fixed Assets Turnover ratio (FATR)

(i) Current Ratio

First among these ratios, is the CR which is a measure of liquidity of the company's Current Assets. In the case of heavy industries like integrated steel plants, a CR of 2:1 or higher is considered to be desirable as it represents the margin of safety, the reason being that the cost of current assets may decline but not the current liabilities. In Table 4 and Fig.15, the variation in CR over the period of 2004-2013 for different policy options is shown. Among the policies tested, Policy-10 results in a higher ratio. It gives a ratio of 2.08 in 2004, reaches a peak of 5.45 in 2007 and then starts declining to 4.31 in 2013. Policies- 9, 5, 8, 4, 3, 2 and 7 follow Policy- 10 in that order and result in higher ratio than that of Policy- 1. The lowest ratio is obtained for the Policy- 6. Thus, through out the period of policy testing, the model exhibits a higher ratio indicating the financial soundness of the company in meeting its current obligations. This may be attributed to the improved sales revenue resulting in increased cash flow of the company. However, in view of the increase in the value of Accounts payable due to increase in input costs like labour costs, material costs and production related costs, the value of CR is slowly declining even though it is still on safer side.

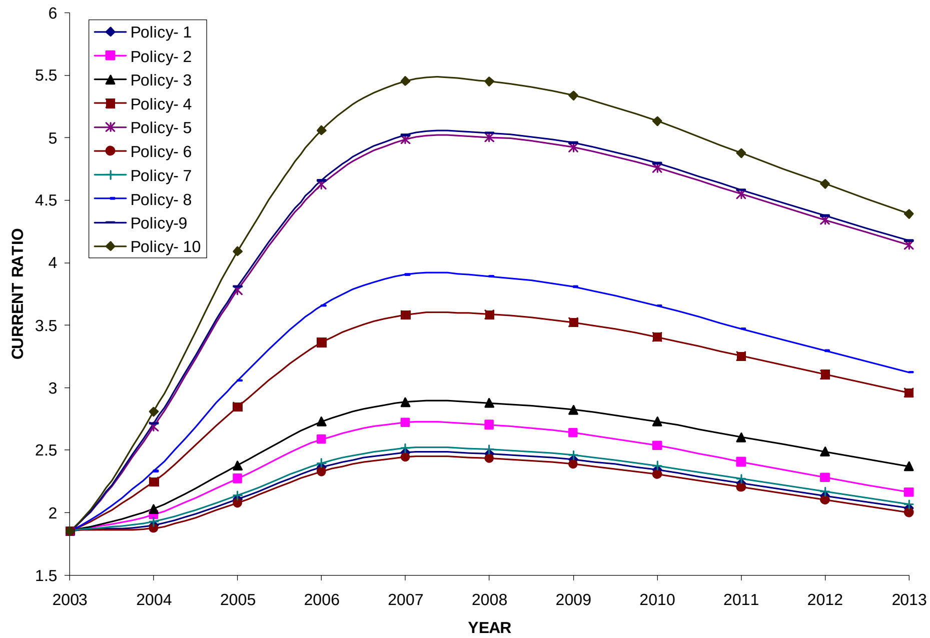

Fig.15 Current ratio with policy changes

5.5 PROFITABILITY RATIOS

Profitability ratios are calculated to measure the operating efficiency of the company. The ROIR and GPMR reflect the relationship between profit and investment. The variation of GPMR and ROIR for different policy options are presented in Table 4 and Figs.16 and 17. These two ratios exhibit similar trends. In both the cases, the highest ratios are obtained for Policy-10 followed by Policies-5, 9, 8, 4, 3, 6, 2, 1 and 7 in that order. Thus Policy-7 results in the lower values than that of Policy- 1 (Base Run) indicating that a slight increase in the production costs will upset the profitability margins of the company.

In the case of Policy-10, the GPMR is increasing from 0.63 (or 63%) in 2004 to 0.74 or (74%) in 2013. The rest of the policies are exhibiting an identical behaviour and showing a declining trend after reaching a peak level in 2007. This can be attributed to the declining trend of the Gross profit which in turn is being affected by the gradual increase in input costs.

Also for Policy- 10, the ROIR is 0.32 (or 32%) for the year 2004 and it increases gradually to 0.45 (or 45%) in 2013 where as Policy-7 gives the lowest values for the period under consideration. In the present case, every policy is showing an upward swing towards the end of 2013. This can be attributed to the stagnation in the acquisition of fixed assets and the influence of depreciation.

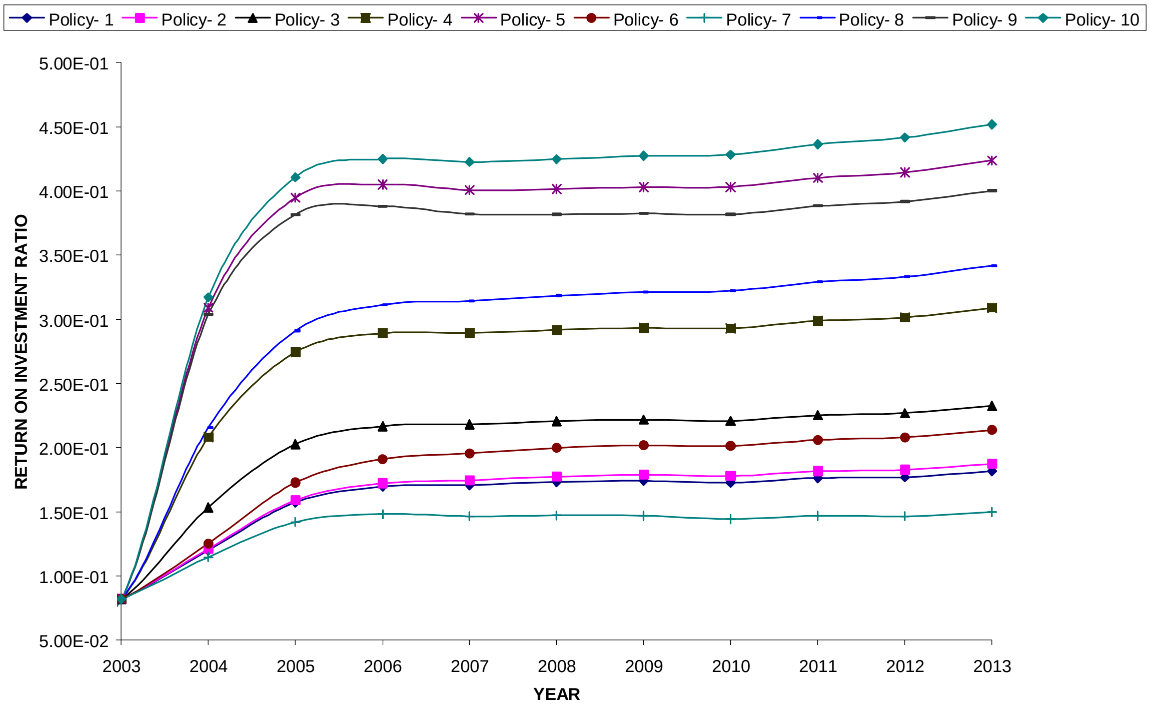

Fig. 16 Return on Investment ratio with policy changes

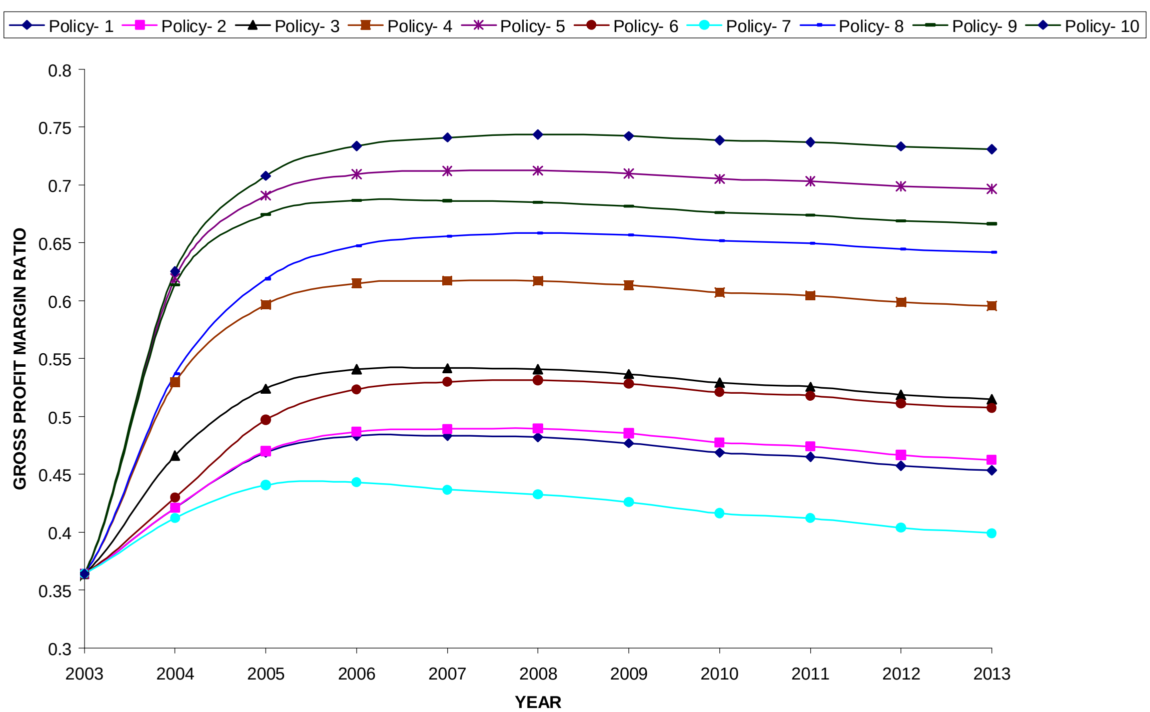

Fig. 17 Gross profit margin ratio with policy changes

5.6 TURNOVER RATIOS

The two ratios- ITOR and FATR- are considered as efficiency ratios as these ratios indicate the efficiency with which the company manages and utilizes its assets. In the case of ITOR, an increasing value of the ratio is considered to be a sign of good inventory management. ITOR tells the rapidity at which the inventory is turned over into receivables through sales. In the present case, the increase in ITOR is marginal and for this type of industry, it can be taken as normal in view of the cyclic pattern of sales. In the present study, Policy- 2 (a 10% decrease in inventory of spares and raw materials) gives a higher turnover ratio the value being 2.42 in 2004 and gradually increasing to 2.86 in 2013. This is followed by Policies- 8 and 10 both of which result in the same values. This is followed by Policies-7 and 9. Similarly, the results of Policies-1, 3, 4 and 5 are identical in their behaviour. Policy- 6 resulted in lower values than that of Policy-1 as shown in Fig.18.

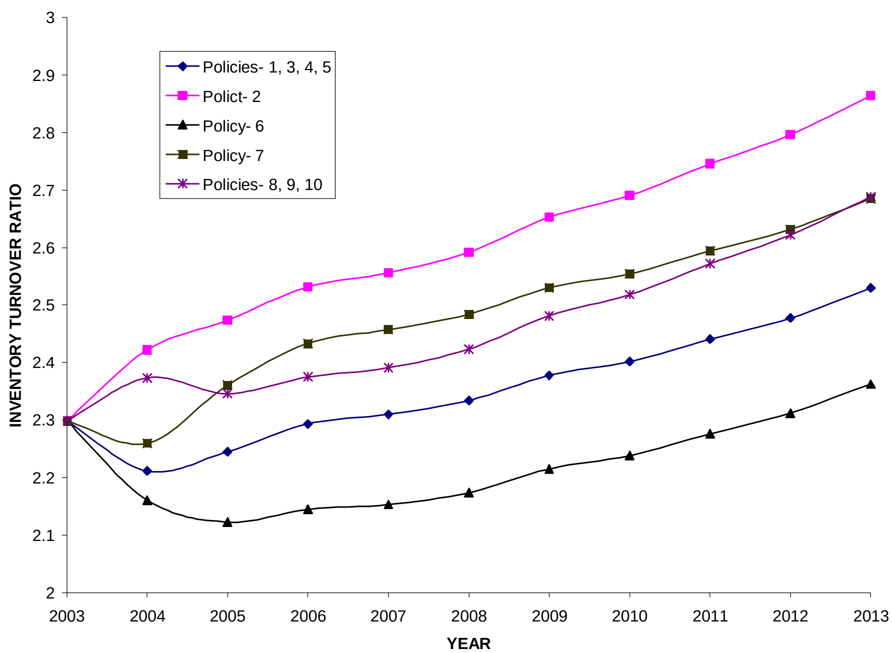

Fig. 18 Inventory turnover ratio with policy changes

FATR measures the efficiency with which Fixed assets are employed. In the present study, Policies-5, 9 and 10 yield a higher ratio followed by Policies- 4, 8, 3, 1, 2, 6 and 7 in that order. Policies-5, 9 and 10 exhibit identical pattern and these three policies give an FATR of 2.78 for 2004 which gradually increases to 7.88 for 2013. This indicates an encouraging trend. Interestingly, Policies-2, 6, 7 and 1 are also resulting in the identical values.

After carefully analyzing the results obtained, it is concluded that Policy-10 is the best option for the management to adopt. As per this policy, the management should thrive to reduce the inventory at the rate of 10% till it reaches an optimum level and also concentrate to reduce the production costs by adopting the latest state-of-the-art technology. Selling price of the products in not within the control of the management. At present, the demand for various products is on the increasing trend and also the price escalation is more than what is assumed in the model. In view of this reason, even if the selling price of the products comes down, there may not be any risk involved to the management.

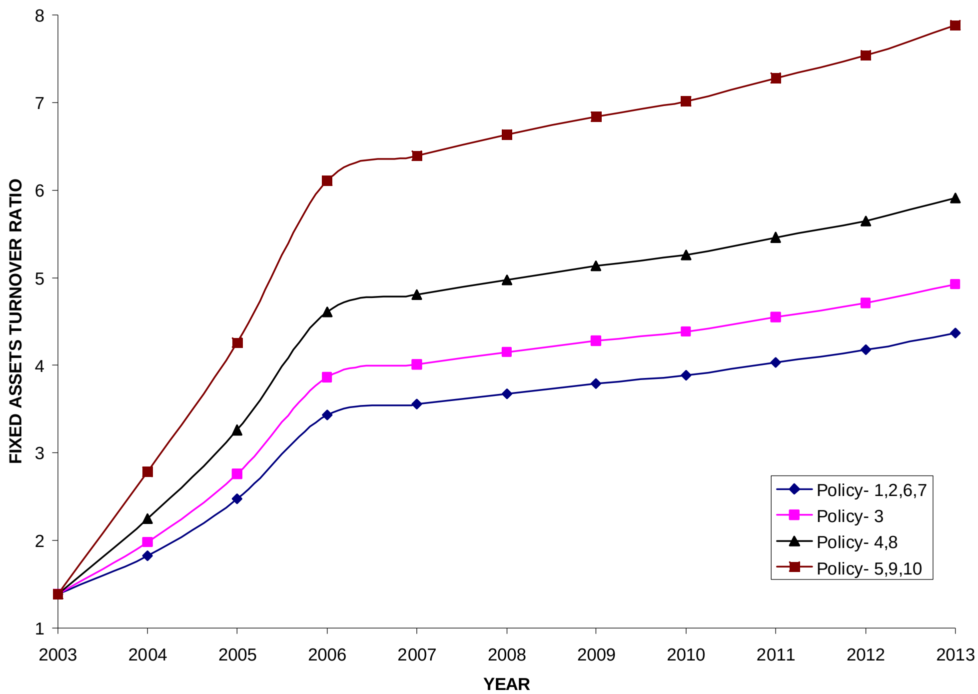

Fig. 19 Fixed Assets turnover ratio with policy changes

6. CONCLUSIONS

1. SD model has been successfully applied to portray the dynamic behaviour of the financial subsystem of the plant.
2. The reasons for excellent performance have been identified as (i) increase in production and sales volume (ii) Cost reduction measures (iii) reduction in borrowings and (iv) Buoyancy in steel market.
3. The availability of funds entails the plant to go in for revamp, modernization, expansion and production of value added items.
4. A close look at the complex scenarios generated by extending the SD model and assessing various policy options, it is clear that policy-10 is the most effective of all the policies for all the variables considered for study except for the Inventory turnover ratio.

5. In the case of Inventory turnover ratio, Policy-2 gives the best value followed by Policies-8 and 10. However, the difference among the values of these three policies is marginal and therefore, Policy-10 can be recommended for implementation without any hesitation.

REFERENCES

Bora, M.C. and Mohapatra, P.K.J., (1982), *Dymosim Package*, Industrial Engineering and Management Dept, IIT Kharagpur, India

Forrester, J.W., (1961), *Industrial Dynamics*, MIT Press, Cambridge, MA.

Goodman, M.R., (1975), *Study Notes in System Dynamics*, MIT Press, Cambridge, MA

Koul, S and Vrat P.(1988), *Evaluating the Performance of an Engineering Firm*, System Dynamics for Management Support, Wiley Eastern Ltd., India, pg 122-137.

Mohapatra, P.K.J. Mandal P., & Bora M.C., (1995) *Introduction to System Dynamics Modelling*. Universities Press: India.

Richardson, G.P. and Pugh III, A.L. (1983), *Introduction to system Dynamics Modelling with DYNAMO*, MIT Press/Wright-Allen Series in System Dynamics.

Roy, K.R. Divakar. (2009) *Growth Strategies for an integrated steel plant Indian Steel Industry*, PhD Thesis, Dept. of Mechanical Engineering, Andhra University, Visakhapatnam, India.

Roy, K.R. Divakar and Kumar, K. Vizia.,(1997), "*Financial Performance Analysis of An Integrated Steel Plant - A System Dynamics Approach*", Ed Proceedings by Yaman B et al, 15th International System Dynamics Conference, Istanbul, August 19-22, 1997.