CHAPTER 3:

RESEARCH METHODOLOGY

3.1 Introduction: In the previous chapter, we have reviewed the literature and observed the cost behavior and cost efficiency of firms. This chapter has introduced the research methods used for the study. Moreover, it contents how the sampling was framed and how the data collection was carried out. Research Methodology proposed to be adopted for the study and discussed here includes data source, sampling design, variable description, and analysis techniques. These are discussed below:

3.2 Source of Data and Data Collection: Data and information for the purpose of the study are mainly collected from secondary sources. Secondary data are collected from Annual Reports, Bombay Stock Exchange, National Stock Exchange and Capitaline Corporate Database. Data like Market Capitalisations, names of listed or unlisted companies, etc. are mainly collected from BSE and NSE. Further, financial data, cost related data and industry specific data are collected from companies' Annual Report, Capitaline Corporate Database (data updated up to 31 March 2014) and various Government websites.

3.3 Sampling Design: The sampling frame comprises of the complete scheduling of listed companies from which the sample is drawn. The sampling frame, ideally, should include all the sampling units in the population (Frankfort-Nachmias & Nachmias, 1996). Population refers to the total collection of elements about which we wish to make some inferences (Cooper & Emory, 1995).

The universe of the study is the listed Indian companies publishing audited Annual Reports continuously over the periods of 12 years during the study period, i.e. from 2002-03 to 2013-14. Out of the total numbers of listed companies (which were 8790 in March 2014), 2828 companies are continuously publishing Audited Reports during 12 years, as per Capialine Corporate Database, BSE and NSE.

TABLE 3.1: COMPANIES LISTED ON STOCK EXCHANGES

			Listed Companies
a.	**Listed companies in India**-(b+c+d)*		**8790** *(76 Industries)*
b.	Listed on NSE (FY 2014)	1961	
c.	Listed on BSE (FY 2014)	5592	
d.	Listed in Others Sock Exchange	1237	
e.	**Listed companies with continuously publishing annual reports for 12 years.**		**2828**

Sources: Capitaline Corporate Database, BSE India, NSE India. As on 31st March, 2014.*

For selecting sample for the study, first, we have selected two broad Sectors – Service Sector (24 Industries; 1173 companies) and Manufacturing Sector (43 Industries; 1583 companies). [{Comprising of 88.16% of Industries, i.e. (24+43)/ 76 }and {97.45% of companies, i.e. (1173 + 1583)/2828}]. Total companies under two Sectors are shown in *Annexure-I.*

We have selected top three Industries from both the Sectors on the average ranking method based on Total Assets, Sales, and Market Capitalization. This ranking procedure is widely used in the existing literature (Hart and Oulton, 1996) (Kumar et al, 1999), (Kirchhoff & Norton,1992),(Dang & Frank Li, 2013), etc. Selection procedure of Industries is highlighted in *Table no 3.2.*

TABLE 3.2: SELECTION OF INDUSTRIES BASED ON AVERAGE RANKING METHOD

Industries	Gross Sales*	(A) Rank	Market Capitalization*	(B) Rank	Total Assets*	(C) Rank	(D)** Avg. Rank
Banking	738007.83	2	816737.57	2	9044051	1	1.67
Refineries	1537249.74	1	421271.62	3	573315.5	3	2.33
IT-Software	209289.66	4	914570.36	1	191730.5	7	4.00
Finance	144568.41	7	350396.84	5	1136366	2	4.67
Power Gen. & Dist.	151230.58	6	286652.73	10	555423.3	4	6.67
Steel	254334.68	3	145175.85	14	383901.3	5	7.33

Source: Complied and calculated by the researcher
**Values (Rs. Crore) as on March 2014; **Average ranking calculated above is D= (A+B+C)/3.*
Note: Ranking of all Industries are shown in Annexure-II.

Selected three Service Industries (618 companies) has covered 66% (sales turnover) of total sales of Service Sector and three Manufacturing Industries (120 Companies) has covered 58% of total sales of Manufacturing Sector.

Among the selected six Industries (738 companies) we have chosen top 21 companies from each Industry (based on average ranking method), which are the required minimum sample size for applying DEA model (total 108 companies, subject to availability of data). DEA model used in most of the similar studies(Cooper, W.W. et al., 2007),(Mahoney et al.1972), (Hitt & Ireland (1984), (Patibandla, 1995), (Onyeiwu, 2003) and (Ali, 2004).

Sample size under DEA model is calculated on the basis of Inputs and outputs. And Decision Making Units (DMUs), (which is also the sample size) is calculated as the maximum of (m x s) or 3 x (m + s). In the present study the inputs is (m=4) and output is (s=3), i.e. DMU is = 3 X (4+3) = 21(Cooper, W.W. et al., 2007). DEA models have discussed in details later in this Chapter and also in *Chapter 6.*

Based on the predetermined criteria, finally, we get 108 companies as the sample units, i.e. 21 from IT-Software industry, 21 from Banking, 21 from Finance, 7 from Refineries, 17 from Power Generation and Distribution and 21from Steel (only 7 companies from Refineries industry and 17 companies from Power Generation and Distribution industry are continuously publishing Annual Reports for 12 years). Ranking of sample companies are shown in *Annexure-III to VIII.*

The selected sample companies cover the major portion of the market share of the total sales of the respective industry, which is shown in *Table no 3.3* below.

TABLE 3.3: MARKET SHARE OF SELECTED COMPANIES OF TOTAL SALES TURNOVER OF THE RESPECTIVE INDUSTRY

Industries	Market Share (% of Sales Turnover)
IT-Software	94.05%
Banking	88.63%
Finance	79.62%
Steel	91.77%
Power Generation and Dist.	89.72%
Refineries	100%
	90.63% (Average)

Source: Complied and calculated by the researcher

Note: Detailed Market share of all sample companies are shown in Annexure-IX.

Market share of selected top companies varies from 79.62% to 100%. We have selected top ranking companies from each industry in order to provide a benchmark relating to cost structure strategies in respective industries. This is because the other companies normally follow the standards taken by the top companies in the respective industries.

3.4 Data Analysis Techniques:

Data analysis techniques used for the purpose of the study is different for different objectives. The Techniques used are discussed below:

3.4.1 Methodology Applied for Objective Number One

Objective: To investigate the major cost components of the firms and its behavior over the years.

To investigate the major cost components of the selected six industries and sample companies from each industry, we have calculated the proportion of each cost elements to total expenditure (each year). Graphical representation of industry & company's cost structure (based on total expenditure) shows the details pictures of major cost elements in each industry and sample companies of the industry.

To get an idea of cost behaviour of major cost elements on selected industries, we have applied ABJ regression model (Anderson, Banker & Janakiraman, 2003) (referred to as ABJ). ABJ highlighted two models of cost behavior; (a) non-sticky "traditional model of cost behavior", and (b) sticky or anti-sticky cost behavior. The asymmetric cost behaviour literature suggests that there are two competing hypotheses, i.e. sticky cost behaviour hypothesis and anti-sticky cost behaviour hypothesis (Banker & Byzalov, 2014). Costs are said to be "sticky" if they increase to a greater extent for a 1% increase in sales revenue than they decrease for a 1% decrease in sales revenue (ABJ, 2003). Conversely, costs are "anti-sticky" if they increase to a lesser extent for a 1% increase in sales revenue than they decrease for a 1% decrease in sales revenue (Weiss, 2010).

The ABJ model:

$$\text{Log}\left(\frac{TC_{i,t+1}}{TC_{i,t}}\right) = \alpha + \beta_1 \times \log\left(\frac{S_{i,t+1}}{S_{i,t}}\right) + \beta_2 \times dec \times \log\left(\frac{S_{i,t+1}}{S_{i,t}}\right) + \varepsilon.$$

Where,

TC_{it} is total cost and S_{it} is the sales of firm i in period t, and 'dec' is an indicator that assumes value = 1 if sales decline from period t to period t+1, and 0 otherwise. In this equation, the coefficient β_1 measures the percentage change in costs associated with a 1% increase in sales activity. Coefficient β_2 measures the behaviour of cost, $\beta_2 < 0$ if the sticky cost model holds; $\beta_2 > 0$ if the anti-sticky cost model holds; $\beta_2 = 0$ if the traditional model of cost behavior holds. The sum of the coefficients, $\beta_1 + \beta_2$, measures the percentage change in costs associated with a 1% decrease in sales activity.

3.4.2 Methodology Applied for Objective Number Two

Objective: To study the impact of cost components on firm performance.

To study the impact of cost components on the firm performance we have used multiple regression models separately for two depended variables, i.e. RNP (Reported net profit) and ROA (Return on assets) and major costs are the independent variables.

We have considered RNP as the bottom line of the companies for the direct impact of cost components and ROA ratio to show the benefit from the improvement of the profit as a result of cost control.

In Regression equation, we have used the dummy variable for the show the impact of the recession on RNP and ROA.

Usually, the dummy variables take on the values 0 and 1 to identify the mutually exclusive classes of the explanatory variables. For example,

D = {0 if the year is under recession periods
{1 if the year is under post-recession periods

Consider the following model with x_{it} as quantitative variables and D as dummy variable

$$y = \beta_0 + \beta_1 x_{it} + \beta_1 D_{it} + \mathcal{E},$$
$$E(\mathcal{E}) = 0,\ Var(\mathcal{E}) = \sigma^2$$

Here; β_0 is the unsystematic predictable constant component or the estimated constant, i = Selected companies from respective Industry, t = is time lag, it covers total periods (2003-2014).

3.4.3 Methodology Applied for Objective Number Three

Objective: To examine the cost efficiency of the selected companies during pre and post recession periods.

To examine the cost efficiency in pre and post recession periods, we have applied DEA model. Data Envelopment Analysis (DEA) is a nonparametric approach used to measure the efficiency. DEA is a technique to evaluate the relative efficiency of decision-making units (DMU). DEA uses the linear program as the base of measurement (Fiorentino et al. 2006), that allows comparing the efficiency of a combination of several units of input (Cooper et al., 2000), and several units of output (Casu and Molineux, 1999). Efficiency ratio will produce a value between 0 and 1. The value 1 indicates that Decision Making Unit (DMU) is in full efficient condition and 0 indicates that DMU is totally inefficient-condition. To examine the efficiency of each DMU, we have considered only relevant input and output for the selected six industries.

There are mainly two types of DEA models observed in the DEA literature, namely CCR model (named after Charnes, Cooper and Rhodes, 1978) and BCC model (named after Banker, Charnes and Cooper, 1984), which are applying radial and nonradial approaches. Models which measure radial efficiency are of two types, i.e. input oriented and output-oriented. Input-oriented technical efficiency aims at reducing input amounts as much as possible while keeping at least the present output levels intact, and outpu- oriented technical efficiency maximizes the output level while using at least the present input levels.

Mathematical Formulation of CCR (Charnes, Cooper, and Rhodes) and BCC (Banker, Charnes and Cooper) Models

The first mathematical linear programming based formulation of the frontier analysis was developed by Charnes et al. (1978) after 20 years of frontier analysis technique described by Farrel in 1957.The authors also coined the name Data Envelopment Analysis.

CCR Model

Assuming that, there are n DMUs to be evaluated [DMUj (j = 1, 2… n)]. Each DMU consumes m different inputs of identical nature for all DMUs [x_{ij} (i = 1,2, …..,m)] to produces 's' different outputs of identical nature for all DMUS [y_{rj} (r = 1,2, …….,s)]. x_{ij} and y_{rj} are assumed to be positive ie $x_{ij} \geq 0$ and $y_{rj} \geq 0$ and the further assumption is that each DMU has at least one positive input and one positive output value. Given the data, the efficiency of DMU_k can be measured by the following programming

$$\underset{(\theta, \lambda_j\, s_i^-,\, s_r^+)}{\text{Min}}\ \theta_k - \varepsilon \left(\sum_{I=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right)$$

Subject to

$$\sum_{j=1}^{n} x_{ij} \lambda_j + s_i^- = \theta_k\, xi_k \qquad i = 1,2,\ldots,m.$$

$$\sum_{j=1}^{n} y_{rj} \lambda_j - s_r^+ = y_{rk} \qquad r = 1,2,\ldots,s$$

$$\lambda_j \geq 0 \qquad j = 1,2,\ldots,n$$

s_i^-, $s_r^+ \geq 0$ for all i and r.

Where,

x_{ij} = Amount of input of 'i' utilized by the 'j'th DMU
y_{rj} = Amount of output of 'r' produced by the 'j'th DMU
x_{ik} = Amount of input of 'i' utilized by DMU_k
y_{rk} = Amount of output of 'r' produced by DMU_k
θ_k = efficiency score of DMU 'k' being evaluated
λs represent the dual variables which identify benchmarks for inefficient units.
Slack variables: s_i^- (input slacks), s_r^+ (output slacks)

Here, $\varepsilon > 0$ is an element defined to be smaller than any real number and to be accommodated without having to specify the value of ε.

Above mathematical formulation is the input oriented CCR model (envelopment form or dual form) used in this study to estimate OTE (Overall Technical Efficiency). Note that primal DEA programe and dual DEA programe are relative. The above DEA programe, i.e. input oriented envelopment programe is the dual of the output maximizing multiplier program. In the dual form, the number of constraints is restricted to the number of inputs outputs, whereas, number of constraints of the primal depends on the number of DMUs evaluated.

The above mathematical program yields an efficiency score (θ) of a particular DMU_k only. To get the efficiency score of other DMUs, it is required to repeat this process for each DMU i.e., 'n' optimization one for each DMUj. DMUs for which $\theta < 1$ are inefficient, while DMUs for which $\theta = 1$ are on the frontier line and efficient. Some frontier points or boundary points may be 'weekly efficient' because of presence of non-zero slacks in inputs and/or outputs.

CCR efficient – a DMU is CCR efficient if the optimal solution of the above two-phase procedure satisfies both, (i) $\theta = 1$, and (ii) all slacks are zero. So, DMUs which satisfy both the conditions are also called CCR efficient or strongly efficient or Pareto-Koopmans efficient.

CCR inefficient - a DMU is said to be CCR inefficient -

Case I: if and only if both (i) $\theta < 1$ and (ii) $s_i^- \neq 0$, $s_r^+ \neq 0$ for some i and r. or all slacks are non-zero.

Case II: if and only if both (i) $\theta = 1$ and (ii) $s_i^- \neq 0$, $s_r^+ \neq 0$ for some i and r. This case is also termed as weakly efficient in DEA.

So there are two sources of inefficiencies: purely technical inefficiency represented by the radial measure (1- efficiency score obtained) and mix inefficiency represented by the input and output slack values.

BCC Model

The BCC (ratio) model is one of the most important extensions of CCR model. It measures pure technical efficiency. BCC model differs slightly yet remarkable from CCR model with an additional constraint

$$\sum_{j=1}^{n} \lambda_j = 1$$

in the above CCR envelopment model. This constraint is called convexity constraint in mathematics literature. It helps in assessing the efficiency under VRS.

A DMU is BCC efficient if the optimal solution satisfies both the conditions, i.e. (a) $\theta = 1$, and (b) all slacks are zero. Otherwise, DMU is BCC inefficient.

CCR and BCC Models

The study has utilized two most popular and widely used basic DEA models, i.e. input-oriented CCR model and input oriented BCC models to estimate the relative technical efficiency. CCR model measures the efficiency called overall technical efficiency (OTE) and BCC model measures efficiency called pure technical efficiency (PTE). OTE and PTE allow measuring scale efficiency (SE). SE = OTE/ PTE. So, using these CCR and BCC models the study has estimated three types of efficiencies namely- OTE, PTE, and SE.

Overall Technical Efficiency (OTE) or CCR efficiency under constant returns-to-scale (CRS) assumption represents the efficiency which measures inefficiency due to the wrong mix of input-output configuration, i.e. operational inefficiency as well as scale inefficiency. That is why this efficiency is also called overall technical efficiency (OTE) or (global) technical efficiency or technical and scale efficiency.

Pure Technical Efficiency (PTE) or BCC efficiency under variable returns-to-scale (VRS) measures efficiency without considering the scale of operation. This efficiency is also rightly named as pure technical efficiency (PTE) or technical efficiency which provides inefficiency resulting from managerial underperformance. It is significant to note that PTE is greater than or equal to OTE since VRS frontier is the piecewise boundary and closer to observed inefficient points. If a firm is BCC efficient but not CCR efficient then it is locally efficient but not globally efficient due to scale inefficiency. It is important to note that if a DMU is fully efficient under both CCR and BCC score, the DMU is said to be operating in the most productive scale size, i.e. scale efficiency is 100%.

Scale Efficiency (SE) - Another type of efficiency which measures whether a DMU has the right size of the operation is known as scale efficiency (SE). This is the relationship between a firm's per unit production cost and production volume. Thus, scale efficiency (SE) based on CCR and BCC score is defined by SE = CCR score / BCC score, SE is not greater than one.

Slack-Based Measurement (SBM)

Slack-Based Measurement (SBM) has been used to adjust the flexibility within DEA model. The SBM is non-radial and has ability deals with input and output slacks directly. It measures the efficiency by considering the efficiency score between 0 and 1 and identifies its unity (Lozano and Gutiérrez, 2011). The original SBM model can be computed the ratio between the average of input decrease and the average of output increase. The SBM is both, a non-oriented model and non-radial which does not control the inputs and outputs to be improved uniformly or equip proportionally. Lozano and Gutiérrez (2011) use SBM model to improvement in term of undesirable outputs and parallel with the inputs improvement, these conductions are handled in the conventional SBM DEA model. According to Chang et al. (2014), the desirable and undesirable outputs will be considered jointly weakly disposable and are assumed that the undesirable outputs can be reduced in the same proportion by following the decreasing of desirable outputs. Therefore, the findings in this result can be used for planning in term of best activity managements to enhance more operational efficiency and also enlarges a high discriminating power for measuring the performance management.

Selection of Strategic Variables

The selection of Input variables for the DEA model based on the major cost elements of respective industry, and for Output variables we have considered Sales turnover, Other Income, and Reported Net Profit. The present study has selected maximum four inputs (m=4) and maximum three outputs (s=3) among the selected input-output data sets as per with appropriate sample size. i.e. 21 (n=21). Therefore, the sample size in the study exceeds the desirable size as per the rule of thumb (21), i.e. n (number of DMUs) equal o or greater than max {(m x s), 3 x (m + s)} (Cooper, W.W. et al., 2007). According to Dyson et al. (2001), the number of DMUs must be at least 2 × m× s where m is the number of inputs and s the number of outputs. Thus, selected number of input and output variables and the number of DMUs in all the cases allow accepted number of degree of freedom i.e. efficiency discriminator powers.

3.4.4 Methodology Applied for Objective Number Four

Objective: To analyze the cost strategies adopted by the firms during the study periods.

Since the present study is based on secondary data, the only reliable source for identifying the cost structure strategies adopted by the companies is the published annual report. However, none of the selected companies has mentioned anything about the cost strategies adopted during the study periods. Hence, the present study relay on accounting based indicators in order to identify the strategies adopted by the companies during the study periods.

Modified DuPont model was applied to observe the firm's strategies. To observe the strategies applied by the selected firm we have considered variables, such as; OPM %(Profit before interest deprecation tax margin), APATM % (Adjusted profit after tax margin), Assets Turnover (AT), RONOA (Return on Net Operating Assets), MS (Market Share), Return on assets (ROA), Return on equity (ROE), Average Market Share (Avg.MS%) during the period covering twelve years ending on March 31, 2014.

The modified Du Pont model is as follows: RONOA = OPM x AT

Where; RONOA (Return on Net Operating Assets) = Net Income/ (Fixed Assets + Net Working Capital)

OPM (Operating Profit Margin) = (Operating Income / Sales);

AT (Asset Turnover) = (Sales / Net Operating Assets);

Operating Income = Sales - Cost of Sales - Operating Expenses;

Net Operating Assets = Accounts Receivable + Inventory + Net Property, Plant, and Equipment. OR

= Operating Assets – Operating Liabilities

= (Total Assets-Cash & Investments) - (Total Liabilities - Long term debt including current portion) as per CFA Glossary.

OPM (%) = (adjusted gross profit + interest / sales) * 100

APATM (%) = (adjusted net profit / sales) * 100

The theoretical underpinnings of the DuPont model illustrate that a firm can be successful with either a cost leadership strategy through generating asset turnover (high asset turnover and low OPM) or a differentiation strategy generating profit margins (low asset turnover and high OPM) or follow hybrids or mixed strategies (both OPM & AT is high).

By applying DuPont method, Palepu and Healy (2008) suggest that a firm pursuing cost leadership strategy may generate a relatively low-profit margin, but balance that against a relatively high asset turnover. Companies pursuing a differentiation strategy must balance expenditures for marketing and R&D with the ability to price their product/service competitively against others in the same market. Firms pursuing differentiation strategy may be successful by generating a relatively high-profit margin and a relatively low asset turnover.

Little et al (2009) concluded that the DuPont model enabled them to determine cost leadership and differentiation strategy for the firm**.** Firms with high relative net operating income to sales and low relative operating asset turnover are assumed to be pursuing a differentiation strategy and those with high relative operating asset turnover and low relative net operating income to sales are assumed to be pursuing a cost leadership strategy.

Companies with relatively high Return on Assets (ROA) in their industry clearly follow either a product differentiation or a low-cost strategy. In contrast, companies that achieve relatively low ROA's cannot easily be classified into either strategy categories (Selling and Stickney, 1989). These companies are referred to as what Porter (1980) calls being 'stuck in the middle'. Therefore the ROA is an indication of a company's success in adopting either of the two strategies (Selling and Stickney, 1989).

Philip et al. (2011) show that some firms follow differentiation strategies (i.e. profit margin is high and asset turnover is low) and cost leadership strategies (i.e. profit is low and asset turnover is high).

In addition, the theoretical underpinnings of the DuPont model illustrate that a firm can be successful with either a cost leadership strategy through generating asset turnover or a differentiation strategy generating profit margins or followed hybrids or mixed strategies.

Porter has employed the U-shaped curve in describing the link between profitability and market share. According to this curve, the most profitable firms are the low-market share differentiated (e.g., Mercedes) or focused firms at one end, and the largest high-market-share practitioners of cost leadership strategy at the other (e.g., General Motors).

Hambrick (1983) also argues that market share leaders tend to compete more on the basis of differentiation than low cost. As Gale (1992) suggests, market share leaders accomplish this distinction via a strategy of differentiation--higher quality--rather than through cost leadership.

In our study, we observed the changes in the market share of the selected companies in the respective industries along with others tools.

In order to compare the performance of each firm in respect of the components of RONOA (i.e. AT and OPM), we need a standard or benchmark. Normally, in academic literature, the industry average is used as the standard for comparison. However, in the present context, only top 21 companies have been selected. In this circumstance, if industry average is taken as standard, the comparison may be biased since the result of top companies may be better than the average performance of the industry. Hence, in order to obtain more realistic comparison, the average of the top 21 select companies has been considered as standard in this study instead of the industry average.

3.5 Limitations of the Study: This study is based on some selected industries and top companies of that industry, based on average ranking method. So, the result may differ in case of other small companies, holding very low rank. We have taken the major cost components for getting a comparative picture, except CSR cost, [Company Act 2013 mandates the CSR expenditure for the Every company having; (a) net worth of Rs.500 crore, (b) turnover of Rs.1000 crore, (c) or net profit of Rs.5.00 crore and Section 135 mandates 2 percent of the Average net profit during the three immediately preceding financial years], because of non-availability of CSR data for twelve years. In our study, we have covered twelve years starting from March 2003, to March 2014. The study may further be conducted by considering larger period. We have taken only secondary data.

However, primary data of companies for strategic analysis may be used in the field conducing future research.

3.6 Summary: In this chapter, we have discussed objective wise research methods used for the study. Moreover, we have highlighted the source of data, study periods and sampling design, data analysis techniques, like - ABJ regression model, DEA model, and DuPont model. In the next four chapters, we have focused on objective wise result analysis and discussion and have discussed and found out findings of chapters by applying said methodology. The next chapter is highlighting objective no one and findings about the same.