ENHANCING THE CORPORATE PERFORMANCE THROUGH SYSTEM DYNAMICS MODELLING

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Abstract

The aim of the current study is to improve the performance of corporate through application of System Dynamics (SD) methodology. The paper discusses the importance of system dynamics modelling in enhancing corporate performance and how it shows the dynamic behaviour of the system. For this purpose a system dynamics model for an Indian Steel company has been prepared. The paper also covers a brief introduction of the system dynamics modelling, a brief narration of Steel Sector and the process adopted in modelling. Some of the important corporate performance parameters such as market share, revenue, employee's strength, number of shareholders, installed capacity have been taken to reflect corporate behaviour. The behaviour of these performance parameters over time is used for both validation of the model as well as for reflecting their future pattern. The paper concludes that the SD modelling approach has high potential in understanding corporate performance behaviour and their by gaining insight into the corporate functioning and taking appropriate remedial steps for improving its performance.

Keywords: Corporate Performance, System Dynamics, Dynamics Behaviour

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1. Introduction

Corporate performance is a very actual output or result of a corporation as measured against its intended outputs, which can be reflected in many ways. Corporate performances build the image of the corporation in front of shareholders, investors, funding agencies, competitors; fulfil the goal of the company etc. It also effects on the image of the board of the corporation and their governance. It's related to revenue, return on investment, overhead and operational costs. Many companies strive to be the best in their market and most never succeed. Many of the ones that do, so only temporarily and subsequently lose their position through misunderstanding how they got there and what is needed to stay there. Very few, as Collins (2001) has stated, are capable to going from "good to great".

Corporate performance is viewed from the perspective of different stakeholders as businesses respond to contemporary developments and broader strategic, commercial and social consideration.

Dahya, et. al. (2002), In 1992, the Cadbury Committee issued the *Code of Best Practice* which recommends that boards of U.K. corporations include at least three outside directors and that the positions of chairman and CEO be held by different individuals. The underlying presumption was that these recommendations would lead to improved board oversight. They empirically analyse the relationship between CEO turnover and corporate performance. CEO turnover increased following issuance of the *Code*; the negative relationship between CEO turnover and performance became stronger following the *Code*'s issuance; and the increase in sensitivity of turnover to performance was concentrated among firms that adopted the *Code*.

Richard et al. (2009) states that organizational performance encompasses three specific areas of firm outcomes: (a) financial performance (profits, return on assets, return on investment, etc.); (b) product market performance (sales, market share, etc.); and (c) shareholder return (total shareholder return, economic value added, etc.

Beaver (2000) states that performance appraisal is a serious business and not some academic fad that will fade like so much of the indulgent language and management tools and techniques currently in vogue at its most fundamental. Performance appraisal is the principal means for an organization to assess the effectiveness of its decision making. In doing this, judgements can be made about the success or failure of its strategic management in the context of its organizational paradigm. The notion of corporate success is a natural derivative of a firm's achievements which is in turn a reflection of the quality of its management decisions in relation of the quality of its management decisions in relation to strategic objectives, market and a whole range of internal and external circumstances. Given the unpredictability of these circumstances, many of the current methods of measuring corporate performance effectively, realistically and consistently appear to be

facile and inappropriate and subject to imaginative financial engineering and plain management abuse.

Based upon the explanation of Majumdar (1997) whether larger firms are superior in performance to smaller firms, or vice-versa and whether older firms are superior in performance to younger firms, or vice-versa, have generated large amount of theoretical and empirical research in the economics, management and sociology disciplines. Cheng (2008) provides empirical evidence that firms with larger boards have lower variability of corporate performance. The results indicate that board size is negatively associated with the variability of monthly stock returns, annual accounting return on assets, Tobin's *Q*, accounting accruals, extraordinary items, analyst forecast inaccuracy, and R&D spending, the level of R&D expenditures, and the frequency of acquisition and restructuring activities. The results are consistent with the view that it takes more compromises for a larger board to reach consensus, and consequently, decisions of larger boards are less extreme, leading to less variable corporate performance.

Prasetyantoko and Parmono (2008) disused that firm size is positively related to firm profitability, but it is not related to market capitalization and ownership factors matters on firm performance.

Wheelen & Hunger (2002) pointed that businesses are tending to rely less on financial measures (which are based on Accounting Standards) such as, profit, return on investment, and return on assets, alone to assess over all corporate performance

Wheelen and Hunger (2002), defined performance simply as the end result of activity. At one level, it maybe as simple and mundane as this definition, although at another level the notion of a general measure of performance is both intriguing yet continually disappointing (Bonoma & Clark 1988).

Choosing a performance measure is one of the most critical challenges facing organizations (Ittner & Larcker 1998). It is common for corporations to have numerous performance measures (Neely, Adams & Kennerley 2002), though financial measures dominate for Autralian, UK and US executives (Phillips & Shanak 2002; Clark 1999; Kokkinaki & Ambler 1999).

Irala (2007) states that traditionally periodic corporate performance is most often measured using some variant of historical accounting income (eg. Net Profit, EPS) or some measures based on the accounting income (eg. ROI/ ROCE). And he also examines whether Economic Value Added has got a better predictive power relative to the traditional accounting measures such as EPS, ROCE, RONW, FCF, Capital Productivity (Kp) and Labor Productivity (Lp)

Harols and Belen (2001) investigate the relation between the ownership structure and the performance of corporations if ownership is made multi-dimensional and also is treated as an endogenous variable.

Qi, Wu, Zhang (2000), investigate whether and how the corporate performance of listed Chinese firms is affected by their shareholding structure. Adams et al (2005) develop and test the hypothesis that firms whose CEOs have more decision-making power should experience more variability in performance. They suggest that the interaction between executive characteristics and organizational variables has important consequences for firm performance

Joy et al (2007) has shown in their research that women representation on board increase return on equity (ROE), return on sales (ROS), return on investment (ROI) corporate performance. Bryan (2007) state that companies should redesign their financial-performance metrics for this new age. Normally companies focus far too much on measuring returns on invested capital (ROIC) rather than on measuring the contributions made by their talented people. Times have changed. Metrics must change as well.

During the 1990s and beyond, countries around the world witnessed calls and/or mandates for more outside directors on publicly traded companies' boards even though extant studies find no significant correlation between outside directors and corporate performance. Dahya et. al (2007) examine the connection between changes in board composition and corporate performance in the U.K. over the interval 1989–1996, a period that surrounds publication of the Cadbury Report, which calls for at least three outside directors for publicly traded corporations. They find that companies that add directors to conform to this standard exhibit a significant improvement in operating performance both in absolute terms and relative to various peer group benchmarks. They also find a statistically significant increase in stock prices around announcements that outside directors were added in conformance with this recommendation. They do not endorse mandated board structures, but the evidence appears to be that such a mandate is associated with an improvement in performance in U.K. companies.

Norburn, and Birley, (1998) tested the relationship between the characteristics and background of U.S. top executives, and measures of corporate performance. Results were generally positive: managerial characteristics not only predicted performance variations within industries—the top performers having significantly different managerial profiles than poorly performing companies—but also that the characteristics of managers within high-performing companies were similar across the five industries.

Firth et al. (2006) has examined the compensation of CEOs in China's listed firms. First, they discuss what is known about the setting of CEO compensation and then we go on to examine factors that may help explain variations in the use of performance related pay. In China, listed firms have a

dominant or controlling shareholder. Firth et al. (2006) argue that the distinct types of controlling shareholder have different impacts on the use of incentive pay. We find that firms that have a State agency as the major shareholder do not appear to use performance related pay. In contrast, firms those have private block holders or SOEs as their major shareholders relate the CEO's pay to increases in stockholders' wealth or increases in profitability. However the pay–performance sensitivities for CEOs are low and this raises questions about the effectiveness of firms' incentive systems.

Above discussion shows that corporate performance as a whole is missing. Most of them have worked on composition of the committee, financial aspect of the company etc., but corporate performance as a whole like operational performance, financial performance has not been combined together. The purpose of this paper is to combine both operational as well as financial performance together to measures the performance of the company with using management science tools like system dynamics (SD).

2. System Dynamics: principles and concepts

The system dynamics (SD) has been developed as industrial dynamics approach has at MIT by Prof. J. W. Forrester in late sixties. It amalgamates ideas developed in various system theories. It is a branch of control theory, which deals with socio-economic systems and also a branch of management science, which deals with the problems of controllability. It is a way of studying the behaviour of any systems to show how policies, decisions, structure and delays are inter-related to influence growth and stability. It integrates the separate functional areas of management – marketing, investment, research, personnel, production, accounting etc. Each of these functions is reduced to a common basis by recognizing that any economic or corporate (candidates, instructed) activities consists of flows of money, orders, materials, personnel, and capital equipment. These five flows are integrated by an information network. Industrial dynamics recognizes the critical importance of this information network in giving the system its own dynamics characteristics.

It combines both qualitative and quantitative aspects to explore, realize and communicate complex ideas. The qualitative part entails the creation of causal relationship, in which variables are mapped in a cause and effect relationship pattern.

The quantitative aspect involves the development of a computer model based upon a "stock and flow diagram, and equations which depict interrelated variables in the system. Stock variable (rectangles) represents the state variables and are the accumulations in the system. Flow variables (valves) alter the stocks by filling or draining the stocks. Arrows point the causal relation between two variables and also reflects the flow of information within the model structure.

System dynamics models, however, have two important differences which are major advantages:

1. They allow for far more complex multiple interrelationships of variables over time, and outcomes of those relationships are calculated by the model rather than being done externally and inputted in advance.

2. They can include the impact of variables which are not normally subject to quantification. This is done by arbitrarily assigning a value of 1.00 to a subjective variable, and allowing it to vary based on the management group's expectations of what would happen under certain conditions.

System thinking and dynamics plays an important role in understanding the relationship between strategic choices and its outcomes. Five decades ago, Jay Forrester, regarded as the father of SD, started to advocate for the application of systems and feedback theory to the formulation of organizational and social policies (Forrester, 1961). Peter Senge's *The Fifth Discipline* (1990) has been an important source for understanding system thinking and dynamics to a wide audience. SD importance is rooted on the decision-makers limitations to fully understand their environment and business system realities due to three main conditions: complexity, uncertainty, and cognition limitations (Folke, 2006). Rather than try to optimize for a solution, the decision-maker choose for satisfying explanations. This is the groundwork of Simon's "theory of bounded rationality", the type of rationality that a decision-maker draws on when the situation is too complex relative to their limited rational abilities (Simon, 1979). He reasons that decision-making in practice challenge existing assumptions that "…decision-makers pursuit optimal choices in all conditions." For the operational strategist this discussion implies that he/she will be only somewhat capable of retaining and manipulating sufficiently representative information and structural relations during the process of strategy formulation due to the steering of intermediaries, which may be particularly difficult to anticipate and control (Nobs, Minkus, & Rummert, 2007).

In SD, a system is a way of understanding any dynamic process and many complex relations in the organizations. SD creates a representation of the operations choices and studies their dynamics, facilitating the understanding of the relation between the behavior of a system over time and its underlying structure and decision rules. Better performing organizations attempted to gain an understanding of the system structure before they proceeded to develop strategies and take action. Concisely, SD is based on a structural theory that offers a panorama on operations strategy issue

Rahdari and et.al (2007) discussed the model the effects of fluctuations in world steel price on stockprice of one of Iranian steel producers. They also offer some policies to mitigate the global fluctuation effects on stock price of steel-makers in Iran

Sahay (2011) highlighted an application system dynamics methodology and develop a cause and effect relationship model for corporate strategy, which has potential of integrating board parameters/variables significant in corporate strategy development.

Kumar and Vrat (1989) discussed the application of system dynamics to simulate the production flow in a steel plant. The feedback concepts underlying the model of a production shop were discussed. Models of various shops were assembled to construct the entire flow of the steel production system. The applications of the model in the area of corporate planning were discussed.

Sahay (1984) stated that system dynamics model validation is a systematic trial-search process. He emphasized the use of both qualitative and quantitative criteria for model validation followed by sensitivity testing for monitoring information economically for the purpose of exercising desired controls in organizational functions to achieve its goals.

King et al (1983) conceptualized an integrated general model of business performance that combined the individual management disciplines of industrial economics, reenfield theory and business policy within the framework of a dynamics feedback model. Measures to assess the position of a company in its business environment and the process of strategic choice were discussed.

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Brugnoli (1999) states that Trainers can improve the evaluation-decision process of management through improving its system thinking capabilities.

Gary et al (2008) have found that there is opportunity for system dynamics research to develop explanations for the observed longitudinal patterns of performance differences among firms. Such work addresses an important issue for policy makers, shareholders, and general managers, and would make enormous contributions to the strategy field.

3. Objectives of the Paper

Objective of this research paper is to prepare an integrated dynamic model for improving the performance of Indian steel company both in its operational performance (installed capacity actual production, market share, manpower involved etc.) as well as financial performance (return on investment, expenditure and revenue etc.). Authors have chosen system dynamics techniques for developing a model among the availability of number of management science tools and techniques due to its effective and dynamics behavioural pattern.

4. Steel Industry

Steel industry is a booming industry in the whole world. The increasing demand for it was mainly generated by the development project that has been going on along the world, especially the infrastructural works and real estate projects that has been on the boom around the developing countries. Steel industry was till recently dominated by the United Sates of America but this scenario is changing with a rapid pace with the Indian steel companies on an acquisition spree.

Steel Industry has grown tremendously in the last one and a half decade with a strong financial condition. The increasing needs of steel by the developing countries for its infrastructural projects have pushed the companies in this industry near their operative capacity.

The main demand creators for Steel industry are Automobile industry, Construction Industry, Infrastructure Industry, Oil and Gas Industry, and Container Industry.

The Steel industry has enough potential to grow at a much accelerated pace in the coming future due to the continuity of the developmental projects around the world. This industry is at present working near its productive capacity which needs to be increased with increasing demand.

It is common today to talk about "the iron and steel industry" as if it were a single entity, but historically they were separate products. The steel industry is often considered to be an indicator of economic progress, because of the critical role played by steel in infrastructural and overall (*"Steel Industry". Retrieved 2009-07-12.*)

The economic boom in China and India has caused a massive increase in the demand for steel in recent years. Between 2000 and 2005, world steel demand increased by 6%. Since 2000, several Indian and Chinese steel firms have risen to prominence like Tata Steel (which bought Corus Group in 2007), Shanghai Baosteel Group Corporation and Shagang Group. ArcelorMittal is however the world's largest steel producer.

In 2008, steel began trading as a commodity on the London Metal Exchange. At the end of 2008, the steel industry faced a sharp downturn that led to many cut-backs. (*Unchiselled, Louis (2009-01-01). "Steel Industry, in Slump, Looks to Federal Stimulus". The New York Times. Retrieved 2012-04-15*)

Iron and steel are used widely in the construction of roads, railways, other infrastructure, appliances, and buildings. Most large modern structures, such as

stadiums and skyscrapers, bridges, and airports, are supported by a steel skeleton. Even those with a concrete structure will employ steel for reinforcing. In addition, it sees widespread use in major appliances and cars. Despite growth in usage of aluminium, it is still the main material for car bodies. Steel is used in a variety of other construction materials, such as bolts, nails, and screws (*Ochshorn, Jonathan (2002-06-11). "Steel in 20th Century Architecture". Encyclopedia of Twentieth Century Architecture. Retrieved 2010-04-26.*) Other common applications include shipbuilding, pipeline transport, mining, offshore construction, aerospace, white goods (e.g. washing machines), heavy equipment such as bulldozers, office furniture, steel wool, tools, and armour in the form of personal vests or vehicle armour (better known as rolled homogeneous armour in this role).

Authors have chosen the field of steel sector for the study because Indian Steel sector has large contribution in development of economic base and industrialization in India. The demand of steel is growing day by day due to its need in rapid development of infrastructure, Construction Company, power sector, telecommunication, railways, etc.

In India both public and private sector companies are involved in producing steel. Steel Authority of India (SAIL), Rashtriya Ispat Nigam Ltd. (RINL), NMDC Ltd., Maganese Ore (India) Ltd., MSTC Ltd., Hindustan Steel works Construction Ltd, MECON Ltd., Bharat Regrafactories Ltd., Sponge Iron India Ltd., Kundremukh Iron Ore Company Ltd. are the Indian government undertaking public sector's steel plants and Tata Steel Ltd., Essar Steel Ltd., JSW Steel Ltd., Jindal Steel & Power Ltd., Spat Industries Ltd. Bhusan Power & Steel Ltd., Monnet Ispat & Energy Ltd., Sponge Iron Industry, Pig Iron Industry, Electric Arc Furnace Industry, Induction Furnance Industry, Hot Rolled Long Products Units, Steel Wire Drawing Units, Hot Rolled Steel Sheets/Strips/Plates Units, Cold Rolled Steel Sheets/Strips Units, Galvanised and Color Coated Sheets/strips Units, Tin Plate Units are private sectors companies

Steel production in India has increased by a compounded annual growth rate (CAGR) of 8 percent over the period 2002-03 to 2006-07. Going forward, growth in India is projected to be higher than the world average, as the per capita consumption of steel in India, at around 46 kg, is well below the world average (150 kg) and that of developed countries (400 kg). Indian demand is projected to rise to 200 million tonnes by 2015. Given the strong demand scenario, most global steel players are into a massive capacity expansion mode, either through brownfield or greenfield route. By 2012, the steel production capacity in India is expected to touch 124 million tonnes and 275 million tonnes by 2020. While greenfield projects are slated to add 28.7 million tonnes, brownfield expansions are estimated to add 40.5 million tonnes to the existing capacity of 55 million tonnes.

5. System Dynamics Modelling for Corporate Performance of Indian Steel Company

Improvement in corporate performance in traditional way primarily made through the decision makers at various levels such as board of the corporation and the managers of the works based on comparing and judging various identifies factors and the corporate performance empirically; or through factor analysis combining methods of investigating exceptions and drawing commonality in the pattern of the outcome and the behaviour; or using regression analysis/multi-variant analysis or econometric model.

These approaches provide very broadly the future course of action without understanding intrinsic causes. They are piece meal approach and laps coherence and system thinking and dynamics of the system. The application of system dynamics methodology attempts on improvement intervention based on system thinking and has potential to solve complex problem. Sector-wise simulated results are discussed below.

5.1Demand and capacity

Here, demand of product and installed capacity are considered as a level variable. Demand of product is 31000 MT and installed capacity is 3500 MT/year in the reference year 2001.

Figure 1 show that demand of product is increases with demand of product increasing rate and demand of product increasing rate is calculated by demand rising fraction multiply by demand of product and divided by year. Installed capacity is depend on installation time and additional capacity multiplier.

Market share is an auxiliary variable and it has calculated by demand of product, sales and demand fulfilling factor.

We can see in figure 2 that demand of product in the country and installed capacity increases every year. It has rise from 31000 MT to 51000 MT (64.5%) and installed capacity of the company has increased 3500 MT to 6000 MT (71.4%) in six year.

5.2 Revenue and Expenses

In this sector, manufacturing cost, other expenses, loans & advances are considered as level variables. Manufacturing cost changes over the time with the help of increase in manufacturing cost rate and manufacturing cost rate is effected and percentage increase in manufacturing cost per year. Similarly other expense also changes with other expenses increasing rate and inflation rate of general commodity per year. loans & advances changes. Revenue is calculated with sales and price per TMT

and for the calculation of price per TMT, selling price in ref year, product mix factor and ratio of current inflation index to normal index have taken.
Board members salary and compensation, salary of employee, annual manufacturing cost, annual other expenses, S&A expenses, interest payment have considered to calculated expenditure.

5.3 Corporate Performance

In this sector, authors have assumed that desired corporate performance level should be minimum 60 in the reference year 2001 and for the result of corporate performance index; they also have calculated total corporate performance with market share, profit, installed capacity, employee, shareholders etc. and for each variables, there is some weigthages point.

5.4 Validated criteria for the developed model

For validation, very few selected performance indicators for enhancing the performance of corporate has taken like employee's strength, no. of shareholders, installed capacity, return on investment, market share, expenditure, revenue etc.

The validation in the system dynamics modelling means behaviour of the model is resembles the actual behaviour of the system. This means from the model, some important variables are chosen and their simulated behaviour is compared with actual values for the reference period.

The SD model with the data collected from the company's report of the reference year 2001 has been simulated. The results are observed both in the tabular and graphical form for important variables from each sector. By modifying some of the structural relationships, values of some multipliers and graph functions and simulated till acceptable model output is obtained.

Figure 1. Demand and Capacity Stock- flow diagram

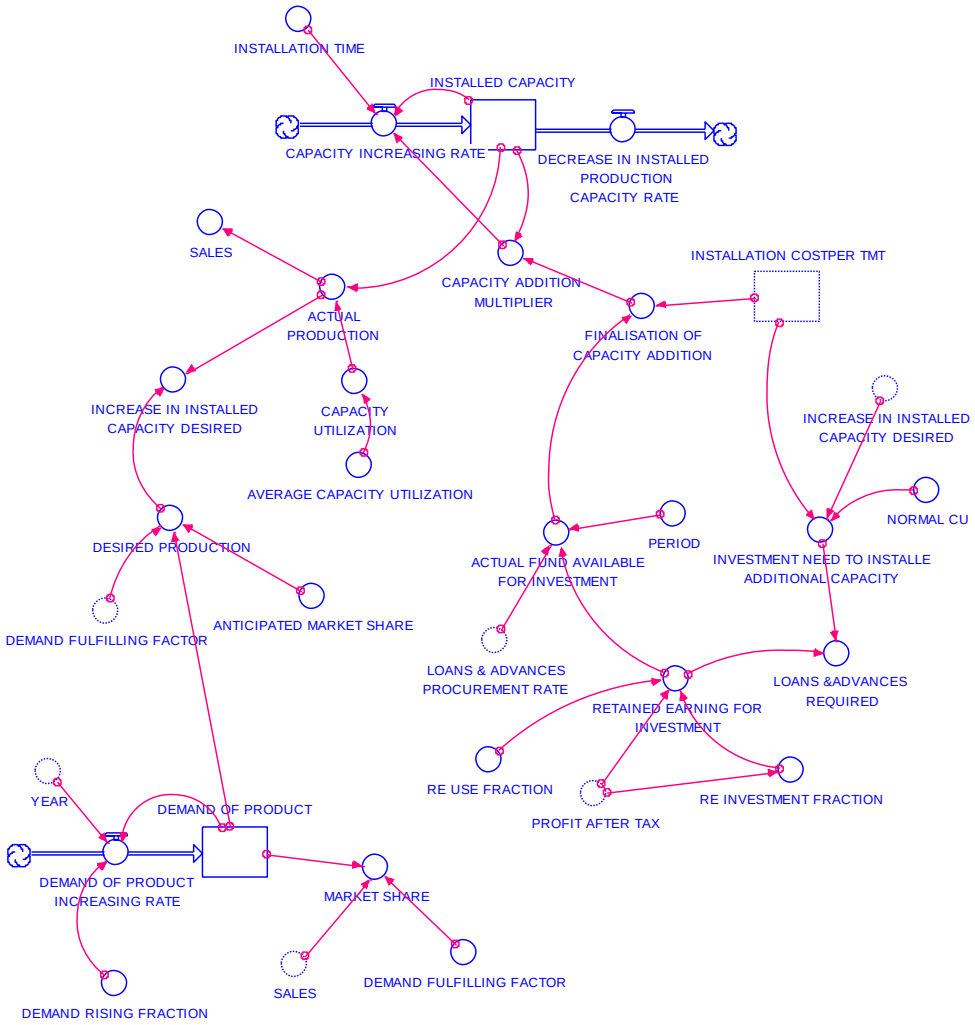


Figure 2. Standard run of demand of product and installed capacity of the company

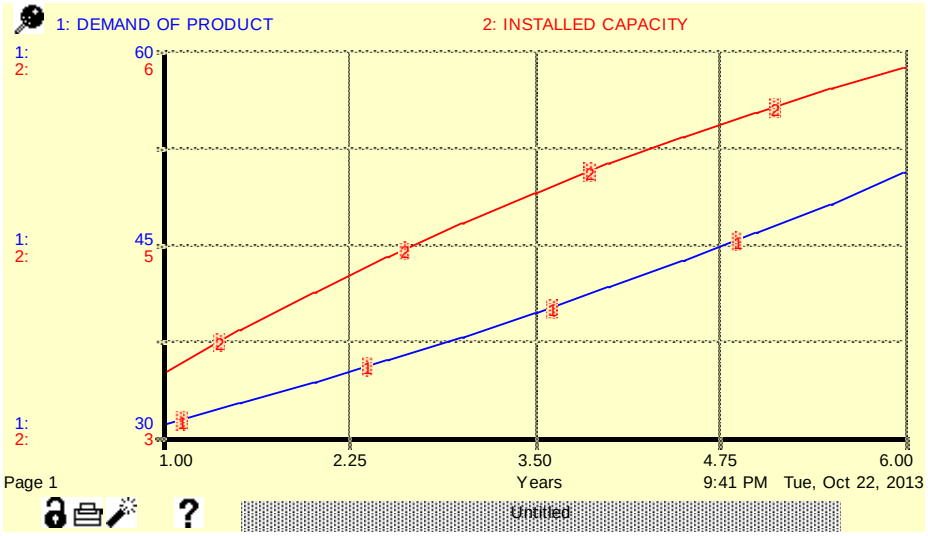


Figure 3. Demand and Capacity Stock- flow diagram

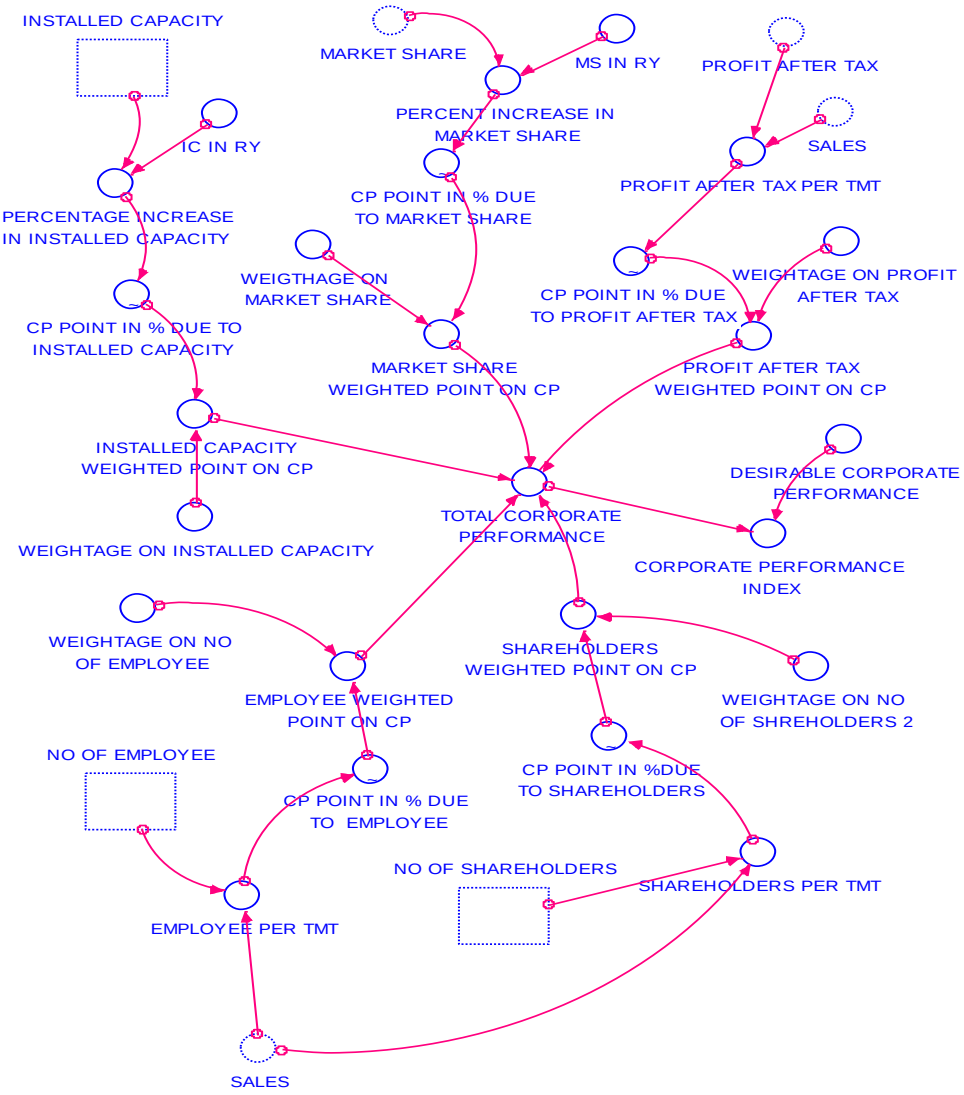
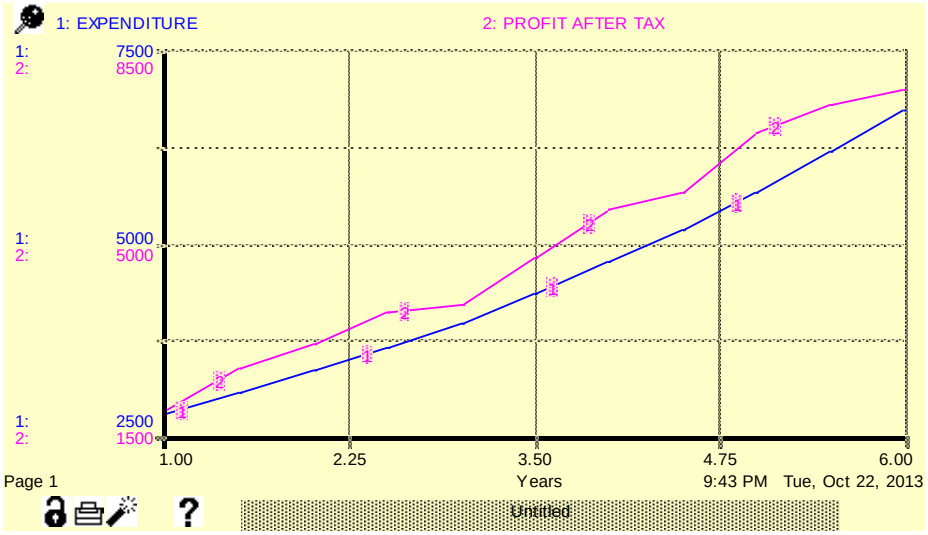


Figure 4. Standard run of demand of product and installed capacity of the company

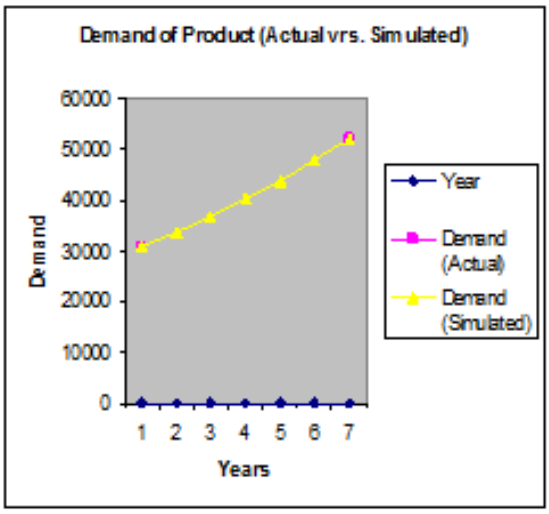


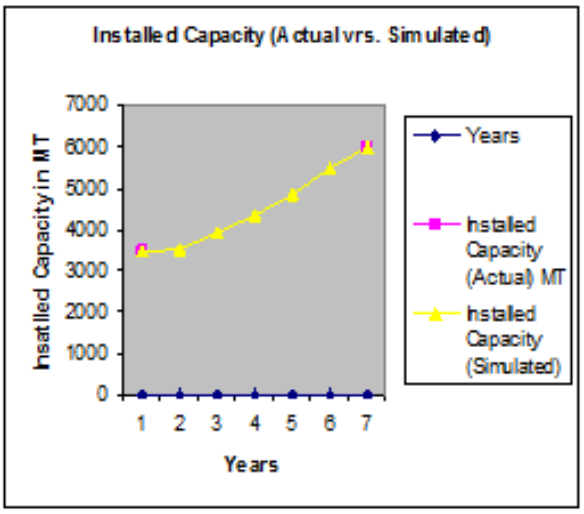
The process of validation progresses after having the initial run often, if modeller finds some erroneous and implausible results, by modifying some of the erroneous structural relationships included in the model by mistake or wrong assumptions or assumed values, of some multipliers, or graph functions etc (taken earlier with some assumptions) The model is run for simulation again and again incorporating some modifications each time, till valid output is obtained.

An attempt has been made to compare the model behaviour with that of the actual data for employee, shareholders, installed capacity, production capacity, revenue, expenditure, return on investment, market share etc as depicted in figures they show close resemblance.

In the reference year installed capacity of the company is 3500 MT and it increases year by year. This table shows the comparison of actual vs. simulated result.

Figure 5. The comparison of actual vs. simulated result





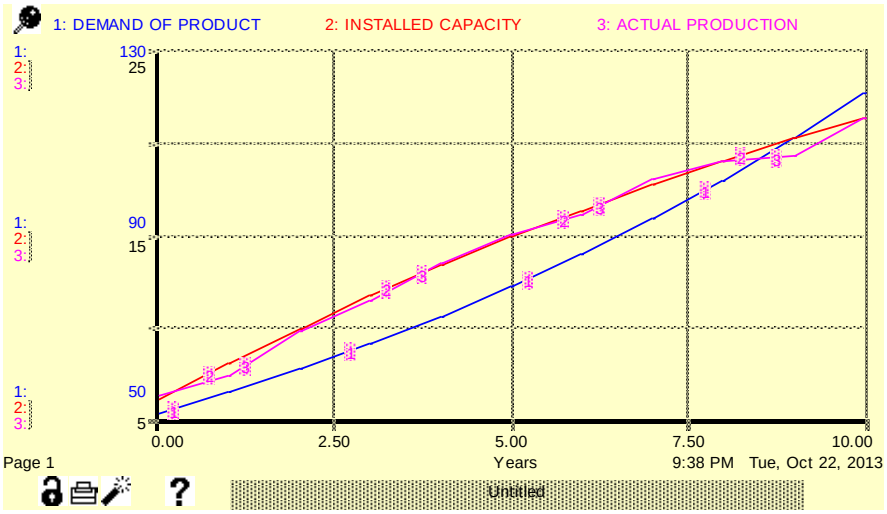
5.5 Future Projection

For knowing the corporate performance in future years say (2008 to 2017), reference year has been changed to the year 2006-2007 and initial values of variables and some other values taken accordingly, keeping other values and relationships is structure of the model unchanged for simulation. This means without modify the structure of the model, the model is run for simulation for next ten years.

The projected result shows for next ten years i.e. 2017, in 2007 installed capacity of the company is 6,000 MT/ year and it shall be double after 3 years (2010) and in 2017 it shall be 22,950 MT. Even company wants to double its capacity by 2010.

Demand of product in the country is shall be from 51,000 MT to 110,000 MT from 2007 to 2017. 11th Five Year Plan of India (ministry of steel) and National Steel Policy of India indicated the demand growth will be 121,000 MT by 2019.

Figure 6. Future projected result of demand of product, installed capacity and actual production of the company



6. Conclusion

System Dynamics is a powerful method to gain useful insight into situations of dynamic complexity and policy resistance. It is increasingly used to design successful policies in companies and public policy settings. In this paper we reported an ongoing research effort to study the performance of corporate. iThink© software has been extensively used to develop a comprehensive system dynamics model of corporate performance. We have also utilised the computer simulation tools of the software to handle the high complexity of the resulting feedback model.

System dynamics model for the corporate performance developed has been put to generate model behaviour by simulating using solution interval 1 year and 6 years as simulation run length with initial values for the year 2001. For future projection, solution interval is 1 and simulation length is 10 yrs with initial value for the year 2007.

The performance of corporate lies not only in having efficient plan but by implementing the plan efficiently to enhance the desired performance without much of deviations.

References

1. Beaver G. (2000), Strategy, performance and governance: the sensitivity of remuneration, Journal of Strategic Change 9(6): September/October, 327-331
2. Bonoma, T. V. & Clark, B. H., 1998, Marketing Performance Assessment", Harvaed Business School Press, Boston.
3. Brayn, Lowell L. (2007) The new metrics of corporate performance: Profit per employee, Mckinsey Quaterly
4. Brown D.Michael (1994) Measuring corporate performance, Long Range Planning, Volume 27, Issue 4, August 1994, Pages 89–98
5. Brugnoli Carlo (1999), System Thinking and Corporate Stagey, System Dynamics conference Procedding, 1999
6. Cheng, Shijun (2008), Board size and the variability of corporate performance, Journal of Financial Economics, Volume 87, Issue 1, January 2008, Pages 157–176
7. Clark, B. H. 1999, "Marketing Performance Measures: History and Interrelationships", Journal of Marketing Management, Vol. 15, pp. 711-732.
8. Collins, Jim (2001) Good to Great: Why Some Companies Make the Leap...and Others Don't,Random House
9. Coyle R. G., (1972), The Dynamics of a Mining Enterprise, 10th International Conference on decision making in the Mineral Industry, Johannesburg.
10. Dahya, Jay; McConnell, John J.; Travlos, Nickolaos G. (2002), The Cadbury Committee, Corporate Performance, and Top Management Turnover, The Journal of Finance, Volume 57, Issue 1, pages 461–483,
11. Dahya ' Jay and McConnell, John J. (2007), Board Composition, Corporate Performance, and the Cadbury Committee Recommendation, Journal of Financial and Quantitative Analysis, Journal of Financial and Quantitative Analysis, 42 : pp 535-564
12. Dangerfield B. C., (1986), System Dynamics as an aid to the present day Corporate Strategic Policy Making, 2nd European Simulation Congress, Antwerp, Belgium.
13. Daqing Qi, Woody Wu, Hua Zhang (2000), Shareholding structure and corporate performance of partially privatized firms: Evidence from listed Chinese companies, Pacific-Basin Finance Journal Volume 8, Issue 5, Pages 587-610
14. Fey W. R., (1962), An Industrial Dynamics Case study, Industrial Management Review, 4(1), PP 79-99.

15. Firth, Michael; Fung, Peter M.Y.; Rui Oliver M. (2006), Corporate performance and CEO compensation in China, Journal of Corporate Finance, Volume 12, Issue 4, September 2006, Pages 693–714
16. Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses . Global Environmental Change , 253-267 .
17. Forrester, J. (1961). Industrial Dynamics. Cambridge, MA: MIT Press.
18. Gary, Michael Shayne; Kunc, Martin; Morecroft John D. W. and Rockart, Scott F. (2008) System Dynamics and Strategy, System Dynamics Review. 24, 407–429
19. Guest, David E.; Michie, Jonathan; Conway, Neil; Sheehan, Maura (2003), Human Resource Management and Corporate Performance in the UK, British Journal of Industrial Relations, Volume 41, Issue 2, pages 291–314,
20. Harold Demsetz and Belén Villalonga, (2001) Ownership structure and corporate performance, Journal of Corporate Finance, Volume 7, Issue 3, Pages 209-233
21. http://steel.gov.in/overview.htm
22. http://steel.nic.in
23. http://steel.nic.in/dev2.htm
24. http://www3.inderscience.wiley.com/cgi-bin/fulltext/85009266/PDFSTART
25. Irala, Lokanandha Reddy, Corporate Performance Measures in India: An Empirical
26. Analysis, WP-2007/01/A available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=964375
27. Ittner, C. D. & Larcker, D. F., 1998,"Innovations in Performance Measurement: Trends and Research Implication", Journal of Management Accounting Research, Vol. 10, pp. 205-238.
28. Joy, Lois; Carter, Nancy M; Wagner, Harvey M.; and Narayanan Sriram (2007) The Bottom Line: Corporate Performance and Women's Representation on Boards, Catalyst Inc USA
29. Kalpan, R. S. & Norton, D. P., 1992, "The Balanced Scorecard – Measures that Drive Performance", Harvard Business Review, January-February, pp. 71-79.
30. King P. D. A., Coyle R. G. and Wolstenholme E. F., (1983), A General System Model of Business Performance, Proc. of the 1983, International System Dynamics Conference, MIT, USA.
31. King P. D. A., Coyle R. G. and Wolstenholme E. F., (1983), A General System Model of Business Performance, Proc. Of the 1983, International System Dynamics Conference, MIT, USA.
32. Kokkinaki, F. & Ambler, T., 1999, "Marketing Performance Assessment: An Exploratory Investigation into current Practice and the Role of Firm Orientation", Marketing Science Institute, Working Paper, No. 99-114.
33. Kumar R. and Vrat P., (1989), Using Computer Model of Material Flow-Case of a Steel Plant, Proc. International System Dynamics Conference, MIT, USA.
34. Legasto A. A and Maciariello J., (1980) System Dynamics: A Critical Review, TIMS Studies in the Management Science 14, PP 23-24.
35. Majumdar, S. (1997), "The Impact of Size and Age on Firm-level Performance: Some Evidence from India", Review of Industrial Organization 112, 231-242
36. Mandal Purnendu, Love, Peter E. D., Gunasekaran, A. (2002) , Towards a system dynamics modelling framework for quality in manufacturing, International Journal of Manufacturing Technology and Management 2002 - Vol. 4, No.3/4 pp. 333-343
37. Milling P. M., (1988), Subjective Knowledge Bases in Corporate Policy Making, Proc. of the 1988 International Conference of System Dynamics Society, La Jolla, CA.
38. Neely, A., Adams, C. & Kennerley, M. 2002, "The Performance prim – the scorecard for measuring and managing business success", FT Prentice Hall, London.
39. Norburn, David; Birley, Sue (1998), The top management team and corporate performance, Strategic Management Journal, Volume 9, Issue 3, pages 225–237,
40. Nobs, A., Minkus, A., & Rummert, A. (2007). Implementing and Controlling an Operations Strategy in Global Industrial Service Networks. In Advances in Production Management Systems (pp. 19-26). Boston: Springer
41. Perelman L.J., (1980), Time in System Dynamics, TIMS Studies in Management Science 14, PP 75-89.
42. Phillillips, B. & Shanka, T., 2002, "Balanced Scorecard (BSC) Measures in Small and Medium Enterprises (SMEs) – An Exploratory Study", in R. Shaw, S. Adam & H. McDonald (eds.). Proceedings of the Australian and New Zealand Marketing Academy Conference (ANZMAC) 2002, Melbourne, Australia, pp. 2452-2456.
43. Prasetyantoko, A. and Parmono, R. (2008), "Determinants of Corporate Performance of Listed Companies in Indonesia" from http://mpra.ub.uni-mucnchen.de/6777/MPRA-paper-6777.pdf
44. Rahdari, Hossein; Forouzan, Alireza; Ramezankhani, Atefeh; Foroughi Pouyan (2007), Analyzing the Effect of Global Steel Price Fluctuation on Iran's Steel-Maker Stock Prices: A System Dynamics Approach, retrieved (may 2012) from http://www.systemdynamics.org/conferences/2009/proceed/papers/P1137.pdf
45. Renée B. Adams, Heitor Almeida, Daniel Ferreira (2005), Powerful CEOs and Their Impact on Corporate Performance, Review of Financial Studies, Volume18, Issue4, Pp. 1403-1432 available at http://rfs.oxfordjournals.org/content/18/4/1403.short
46. Reserve Bank of India's Report, 2001,2002,2003,2004,2005,2006,2007
47. Richard et al. (2009): Measuring Organizational Performance: Towards Methodological Best Practice. Journal of Management.
48. Roberts N., (1983), Computer Simulation using System Dynamics, Adison-Wesley, Reading, Massachusetts.
49. Sahay, Mridula (2011) Corportat Strategy through System Dynamics, System thinking and System Dynamics, System Thinking and System Dynamics, Macmillan Publishers India Ltd., India pp. 64-75
50. Sahay S. S., (1984), Some Studies on a Comprehensive Procedure for corporate Long Range Planning Using System Dynamics and Goal Programming Techniques, Ph. D. Thesis, Indian Institute of Technology, Kharagpur.
51. Senge, P. (1990). The Fifth Discipline. Garden City, NY: Doubleday Currency.

52. Sheth, J. N. & Sisodia, R. S., 1995, "Feeling the Heat", Marketing Management, Vol. 4, No. 2, pp. 8-23.
53. Simon, H. (1979). Rational Decision Making in Business Organizations. The American Economic Review , 493-513 .
54. Spencer R. S., (1966), Modeling Strategies for Corporate Growth, Conf. of American Association for the Advancement of Science, Washington D. C.
55. Sterman, J. D. 2003. Business Dynamics: Systems Thinking and Modelling for a Complex World, McGraw Hill
56. Steve Engelen, Hilda Meersman, & Eddy Van De Voorde (2006), Using system dynamics in maritime economics: an endogenous decision model for shipowners in the dry bulk sector, Maritime Policy & Management, Volume 33, Issue 2, pp 141-158
57. Vij A. K., Vrat P., Sushil, (1987), Application of System Dynamics to Energy Modeling in the National Economy – Conceptual Framework, Proc. Second National Conference on System Dynamic Varanasi, January 15-17, 1987.
58. Wheelen, T. L. & Hunger, D. J., 2002, "Startegic Management and business policy" 8th Ed. Prentice Hall, New Jersey.
59. Wiener N., (1948), Cybernetics on Control and Communication in the Animal and Machine, MIT Press.
60. Wolstenholme E. F. and Coyle C. G., (1983), The Development of System Dynamics as a Methodology for System Description and Quantitative Analysis, Jr. Operations Research Society, 34(7), PP 569-581.
61. Wright R. D., (1971), Industrial Dynamics Implementation: Growth Strategies for a Trucking Firm, Sloan Management reviews. 13(1), PP 71-86.
62. www.tatasteel.com
63. .World Steel Industry, Economic Watch June 2010, retrieved from http://www.economywatch.com/world-industries/steel-industry/?page=full on May 2012