A
Thesis Submitted to
Tilak Maharashtra Vidyapeeth Pune
In Management On

A comparative case study of the role of automation and optimization by the use of Six Sigma and other cost reduction management techniques implemented in major companies from Pune.

Under the faculty of management by
Shri. Narendra Vishwanath Kulkarni

Under the guidance of
Dr. K.M. Parchure

In the department of management
Under the faculty of modern sciences and professional skills.

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CERTIFICATE

This is to certify that the thesis entitled "A comparative case study of the role of automation and optimization by the use of Six Sigma and other cost reduction management techniques implemented in major companies from Pune" which is being submitted herewith for the award of degree of philosophy (Ph.D) of Tilak Maharashtra Vidyapeeth, Pune is the result of original research work completed by N.V.Kulkarni under my supervision and guidance.

To the best of my knowledge and belief, the work incorporated in this thesis has not formed the basis for the award of any degree or similar title of this or any other university or examining body.

Place:- Pune

Date:- Dr. K.M.Parchure

DECLARATION

I hereby declare that the thesis entitled "A comparative case study of the role of automation and optimization by the use of Six Sigma and other cost reduction management techniques implemented in major companies from Pune".

Completed and written by me has not previously formed the basis for the award of any degree or similar title of this or any other university or examining body.

Place:- Pune

Date:- N.V. Kulkarni

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It gives me immense pleasure to present this thesis which is a result of my relentless efforts and the guidance, advice from my guide, friends and family members.

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I am grateful to all my friends and current and ex colleagues who supported me by sharing data for my case studies.

It would just not have been possible to progress and complete my thesis without the intellectual, emotional and continuous moral support from my wife **Vaishali** and emotional and moral support from my daughters **Bhagyashree** and **Harshali**.

Place:- Pune

Date:- N.V.Kulkarni

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Chapter No. 1

Chapter No. 1

INTRODUCTION

Chapter 1

Introduction

1. The Topic of the PhD Thesis

The topic of the thesis is broadly related to the areas of Production Management, with special focus on Cost Reduction Techniques in order to maintain the 'competitive edge of superiority' of a firm in the present ethos of global reforms. It is also closely connected with 'modern science of intrapreneurship', in which the companies promote 'cost cutting' along with 'enhancement of quality' and maintain their market share and leadership not only in conditions of cyclical slowdowns and recessions but also in stable and normal conditions of industrial climate.

It is a common observation that topic of the 'Production Management' and that too 'Cost management' is very rarely chosen by the students of Advanced Management Research. The areas of Marketing Management, Financial Management, Human Resources Management, Supply Chain Management, Materials Management, Strategic Management and in recent years Retailing Management, Insurance and Risk Management are relatively more favourite to young Management Researchers. Production Management specially requires in depth knowledge and experience of Engineering therefore it can only be opted by those MBA students who have

academic background of Engineering faculty. Since this topic has remained much unexplored, I am strongly motivated to choose the same and endeavor to produce some original research work; which not only, will enrich this area of management but will also become immensely useful to those corporate managers who face the crisis of losing the market to their competitors and close the production wing, which makes huge losses during recession.

Just recently, because of Crash of Lehman Brothers and other Financial corporations due to lending against 'sub-prime mortgages' and recession in Automobile Industry, all over the world; many units had to shut down their production operations and were compelled to give lay-off to huge number of their employees.

The deep study of Business Cycles reveals that 'Recessions' are not only recurrent but their frequency has increased in post 1980s. The modern manager therefore has a much more difficult challenge to cope up with the crisis of slowdowns and recessions' by grasping the advanced techniques of 'cost cutting' and retaining the market share, by enhancement of quality and efficiency by the application of 'Six Sigma' and similar techniques. The research done in this field will thus be useful to enrich Management Theory and to improve the Management Practices, too.

2. The Title of the PhD Thesis

The approved title of this thesis is viz. "A Comparative Case study of the role of automation and optimization by the use of Six Sigma and other 'Cost reduction' management techniques." [Case studies of some selected companies in and around Pune.]

3. The Scope and Coverage of the Research Study

The scope and coverage of this study broadly consists of following aspects.

a) The Classical theory of 'Production Cost', cost-plus pricing, theory of Profits Vs. Costs, and Cost Management.

b) The role of innovations in improving the technology, productivity, quality and reduction of the cost and price and still improving the market share and profitability of a firm.

c) The role of cost minimization and cost effectiveness- The effects of rationalization- The pricing policies under different conditions of market.

d) The importance of the concept of 'Optimization'.

e) Survival and Sustainance of efficiency in the keen and ruthless competition caused in recent years after the entire world has adopted economic reforms of privatization, liberalization and globalization. The countries, continents and regions cannot afford to have 'closed economies' due to the new regime of WTO.

f) The vital role of 'Cost reduction' during Recession.

g) Factual cases studies of some selected companies in Pune and around Pune, which have successfully and efficiently managed their costs and improved their market shares; with detailed 'Break-up' of their Cost-cutting item by item, or operation by operation.

4. Objectives of the Study

1) To identify and understand, the 'Creative' and 'innovative role' by which 'Cost-consciousness' is developed and correct diagnosis of the wrongs and weaknesses of the prevalent system of production which causes huge and exorbitant amounts of wasteful expenditure, can properly be adjusted by the persons who try to do the 'cost-cutting'.

2) It is further interesting to note; how appropriate solutions to sort out the problems of wasteful expenditure; bring drastically down the routine amounts of spendings' which for a long time were not noticed and continued in the system, as if taken for granted.

3) To examine the importance of continuous quality enhancement, at the lowest possible cost by means of automation and eliminating fabulous amounts of Labor-Payrolls.

4) To find out ways and means for making the most optimum use of plant, machinery, resources, labour and materials and getting maximum utilization of their capacity.

5) To cut down huge expenses and time consuming practices caused by conventional manual operations involved in secretarial and administrative practices, by introducing use of 'smart cards' and 'paperless office'.

6) To establish the automatic control on the actual working of the personnel and obtain maximum productivity from them.

7) To find out ways and means of saving energy, fuel, natural resources, as well as, finance, time, space , Capital and labour.

8) To prove the vital role of 'Cost cutting' for very survival during recessionary conditions and for sustaining the efficiency in retailing the largest share in the market.

9) To investigate the evidence and concrete proof of the results obtained by 'Cost cutting' by not only global Businesses but by the companies in and around Pune; in which, I had the opportunity to be the member of a team assigned to do the actual cost cutting and expand Our clientele and business.

10) On the basis of this empirical evidence, to prove the validity of the hypothesis of this research study.

11) Lastly to judicially separate the 'qualitative profit' from the normal 'quantitative profit'. Normally, any firm having assured market; can expand its sales (without doing minute and intensive cost cutting) at the prevailing market price; which is a case of a quantitative profit. But when overall market demand reduces, and the firms conduct neck to neck competition by price cuts and cost cuts; and thereby earn profit, that is a case of 'qualitative profit'. It is no doubt easier to earn quantitative profit in any seller's market but it is very difficult to retain market share and profits during the conditions of recession in which 'Cost cutting' occupies place of prestige.

12) To highlight the role of a modern manager, who can accept the challenge of sustaining the leading position of his firm during the common crisis of recession, thus partly it is a study of crisis management, too.

5. The Sources of the Data

There are a large number of text books and advanced theoretical literature published by well known management Gurus, all over the world. E.g.

1. Allan DeMacro-Principles and practices of integrated cost reduction.
2. Dunning- "Alliance capitalism"
3. Joel Dean (Managerial Economics)
4. Alfred Chandler- "Dynamics of Industrial Capitalism"
5. Salvator- "Microeconomics"

6. Robert Lucas- "Mechanics of economic development"
7. Lerter Thurow- Theory of Profits- The Future of capitalism
8. Peter Drucker- "Management by Results" etc. etc.

There are Seminar papers, Conference Research papers published by International Economic Association etc.

There are hundreds of Research papers contributed by renowned management experts and published by leading business journals like Wall Street Journal, Finance and Development Journal, IMF surveys, Business Week, The New York Times, The Economist (London), Times magazine, Harvard Business Review, Fortune etc.

Thus vast and authentic secondary data is available. In recent years, internet access also has become a time saving source of classified data. Especially the topic of 'Cost reduction' has evoked a lot of attention and interest among the worldwide leading management faculty and business experts because of the radical changes in the global market, from protected and closed ones to free and open markets, vulnerable to the recurrent crises of slowdowns and recessions because of the growing pressure of stiff competition!

[N.B-Please refer bibliography which is included in the Appendix A]

6. Methodology of the Study

This research study will collect the theoretical contributions; as well as, the authentic secondary data concerning the results of the actual cases of 'Cost cutting' of Global Giant Businesses like General

Motors, General Electric, IBM, Microsoft, Ford, Crysler, Toyota, Nissan, Honda, Krupp, Mercedes, Xerox, Coca-cola, McDowell, Dominos, McDonald, Canon, Dell, Axlerod, Kodak, Intel, AT&T, American Airline, De Beers Diamond and Walmart etc. This data consists of facts and figures which are authenticated by the prestigious Global Business Journals.

In addition, the author of this study had a good fortune and privilege to be associated with the task of 'Cost cutting' which was assigned to him, as a member of the expert team in initial stage and later on as chief leader of the team by well known International and National companies like Honeywell U.S., Tata Honeywell, Compulink etc. He has successfully been instrumental in maximum cost reduction and promoting the growth of the turnover and profits of the companies which he served. He collected primary data with essential statistics and technical details from following case studies; which were made available to him by his clients.

He has furnished the authentic primary data of following case studies.

1) World's cheapest car-Nano.

2) Cost cutting in Security System of Venus Diamond Jewellers, Surat.

3) Cost cutting by introducing the use of smart cards in H.R. Department of TCS, Hyderabad.

4) Cost cutting by replacing manual security system by introducing electronic security system at Bombay House, Mumbai.

5) Cost cutting of H.R. Department of ONGC.

6) Huge Cost cutting in IT firms like Wipro, Infosys etc.

7) Cost Reduction Automatic Devices of PLC and DCS given to HPCL.

8) Diagnostic Software produced by Eco-axis for getting 'Boiler Health Intelligence'; from minute to minute.

9) Energy Cost Saving by automation in the Building of Taj Hotel, Mumbai, Apollo Hospital, Mumbai, TCE Mumbai.

10) Minimizing Errors and Cost Savings done by application of Six Sigma method given to Tata Honeywell Building controls Division.

11) Capturing the market of HVAC (Heating, Ventilation and Air conditioning of huge buildings) by the lowest bid of the price made by Tata Honeywell and obtaining Number 1 Position in the global market.

N.B. [For all these achievements, Six Sigma Leader of Asia Pacific, as well as, Tata Honeywell company have given him the honor of 'Green Belt holder', The highest level of Award "Chairman's Club Award" and official letters of appreciation.]

The recorded data of these case studies will furnish the quantitative and qualitative evidence of its authenticity as such, any finding derived from both the secondary and primary data; can be,

without a tinge of doubt, acceptable and true. The entire research is based on the analysis and processing of the secondary and primary data.

7. The Hypothesis reads as follows:

"The role of Cost Reduction and Quality Enhancement techniques, has proven their importance for maintaining the competitive edge in the present globalised Business Environment in general, and its vitally indispensable in the conditions of cyclical slowdowns and recessions, in particular."

The hypothesis will be tested, verified, proved and confirmed word by word (in the letter and spirit) by the analysis of the secondary and primary data.

8. The Reason to choose this topic

In the present ethos of globalized competitive market, a global slowdown can erupt any time, anywhere but it will take toll of a number of businesses all over the world like a wild fire. Indian firms should note this 'alarming call' and have to be alert and safeguarded for deploying five key levers, proactively to ride the impending storm namely

a) Revenue and Margin enhancement
b) Cost reduction and performance improvement
c) Reassessing planned capital expenditure

d) Seeking new opportunities and

e) improving employee performance management.

This will enable firms to successfully navigate tumultuous times and position themselves for future growth, Needless to state the extraordinary importance of this subject in current Management Research.

My Guide, after going through my bio-data, measured my potential capacity to undertake this specialized study, because of my B.E. Degree in Industrial electronics, Master's degree in Finance, 27 years of industrial experience, 3 years experience in industrial electronics, 12 years experience in Industrial Automation, 6 years experience in Building Automation, 6 Years experience in Information Technology and my achievements such as Green Card in Six Sigma Technique and letters of Appreciation of my employers. He also gave due weightage to my teaching experience of five years in prestigious Management Institutes of Pune. In fact, I have not chosen this topic of research by myself; My Guide has used his intuitive discretion for motivating me strongly to offer this subject for my Ph.D. Thesis.

9. Research Design and Plan of Chapters

The entire thesis consists of Three Parts. Part 1 deals with the review of secondary literature which provides the highlights of the theoretical background concerning the importance of cost-analysis, along with aspects of Theory of Profit. The optimum output which minimizes the cost and maximizes revenue, hence profit; the role of

innovation, rationalization etc. and the special need of cost management during economic slowdowns and recession. Thus it combines the theory of Microeconomics and Management Science.

Part 2, covers about two dozen factual case studies of World's most renowned corporations highlighting positions by sorting out their problems posed by their competent competitors. This part thus furnishes entire secondary data; which is essential for proving the validity of the main hypothesis of this study.

Part 3, provides detailed case studies of eleven renowned corporations which are located in and around Pune; the authentic material of the Primary data along with statistics and analytical break up of the entire exercise of the cost cutting; has been provided by the courtesy of the concerned companies. This data also is very useful for making key findings and conclusions of this thesis.

In all, there are 5 chapters which are as follows:

1) Chapter 1- Introduction

2) Chapter 2- Theoretical framework of Cost-Analysis (Based on review of Secondary data)

3) Chapter 3- Review of factual cases of cost-cutting done by successful global businesses (Based on Secondary data)

4) Chapter 4- Case studies of 11 companies and the positive results of their 'cost-cutting' (Based on Primary data)

5) Chapter 5- Main findings and Conclusion.

Chapter No. 2

Chapter No. 2

Theoretical Framework of Cost- Analysis

(Based on Review of secondary Literature)

1. Classical Theory of Cost of Production

Adam smith argued that competition would tend to establish 'the natural prices' of commodities produced i.e. the price of any commodity is neither more or less than, what is sufficient to pay the rent of land, the wages of labour and the profit of staff employed; according to their natural rates.[1] In simple words, the price of any produced commodity will under the pressure of competition, be equal to the cost of its production. Thus Price and Cost are two faces of one coin. What is price from the viewpoint of a buyer, happens to be the 'Cost' as per the consideration of a seller-producer.

Ricardo used the 'Cost of production' as a synonym for the value of a commodity[2] as well as the relative quantity of labour necessary for the production of the commodity.[3] A fisherman's catch of Fish during a day's time, will have the 'Price' which will not be less than the cost of food of one day of his entire family.

Marshall argued that classical theory of the Price was 'one sided' and based on only one blade (Supply Side) of the scissors. The value of anything will be determined by the interaction of both 'The Demand' and 'Supply' of that commodity as such, it will be governed by 'Utility' (Demand) and 'the cost' (Supply) of production. Walras also thinks that Demand and Cost of production are

[1] Adam Smith - 'Wealth of Nations' Published in 1776-Page No. 65

[2] D. Ricardo – Essay on Profits. Principles of political economy.

[3] D. Ricardo – Principles of political economy

independent forces which determine the price in conditions of competitive equilibrium.[4]

A cost function embodies the consequences of 'Cost minimizing behaviour' on the part of a consumer or a producer.

Cost benefit analysis is a widely used technique in recent times of applied welfare economics. It is simply a ratio of the value of Benefit produced by a project and the total cost incurred within the investment of that project. The cost of efficiency can be judged by a greater benefit as against the less of the cost. A recent variant of cost benefit analysis is 'Cost effectiveness analysis' which is essential and useful in managerial economics. Here benefits are endogenously specified and the problem is to 'minimize the costs' associated with a given profile of benefits. [2]

For judging the efficiency, Adam Smith had advanced a proposition that output was maximised in a private enterprise economy with competition. If each owner of a resource maximizes the return from his resources, then aggregate output would be maximised. This theorem of maximization of output/maximization of satisfaction was

[4] Palgrave's Dictionary of Economics _ Note the cost of production Page No. 698

[2] Palgrave's Dictionary of Economics- Note on Cost-benefit analysis- Page No. 687 and 688

developed and qualified by Leon Walras (1874), Alfred Marshall (1890), Pigou (1912) and a host of modern economists.

In a regime of change of growing population, capital, innovations, technological advance, discovery of a new resource, new consumer demands; perfect competition was achievable only in the stationary economy or in comparative statics, as well as, dynamic economics.

Joseph Schumpeter believed that incessant change in products and product methods was the very essence of competitive equilibrium. Kirzner emphasized the role of enterpreneurial rivalry in competition. Demsetz explained the concept of 'Laissez faire competition', in which freedom of resources to move anywhere was the central element. Schumpeter also noted that displacing of one product or method by another, a process which he called 'creative destruction' is at the root of innovations, greater productivity and economic progress. Innovations can also reduce the existing levels of costs and at the same time, enhance quality of the products. ②

Schumpeter's Ideas

Schumpeter traced the source of profit, being innovation by which a company can reduce its average cost of the product by even improving the quality of the same and thereby can earn a competitive edge against rival firms. By reduced price and improved quality, the company expands its sales turnover and profits and

② Palgrave's Dictionary of Economics- Note on Cost-benefit analysis- – Page No. 535

capture the Market leadership with a very large share in the total market. According to Schumpeter, the main job of an enterpreneur happens to be of 'innovator'; and profit is the reward for his innovative ability. The very source of profits is innovation. Innovations can comprise introduction of a new 'product', new method of production, opening of a new market, a new process and use of a new machine, technology, energy, materials, inputs or a new source of supply of raw materials or a new organisational set up etc. The economy is supposed to be in a state of stationary or static equilibrium, prior to inception of innovation. An enterpreneur, as a visionary innovates by launching a new product or a new technique. Such a new product may require a large gestation lag before it earns revenue. It may require huge expenditure on R & D, which will increase the financial burden of the company. But once the innovation clicks in one, company, it makes 'monopoly profits' and can compensate for all its risks for generating an innovation.

In the medium/long run, the 'successful innovation' causes further ripples via backward and forward linkages, as well as, by attracting immitators. Innovations occuring singly or largely produce a 'Kondratieff cycle', in which profits, prices and output rise. In the long run, because of intense competition, monopoly profits are bid away and the system returns to equilibrium i.e. with getting only normal profits.

Therefore innovative process happens to be discontinuous and disequilibrating. It is accompanied by a credit boom and a cyclical upturn. Innovations are uncertain and unanticipated. The history of

capitalism was for Schumpeter, made up of successive important waves caused by clusters of innovations.

According to Schumpeter, neither the conventional enterpreneur nor the labour generates profits. Profits are abnormal and sporadic!① Companies will try to retain their markets by holding prices where improved technology will reduce the existing level of costs.

Cost plus pricing & Cost Management

It is a practice whereby firms add a margin on to average variable cost in order to cover fixed costs and some reasonable level of profits. By reducing average variable costs further, the firms can maintain their competitive strength for retaining their markets. Therefore constant vigilance and effort to avoid waste and inefficient, as well as, unwarranted expenses is to be carried out by 'efficient cost management'. ②

Cost minimization and cost effectiveness

Cost effectiveness analysis is a technique closely related to 'Cost benefit analysis'. It asks a special question namely, given a particular objective, which is the least cost way of achieving it? It requires appropriate choice between feasible options.

① Palgrave's Dictionary of Economics – Note on Theory of profit. Page Nos. 1017 & 1018.

② Pearce – Dictionary of modern economics. Page No. 86 and 87

For any given level of output, that choice of input combination which yields the 'smallest possible total cost'; happens to be the most appropriate one.

The choice of a cost-minimizing firm facing fixed input prices and using the two factor inputs viz. capital K and Labour L can be illustrated using isocost lines and isoquants. The choice of minimizing output level Y2 is represented by the input combination A, where the isoquant labelled Y_2 is tangent to the lowest possible iso cost line I_2. Other input combinations lying on I_2,

- Such as representated by points B & C, will not be chosen as they yield the lower output level Y_1; lying on lower Isoquant.

- Any point beyond A, or across Isoquant Y_2 ; will require greater capital and increased wages; therefore cost efficiency will not be possible. Any point lying on Isoquent Y_1 other than point A, will yeild the reduced output of the firm which again is a case of cost output efficiency.②

- Thus within OK capital and OL labour cost, the maximum output AA' will be produced since' the point A is located on the highest possible Isoquant and also tangential to the ISOCOST cc! Any other point on the same ISOCOST such as B or C will bring a reduced quality of output since they are on a lower ISOQUANT No. Y1 instead of Y2.

The tangency conditions for cost minimization, yields the result that the input combination which minimizes the total cost of producing any given output level, must necessarily satisfy the equality of the ratio of the marginal physical products of any two factor inputs, with the ratio of their prices.

In a way, profit maximization implies cost minimization; but cost minimization does not imply necessarily the profit maximization. For instance, a sales revenue maximising firm will choose input combinations which minimize the total production cost; but may require huge expenses for pushing the maximum possible sales revenue! [3]

② Pearce – Dictionary of modern economics. Page No. 86 and 87

[2] Pearce – Dictionary of modern economics- Page No. 87

The operative profit is that profit which could be earned if no resources are diverted to the future expansion of a firm.

The opportunity cost (the special term exclusively used in economic analysis and not used by the book-keepers and business accountants) of any action, is prevalue foregone of alternative option. For example, if one acre of irrigated land is used for growing grapes (and suppose grape yield brings a revenue of about Rs. 1.5 lakh), its second best option of growing alphanso mangoes (Assuming one acre's mango yield brings a revenue of Rs. 1 lakh); the opportunity cost of growing grapes is equivalent to the sacrifice of Rs. 1 lakh revenue from mango yield.

Net advantage of growing grapes on one acre land hence becomes Rs. 50000/- and not Rs. 1.5 lakhs!! Similarly suppose a Pune based professor is offered a job in Mumbai for a monthly salary of Rs. 40000/-; but if he still continues to work in Pune for a monthly salary of Rs. 30,000/-; then his opportunity cost of remaining in Pune becomes equivalent to the loss of Rs. 10,000!!

In cost accounting of economics discipline, therefore while managing the cost efficiency, a due consideration is to be granted to the loss or gain of opportunity costs!

Appropriate choice is to be made by estimating opportunity costs of several input combination options.

In managerial economics, therefore 'optimization exercise' has paramount importance. The optimum level happens to be the best situation or state of affairs. It requires minimization of cost/sacrifice

and maximization of satisfaction and profit. Appropriate allocation of resources will yield maximum productivity, revenue and profits. It will help to make the best use of available/scarce resources for maximization of product/benefit and profit. [1]

Production function & Productivity

It is a functional relationship between inputs (factors of production) and the output. It can be expressed as Q = f (L, K, t ….etc.)
Here Q is output, L is labour, K is Capital and t is technical progress. The nation's production function, nation's output produced by national resources- is termed as an aggregate production function. It will be expressed as GNP = f (L, K, t …. etc.) and will become essential in macroeconomic studies.

If the output will be increased in the same proportions by increasing the inputs; this condition exhibits "Constant returns to scale". If the output/production increases more than proportionately by increasing inputs, it means "Increasing Returns to scale" and if the output does not increase proportionately and decrease more than proportionately, it means "Decreasing Returns to scale". The firms therefore have to be cautious to note the trends of decreasing returns to scale and have to improve the returns to scale for time and again for maintaining their productivity.

[1] Pearce – Dictionary of modern economics- Page No. 316 & 317

Productivity is measured by the ratio of output per unit of labour, capital, materials, energy, time and technology. Increase in productivity comes about from increased efficiency on the part of capital and labour.[2]

Profit maximization

A basic assumption accepted in the discipline of economics is that every firm will endeavour to maximise its profits. This assumption is based on the premises of 'Rational Behaviour' for the last 250 years. Profit maximization is logically possible only when a firm maximises its output & sale within minimum possible costs! Thus profit is inversely related to the 'cost', For managerial efficiency, cost management becomes indispensible. Thus difference between Revenue and Cost happens to be the profit.

[2] Pearce – Dictionary of modern economics- Page No. 348

In this graph, total revenue & total cost curves are shown. At point X_*; the firm can obtain maximum profit which is between points R & C.

Any output less than OX_* i.e. X_1, will bring reduced profit and any output greater than OX. i.e. X_2 will also reduce the profit because of falling revenue and rising costs.

Profit maximization output

Optimum output of this firm happens to be OX_*, where the firm can earn maximum profit.

The slope of total revenue curve is Marginal Revenue of the firm and the slope of total cost curve is the Marginal Cost of the firm. Thus profit maximization is all possible when MC of the firm equals the MR. [1]

[1] Pearce – Dictionary of modern economics- Page No.350

Recession

It is a phase of the trade cycle, followed by contraction in aggregate demand for the products causing loss of confidence among the investors due to disappointing prospective sales. It is a downfall from the peak of the cycle which affects decline in demand, rise in unsold stocks, locking of the capital, reduction in the firm's cash flows of incomes, increased capital stocks, falling rate of profits and declining prices of its shares in the market. If the trend of recession could not be halted by extraordinary measures, the company is likely to face the tragic conditions of serious depression. The phase of recession normally is beyond the control of a firm; caused by sudden changes in the international and national economies, or loosing markets due to intense competition of the rival firms etc. Recession can be checked by special efforts done by the governments of the affected countries by taking urgent and effective measures so as to boost the aggregate demand for the products of affected firms. Recessions are common, frequent and recurrent. All the countries of the world without any exception, have suffered due to recurrent waves of recession. In fact, recession occurs due to fluctuations in aggregate demand and aggregate supply, consequent due to disequilibrium conditions. They are like 'after effects' of irrational buoyancy and booms. Many a time, they are caused due to bankruptcies of giant financial institutions, multinational banks and insolvent conditions of sick and heavily indebted firms.

Recession is initial stage of a slump or depression. In fact, broadly the entire world has faced recurrent trends of recession and recovery throughout the 20th century. It should be noted by efficient managers that recession is the integral and unavoidable part of the whole 'Business life'. Every capable manager therefore, should carefully master the appropriate strategies and techniques to come out of recessions; which has become the most challenging task of modern managers. [1]

Rationalization

Rationalization is a deliberate way of restructuring the industry by introducing new machinery, new product, new processes and by raising the labour productivity by methodological training. It also means new set up of organization by installing American, Japanese or German methods of production to secure the benefits of large scale production and cost cutting of the same product.[2]

International economic conference of 1927 passed a resolution that rationalization is a scientific method of increasing output, improving conditions of labour and reducing prices. It lays emphasis on maximum efforts, reduction in the variety of different patterns, applications of research in manufacture, eliminating waste of materials and power, eliminating ill-organised transport by bringing down the logistic costs, minimizing the days of inventory, avoiding financial burdens by alert financial discipline and eliminating the useless middlemen.[3]

1 Pearce – Dictionary of modern economics- Page No.368

[2] Rationalization of German Industry – Chapter 1 Page No. 2

[3] The International economic conference-Geneva/Switzerland-May 1927

Rationalization is a method to reduce the production costs. It includes standardization, simplification, waste reduction, replacement of hand labour by machinery, reduction in overhead costs and selling economies.[3] It also aims at elimination of the evils of thoughtless competition which create price fluctuations and business instability.[4] It requires perfect coordination among the different departments, planning, purchasing, employing, production, finance, Human Resources, Research and Development, advertising, selling and risk management.

Integrated Cost Reduction

Integrated cost reduction is defined as an organised continuing activity for the reduction of costs involving all the key functions of a business management. It no more remains a temporary or adhoc measure to cure the health of a firm; but it becomes a permanent and statutory system of modern management.[5] The study of cost reduction is in effect a study of modern business management.[6]

[3] Edward J. Mehren-Where stands German Industry? Industrial information service-McGraw Hill Co. New York 1927- Page No. 23, 24

[4] Oliver Sheldon – The significance of rationalization – Harvard B. Review April 1928, Page No. 264-269

[5] Allan V DeMacro- "Principles and Practices of integrated cost reduction." Seminar in Paris-European Inductivity Agency-1960- Page. 15.

[6] Allan V DeMarco- "Principles and Practices of integrated cost reduction." Seminar in Paris-European Inductivity Agency-1960- Page. 19

Normally the profits and jobs in a firm are threatened by undue rise in cost of materials, cost of labour, cost of energy and maintenance of plant, cost of capital, administrative costs and selling and marketing costs.

Integrated cost reduction becomes possible in intra-departmental cooperation and the excellent team work.

The task of cost reduction can be entrusted to a qualified administrator of cost reduction; or by introducing a new department or by appointing of a committee representing all departments or a competent outsider management consulting firm.

During a crisis of recession faced by say- Automobile Industry; the results are that industries are closed, workers are given lay off, production of new cars paralysed and companies are faced with severe financial crunches. Under such circumstances, workers of one automobile unit cannot easily acquire equivalent jobs in other automobile units, auto companies may also close some shifts or reduce the working hours.

In order to come out of such a crisis, the firm which can develop understanding of relationship between job security and reduced operating costs, is likely to secure industry leadership by minimizing the costs and slowly gaining the markets by reducing prices. Such industries continue to be successful during periods of both recession, and prosperity.[1]

[1] Allan De Marco – Integrated Cost Reduction- 1960- Page No. 16

The process of globalization also is leading to a structural transformation of firms and nations and is creating new relationships and interdependencies.[2]

The state during recessionary crisis, should adopt a role as an administrator and facilitator. It should provide favourable conditions such as infrastructure, power, education, finance and industrial peace.[3]

Pricing Decisions

While fixing the prices of the products, firms in general follow 'the rule of thumb' (Hall & Hitch 1939 & 1951). The Oxford Economist's Research Group undertook a study to investigate the decision process of businessmen in relation to government measures. The study consisted of 38 eficiently managed enterprices. (Barback 1964)

[2] Martin K Weldge & Dirk Holtbrugge – The German economy after unification Page No. 335

[3] Dunning – "Alliance Capitalism". Pule in 1994- quoted by Weldge & Holtbrugge on Page No. 355 in the part of summary.

The results as reported by Hall & Hitch are as follows.

i) In real life, firms did not attempt to maximize their profits.
ii) They did not use the Marginal Rule of MC = MR in order to optimise and maximize their profits.
iii) Oligopoly was the main market structure of the business world as against the 'monopolized competition'. (Chamberlin)
iv) Firms were not independent in decision making.
v) Firms priced their products on the average cost principle i.e. P = AVC + AFC + Profit margin.
vi) Firm's main occupation is price not output.
vii) Prices remain fairly sticky despite changes in demand and cost.[1]

Attack on Marginalism

The marginal pricing principle has been challenged on many grounds in the context of its practical use in the real world. (Gordon 1948) Gordan pointed out some of its limitations as follows.

i) Inability of the marginal theory to cope up with the ever-changing factors determining the Demand & Supply.

[1] Author M.L. Trivedi- Managerial Economics – Chapter 29 Page No. 504 Tata McGrams Hill – N. Delhi

ii) Marginal analysis assumes perfect information, which is not the case in real life. Uncertainty does not fit in the scheme of things.

iii) Businessmen adopt several goals (not only profit maximization) to avoid uncertainty.

iv) The average cost pricing has been widely used even by multi product firms.

v) Marginal analysis deals with objectively determined Demand & Supply curves, not with a businessman's subjectivity conceived ones.

vi) Expectations about future environment do not fit in Marginal Analysis.[2]

J.S. Easley (1956) made a study and found that modern accounting provides perfect information on marginal revenues and cost and it is used by organized firms. It also found that profit maximizing firms survive better than other firms.

Joel Dean in his pioneering work of Managerial Economics, discussses the problems of pricing techniques in three broad groups.

a) Determination of basic price.
b) Determination of prices of the members of the product line.
c) Price differentials or discount structure.[3]

[2] Author M.L. Trivedi- Managerial Economics – Chapter 29 Page No. 505 Tata McGrams Hill – N. Delhi

[3] M.L.Trivedi – Managerial Economics – Page no. 505 (Tata McGrowHill)

Basic price is defined as the price of a commodity with which the prices of other members of the product line are related to. Prices of other products can be determined by some price differentials depending upon their cost, competitive maturity, local conditions, profitability etc. The discount structure helps the firms to capture new markets by granting large discounts than their rival firms.

The cost structure of a firm depends upon its internal environmental forces while the Demand for a firm's product depends upon external environmental conditions.

Therefore Cost of production sets the lower limit of the price which a firm can accept; or further lower the price ignoring AFC in conditions of recession; so as to sustain its survival. On the other hand, Demand conditions determine the 'Highest price a firm can fetch in the market'. A firm therefore normally fixes the price of its product between these lower and higher limits.[2]

According to Joel Dean, pricing policy decisions of big firms remain a patch work of adhoc decisions.[3]

If a firm produces some high class products which are used by upper income groups as a status symbol, the firms deliberately keep their prices high; so as to attract its elite clientale. Such high prices are called 'skimming prices'.

[2] Joel Dean – Managerial Economics – Chapter on Pricing Techniques.

[3] Joel Dean – Managerial Economics – Ed. 1976 Page no. 401

By fixing a price as low as possible to start with in order to penetrate the market (and then gradually raising it) & gain acceptability in the mass consumption market. This price is called a 'Penetration price'.[4]

J.S.Bain (1947, 56) developed the theory of 'limit pricing'. He observed that duopoly firms charge a price below the short-run profit, maximizing equilibrium price so as to prevent the entry of new firms. Thus it is between Monopoly price and competitive price; .. (less than monopoly price & greater than competitive price.)[5]

Bain also explained four barriers to entry viz.

a) Product differentiation barrier
b) Absolute cost advantage barrier
c) Economies of scale barrier
d) Large initial capital requirement barrier.

Full cost pricing

It is also called 'average cost pricing' or 'cost plus pricing'. (Hall & Hitch 1939) Andrews (1949) Edwards (1964). In the short run, as well as, recessionary conditions, since the objective is not profit maximization, full cost pricing is not feasible.[6]

[4] M.L.Trivedi – Managerial Economics- Page no. 508 Tata McGrawHill

[5] M.L.Trivedi – Managerial Economics –Page No. 511- Tata McGrowHill

[6] M.L.Trivedi – Managerial Economics –Page No. 513 & 514 - Tata McGrowHill

Optimization

Optimizing behaviour is one of the basic postulates of microeconomics. It is based on the principle of 'rationality'. On that basis, a consumer will always try to maximize his satisfaction by minimizing his expenses; a producer will try to maximize output at minimum cost and a firm will aim to maximize its profit or market share.[3]

Baumol's model suggests 'Sales maximization' as another possible goal of a firm along with profit maximization. Williamson's model suggests the maximization of managerial utility. Marris's growth model suggests a balanced growth rate between the rate of growth of Demand (gb) and a rate of growth of capital (gc).

Managers would like to maximize their utility (Um) which is dependent on the growth of Demand (gb) whereas shareholders' utility (Vo) will depend on the growth of capital (gc). The growth of the firm can be maximised by balancing gb and gc… $=g_{max}=gb=gc$.[4]

Herkerl Simon (1955) suggested that the modern firms are motivated by 'Satisfying behaviour' rather than maximizing behaviour. Behavioural theory as developed by Cyert & March (1963) is based on the principle of the divorce of ownership from management and view the firm as a cooalition of individual members called stockholders and professional managers acting as

[3] M.L.Trivedi – Managerial Economics –Page No. 293 (Chapter 15) McGrowHill

[4] M.L.Trivedi – Managerial Economics –Page No. 294 McGrowHill

their caretakers! According to this approach, managers perform upto their 'aspiration level'.

There are five goals of the modern firms namely –

1) Production goal
2) Inventory goal
3) Sales goal
4) Share of the market goal &
5) Profit goal.[1]

The first four goals are subordinate to the 5th goal i.e. profit which is very favourite of the Top Management.

Technology and Economics of Firms

Technology happens to be 'applied science'. Modern Research & Development aims at the commercial exploitation of the existing scientific knowledge by technological innovations, that is product or process development. Technology aims at finding new products, devices, systems, methods & processes.

Development is an activity & effort leading to innovation. An assessment of its commercial viability is also an integral part of Development. Innovation thus becomes the ultimate outcome of R & D activity. In short, commercial exploitation of an invention is called 'innovation'.

[1] M.L.Trivedi – Managerial Economics- Page No. 295 – Tata McGrowHill, New Delhi

Normally there is a gap of about 13 years between an invention and an innovation and of about 50 years between an invention and its diffusion.

Technological change is a continuous process between present and future innovations having cross-linkages among them.[2]

The State and Wealth of Nations

Adam Smith maintains his ideas of 'invisible hand of the market focus', 'impulses of personal interest and profits' and the Laissez Faire (i.e. uninterferred free market economy) as main engines to the growth of businesses and industries and sees very little role for the state. According to him, the role of Government is to create the minimal facilitation conditions. He strongly advocated private operations of roads and waterways.

In fact, very few countries like U.K. and U.S. have made industrial progress by maintaining practices of limited government, high individual liberty and good administrative justice. The modern history of majority of nations such as Germany, Soviet Union, Japan, South Korea, Taiwan, Brazil, Antarctica, China, India, Israel etc. reveals that the role of the state has been very substantially

[2] M.L.Trivedi – Managerial Economics- Page No. 295 – Tata McGrowHill, New Delhi

influential for rapid and planned growth of them. World's majority of countries have adopted policy of 'guided market economy'.

Fredrick List highlighted the supportive role of the state for raising the wealth of nations and advocated the policy of protectionism; which is necessary in the transitional stage of a country's take off to reach matured growth. He also pointed out that during Victorian Age, when England reached Zenith of prosperity, the state had deliberately developed various institutions, as well as, infrastructure necessary for the progress of industries and businesses.[1]

Similarly, to understand the history of Krupp or Thyssen in Germany, we must know about universal banks, cartel policies, protective tariffs and state patronage. When we study the history of Toyota in Japan, we learn about the transition of making Textile machinery to making trucks and automobiles due to the pressure of militarizing Government of Japan in 1930s. [2]

We know from Chandler's book the Visible han d (1977) that in the history of American economy, certain industries always adopted large scale like railroads, telephones, steel, oil, chemicals, automobiles, aluminimum, copper, pulp and paper etc. [3]

[1] Thomas K. Maccrani – Government Article, Big Business and the wealth of Nations – Published in the book Viz "Big Business and wealth of Nations," eidited by Alfred Chandler – Cambridge Univercity Press – Pages 522,523 and 524.

2 Thomas K. Maccrani – Pages 526

3 Thomas K. Maccrani – Pages 527.

Even in retail trade and small scale industries, systems of franchising developed in the post world war II years; e.g. Reebock and Loto shoes , Adidas garments, Midas Muffler (in auto repair), Walmart in retail stores, Holiday Inn in hotels, McDonald's in food services etc. It is the vertical disintegration which is prevalent in this system, cuts down the costs due to the optimum combination of large and small scales.

While the industrialized countries exhibited along economic performance, many 'developing' countries failed to develop at all; therefore in post World War II years; the gap between rich and poor countries widened. It can be proved by following figures.

Index of GDP per capita in 1990 for the basis of PPP –
A sample of 125 countries; US = 100 (absolute amount in current dollars=$21,360)

High Income Economies

Country	Per capita GDP index
United states	100
Japan	79.4
West Germany	76.3
France	71.2
United Kingdom	70.0
Italy	68.1

Middle Income Economies

Ratio of India per capita GDP

compared to following countries

Country	Per capita GDP index
Greece	34.4
South Korea	33.7
Brazil	22.4
Argentina	21.9
Thailand	21.6
Poland	21.2

Lower Income Economies

Country	Per capita GDP index
Indonesia	11.0
China	9.1
Pakistan	8.3
Nigeria	6.6
* India	5.4
Ethiopia	1.5

India to U.S.	1: 20 (i.e. Twenty times than that of India)
India to Japan	1: 16
India to W. Germany	1: 15
India to U.K.	1: 14
India to Greece	1: 7
India to S. Korea	1: 6.5
India to Brazil	1: 4.5
India to Argentina	1: 4
India to Thailand	1: 4
India to Indonesia	1: 2
India to China	1: 1.8

Source- World Development Report 1992 (New York, World Bank, Oxford University Press 1992 Page 276-277

The important role of Big Businesses in Advanced countries has been noted by Robert Lucas, who has developed a 'new growth theory'.[1] Obviously, Big Businesses could capture and expand their markets due to their lowest prices consequent of their managerial efficiency in reducing the costs for maintaining the competitive edge.

According to Alfred Chandler, countries like U.S. & Japan have made tremendous industrial progress by their support to 'competitive managerial capitalism' and in order to gain competitive superiority, it is necessary that the industries ought to minimize their costs of products. [2]

[1] Robert Lucas- "On the Mechanics of Economic Development".
Journal of monetary economics, 22-No. 1, July 1988 page 2 to 42

[2] Hide masa Morikawa- Japan. Increasing organizational capabilities of large industrial enterprises-1880s to 1980s.
Article from 'Big Businesses & Wealth of Nations'. Edited by Alfred Chandler.
Cambridge University Press- Page 326

Distribution of the largest industrial enterprises in U.S. by industry [1]

Industry	Year 1930 (No)	Year 1988 (No)
Food	31	18
Tobacco	5	3
Textiles	4	2
Printing & Publishing	2	9
Chemicals	20	40
Petroleum	26	18
Primary Metals	23	10
Machinery	19	13
Electrical Machinery	5	21
Transportation Equipments	23	20

It is the Research & Development which brings innovations and helps to reduce the existing 'Cost-structure'.

Advanced countries sustain their industrial competitive efficiency by spending huge amounts on Research & Development; e.g. U.S. Research & Development Total expenditure went up to $130 million dollars ($130 million) from 70 lakh dollars ($7 million) in the year 1930.

[1]Source- Alfred Chandler Jr. 'Scale and Scope: Dynamics of Industrial Capitalism.' Harward University Press 1990 – P.19

Innovative capacity happens to help countries, for the growth of Big Business Enterprises of the World; for example; U.S. in the year 1993 alone had 160 large industrial enterprises which were from the 500 largest enterprises of the World. In the year 1962, U.S. had 298 i.e. (nearly 60 percent) out of 500 largest industrial enterprises of the World. [1]

Due to Research & Development innovations and the capital intensity; the productivity i.e. Output per labour-hour in manufacturing multiplies and simultaneously brings reduction in cost per unit of output. It can be illustrated by the following Table.

Output per labor-hour in manufacturing [2]
1955-1988 (Indices)

Year	U.K.	U.S.	Germany	France
1951	100	270	68	71
1964	100	268	117	90
1973	100	234	133	101
1979	100	243	163	129
1988	100	224	138	122

[1] Alfred Chandler Jr and Takashi Hikino- the large industrial enterprise & the dynamics of modern economic growth. Table No. 2.10 Page 51
Article from 'Big Business & Wealth of Nations – Cambridge University Press.

[2] Source: Nick F.R. Crafts- "Economic Growth"-
Editors- Crafts & Woodward – "British Economy since 1945'-
Oxford Clarendon Press 1991- page 262

Note:

i.) U.S. has consistently maintained its highest productivity per labour hour.

ii.) Britain was second best in productivity during 1951-1964

iii.) Germany became the second best and remained so during 1951-1988

iv.) France snatched the third best position since 1973 onwards and U.K. became the fourth ranking nation in Europe.

v.) In recent years, South Korea, Japan and China have improved their productivity.

Theory of Profits

Profits are defined as Sales Revenue minus Operating Costs where Operating Costs are defined as current outlays minus investment in stocks. [1]

Since Profit = Revenue minus Cost; Profit is inversely related to the cost of product; which means, if costs will increase, other things remaining constant; profits will decrease and if costs will reduce, profits will automatically increase.

Thus Profit is an Inverse Function of the Cost. P = f (1/C). Therefore Cost Management becomes very essential for the profit management. Similarly Productivity is inversely related to Labour-cost per hour.

[1] Adrien Wood – A Theory of profits- Cambridge University Press- Ed 1975- Page 1, Footnote-Definition accepted by British Company Accounts.

If Productivity per labour-hour is increased, the cost per labour hour per se, decreases. Thus Cost Reduction is essential for profit promotion.

The successful business is to be all round best; in implementing innovations, design, manufacturing, sales, logistics and services that competitors cannot match. [1]

The secret of being the best is found in having the 'skills base' throughout the organization that allows it to be the 'LOW COST INTEGRATOR' of all the activities. [2] In an era of man-made brain power industries capital/labour ratios cease to be meaningful variables. [3]

Being a low cost producer is partly a matter of wages, but to a much greater extent, it is a matter of becoming the masters of process technologies. [4] In the era ahead, countries have to make the investments in knowledge and skills that will create a set of man-made brainpower industries.

Consider the list of the twelve largest companies in America on January 1, 1900. They are viz. 1) American Cotton Oil Co. 2) American Steel 3) American Sugar Refining Co. 4) Continental Tobacco 5) Federal Steel 6) General Electric 7) National Lead 8) Pacific mail 9) People's gas 10) Tenesse Coal & Iron 11) U.S. Leather and 12) U.S. Rubber.

[1] Lester Thurow- The Future of Capitalism- WmMorrow & Co. N.Y.Ed. 1996, Page 69

[2] Lester Thurow- The Future of Capitalism- WmMorrow & Co. N.Y.Ed. 1996, Page 69

[3] Lester Thurow- The Future of Capitalism- WmMorrow & Co. N.Y.Ed. 1996, Page 68 [4] Lester Thurow- The Future of Capitalism. W. Morrow and Co.- New York – Ed 1975- Page 69

Ten of the twelve companies were natural resource companies. The economy at the turn of the century was a natural resource economy.

But only one of these companies , General Electric, is alive today. The moral of the story is clear. Capitalism is a process of creative destruction whereby dynamic new small companies are continually replacing the old ones that cannot adjust to new conditions. Similarly, before World War I, more than one million workers toiled in the coal mines of Great Britain i.e. six percent of the total Workforce. Coal was king.

Today less than thirty thousand workers toil in the same coal mines. Argentina and Chile were rich due to their natural resources during 19th century when Japan was damn poor.

In 21st Century, Japan is busy in promoting microelectronics, civilian aircraft manufacturing, machine tools and robots and computers; all of them were man-made brain power industries. Japan developed its very dominant steel industry yet having no coal and no iron ore. Biotechnology is going to bring another Green Revolution in agriculture. [2]

[2] Lester Thurow- The Future of Capitalism- W. Morrow & Co. New York Ed. 1975, Page 70, 71

The World's wealthiest persons like Bill Gates etc. have become successful in very short period of time due to very high percentages of net profit in Computer Hardware & Software Industries. There is virtually no proportionate relationship between the cost of production and sales revenue. Thus knowledge has become the only source of long run sustainable competitive advantage.

Today's communication technology has become cost efficient, because skilled components are made in the 'first' world and then chipped to the 'Third' world to be assembled with low skill components. This combination helps to cut costs, raise profits and higher wages and dividends. Rapid transportation also has helped to globally connect the markets. Due to the availability of very large number of unskilled workers from the 'Third World', those laborers from advanced countries of the 'First World' who happen to be equally unskilled, at present are either losing their jobs or getting low wages which are almost equal to the wages of unskilled workers from the 'Third World'.[1]

U.S. Boeing Company had almost monopoly in manufacturing and supply of 'Airbuses'. But recently in the first decade of 21st Century, European companies have got more orders than Boeing and because of competitive price/cost cuts, the Boeing Company is now on the 'back foot' and has become defensive. Even it is bringing pressure on Americal President, for canvassing and making sale deals in the 'Third' world;

[1] Lester Thurow- The Future of Capitalism. W. Morrow and Co.- New York – Ed 1975- Page 74 & 75

What is true in sports/war is equally true in business and industries; If onel plays defence all of the time and is never on offence, never wins![2]

The Role of Cost-reduction efforts during Recession

Recession adversely affects the aggregate consumer demand. Due to recession, companies forced to give lay-offs, retrenchment of labor and together they bring mass unemployment. There is a sort of glut due to overproduction and under consumption. Therefore companies face huge burden of lacking of its capital in inventories and unsold stock of products and experience liquidity crunch and shortage of cash flow funds. They are compelled to approach banks and financial institutions for additional loans and further get trapped in raising their burdens of debts. The prices of their shares collapse and due to sickness are pushed on the brink of bankruptcy. When many industries are closed during general slow down and recession; some industries can sustain their viability and marginal profitability by cost cutting and selling their products at lowest possible prices. Thus cost cutting becomes an indispensable measure during the crisis of recession.

Recessions are frequently recurrent and they are normal. They are part of the economic system. They cannot be eliminated; they are to be tolerated. Business cycles are as natural as earthquakes and high tide and ebbs and climatic seasons.

[2] Lester Thurow- The Future of Capitalism. W. Morrow and Co.- New York – Ed 1975- Page 78 & 79

Let us take a concrete case of U.S. during 50 years from 1945 to 1995. The U.S. had ten years in which output, employment and profit seriously declined. They were viz. 1946, 1949, 1954, 1970, 1974, 1975, 1980, 1982 and 1991. These recessions occur due to changes in global, national, political or abnormal reasons and sometimes due to trivial reasons; too.

Negative growth in 1946 and 1954 was caused by cutbacks in military procurement following World War II and the Korean War. The 1957 recession followed in the wake of an unsustainable boom in auto sales, where people in the preceding years were buying the cars that they were unable to buy in the 1930s and during Second World War period. [1]

But once that pent up demand had been satisfied, sales fell back dramatically in 1958. The recessions of 1970s were due to oil and food shocks. The 1982 recession was deliberately engineered by the Government because Fed had raised high rates of interests to tame inflation. In addition to exogenous upward or downward shocks, the internal dynamics of economic decisions, leads to business cycles (Multiplier accelerator combined effect).

Hearing about shortages, consumers start to buy ahead of their needs. Panic buying may brighten the profit expectations of the firms and they will also increase purchases of their inventories. It is rise in demand itself, induces further rise in demand. This tendency of booming demand again produces glut of unsold stocks.

[1] Lester Thurow- The Future of Capitalism. W. Morrow and Co.- New York – Ed 1975- Page 210

Thus booms lead to booms and recession leads to slumps. [2]

Sometimes because of drastic changes in global trade and finances, recessions explode like epidemics. For example, South East Asian Crisis of 1997 (p. 212) currency inflations, flight of foreign capital, drastic fall in export orders and complete dependence on export incomes, collapsing prices of real estates, bankruptcy of banks and financial institutions; produced recession even in the Third World Countries including India. Many big industries like Automobiles, Machine Tools, Engineering, Electrical etc. were compelled to shut their factory gates and relieved their employees by announcing 'lay-offs';. Lakhs of labourers lost their jobs during those recession years.

Recession became a blessing in disguise. During recessions, various units having positive outlook; made special efforts to install, new machinery, new technology, new organization, new products and introduced Research and Development activities for reducing their costs of products and simultaneously enhancing the quality of the same of international level.

In fact, the new inventions of cost cutting and Technological upgradation happen to be the 'unexpected and generous' products of recession !

[2] Lester Thurow- The Future of Capitalism. W. Morrow and Co.- New York – Ed 1975- Page 212

The theory of 'Competitive cost Management'

Michael Porter – A management Guru – is the prominent and pioneer exponent of the theory of competitive cost leadership. He has elaborately researched the area of strategic management, which is not only an adhoc measure to tackle the problem of 'economic slow down / recession; but it is vitally essential even in booming business conditions; so as to sustain the cost leadership and thereby largest share of the product / service market.

According to him,"Many firms do not fully understand the behavior of their costs from a strategic perspective and fail to exploit opportunities to improve their relative cost position"; as a result of which, they are unable to maximize their efficiency and profits.[1]

Porter further states that, "there are two basic types of competitive advantage, a firm can possess: low relative cost or differentiation. Three generic strategies for achieveing above – average performance in an industry are viz

a) Cost leadership
b) Differentiation and
c) Focus.

[1] Intangible intelligence leadership software – overcoming the pitfalls of cost leadership. Pages 1, 2 and 3

The focus strategy has two variants:

i) Cost focus and

ii) Differentiation focus"[2]

A firm must strive to become' the low cost producer' in any industry. A firm which ignores the 'cost management' often face following problems; viz

1) Wasted cost and wasted time
2) Decreased engagement and motivation
3) Decreased productivity
4) Decreased brand value.

Cost of manufacturing activities and pitfalls of cost leadership identified by porter.

1) Many costs are service related, not manufacturing related. Automation, Business Process Engineering, Six Sigma and Outsourcing are forcing manufacturing processes offshore to low cost countries.

2) Ignoring Procurement – The majority of firms are now service firms. Many manufacturing firms now manage outsourced manufacturing processes rather than perform them internally. As such, efficient procurement and purchase and supply chain management are very essential factors.

[2] Intangible intelligence leadership software – overcoming the pitfalls of cost leadership. Pages 1, 2 and 3

Today the value of a purchase is often in its ability to make employees more productive and effective; not to reduce 'head count'. Head-count reductions in understaffed firms decrease cost leadership. Efficient procurement means ability to save time, increase cost. Effectiveness of increase in revenue capability, decrease in revenue losses, market value and share price losses, must be duly exercised.

3) Overlooking indirect or small activities- Often indirect costs of small activities are overlooked. 'Intangible Intelligence Leadership Software' helps us to valuing the productivity of value creation, assessing the cost effectiveness. All activities are measured and accounted for quickly through advanced data collection tools and benchmarking.

4) False perception of cost-driven and wrong decisions of reducing the labor un-thoughtfully- Suppose a firm decides to reduce company's sales force due to its cost; is not an intelligent decision if the firm has excess customer demand. Understaffed organizations cannot supply enough customer time to customers to meet their demands in a timely manner. The result is 'Customer base erosion'. Cost quality of every decision can be examined and verified from the cost leadership software. For instance, a project costing $ 1 million that result in a $ 5 million loss of revenue has negative cost quality whereas a project costing $ 1 million that raises revenue by $ 5 million has positive cost quality. The software helps us to understand and assess the cost effectiveness of every management decision.

5) Failure to exploit linkages- It is very essential to know the difficulties of your vendor suppliers; who may be willing to reduce their prices but they are unable because of their own costs of purchasing raw material from other suppliers. It is better to apply the principle of aggregation which means you will form a team of all those producers and suppliers and remove their individual difficulties and help them to reduce their costs.

6) Cost reduction does not mean reduction in value.

7) Undermining differentiation- Differentiation is the maximization of unique value creation for customers. Reducing costs can decrease differentiation and uniqueness. [1]

Cost Reduction- A Key to Survival & Success[2]

Cost reduction is the key word for success in today's global competitive market scenario. It is one new economic mantra. Gone are the days where vendor can pass on the cost of his inefficiency and low productivity to the customer. Today's customer has a wide choice in a 'net connected global market' where n numbers of market savvy vendors are available.

[1] Intangible Intellignece Leadership Software – Overcoming the pitfalls of cost leadership. Page no. 2 & 3

[2] Cost reduction through Business Partnership IIMM - Page no. 1 of 4

How to develop Cost-Reduction Ideas[1]

The first thing that you have to do while developing cost-reduction ideas is to consider alternate and all feasible cost- reduction measures. Sourcing for new suppliers offering cheaper rates is a sub-optimal alternative.

Rob Patton, an associate with sourcing consulting firm Paladin Associates, has identified 7 such cost reduction ideas, including following four major ones.

A) Ask and you may receive- Ask your suppliers if they have cost savings ideas. Answer may probably surprise you. Ask your purchase/supply chain managers for reducing purchase and costs of logistics.

B) Aggression- It is any effort that makes the buyer's requirements more attractive to the seller by bundling those requirements with the volume of other buyers. For external bundling, you can build your own consortium or join an existing group purchasing organization.

C) Space Rationalization involves looking at the goods and services you buy and determining smarter ways to specify them. We discovered that we had between 80 to 100 different specifications across the worldwide sources for water.

[1] Charles Dominick- web based version- Purch Tips- Edition 167, December 9, 2008- Page no. 1 of 2

No reasonable person in purchasing or engineering is going to say that we really need that many specifications for water.

D) Leveraging the supply chain- In this technique, you are looking at suppliers, one or two steps back in the supply chain. Your own intermediate suppliers do not normally have direct control on maintaining low cost purchases. Try to take him in your team and help him to sort out his problems.[2]

[2] Charles Dominick- web based version- Purch Tips- Edition 167, December 9, 2008- Page no. 1 of 2

ABC and ABM of Cost Leadership

We are in the era of indispensable liberalization, inevitable privatization and invincible globalization, where COMPETITION is very intense and the change is rapid. The face of business has changed completely, towards market preferences or customer driven market. Therefore, every firm has to remain cautious about the moves of your competitors and the sensitive responses of the customers. It has further to secure 'COST ADVANTAGE' OVER THE COMPETITORS. In this direction, new cost approaches have emerged as 'Activity based costing' (ABC) and 'Activity Based Management (ABM).

ABC

ABC is a system that first accumulates overhead costs for each of the activities of an organization and then assigns the costs of activities to the products, services or other cost objects which caused that activity. ABC attempts to refine the second stage overhead allocation process and assigns costs on the basis of a cost driver that propels a set of activities leading to such cost.[1]

The new costing system improves the accuracy of cost information. One can identify activities that are not adding 'value' and the activities that can be outsourced so as to reduce the internal cost. [2]

[1] T. Satyanarayan Chary- The ABC & ABM of cost leadership, Business Line, Financial Daily, Hindu Group of publications- Wednesday 26th March, 2003, Page 1 of 3

[2] T. Satyanarayan Chary- The ABC & ABM of cost leadership, Business Line, Financial Daily, Hindu Group of publications- Wednesday 26th March, 2003, Page 2 and 3

ABM

Activity based management is the next step of ABC. ABM is the Special Management discipline by which cost management is done by the aid of ABC. It is the process of understanding Reengineering and making decisions about the activities to put the enterprise on the road to continuous improvement and excellence. ABM aims to improve the value received by customers and to improve profits by providing this value. It is useful for avoiding 'Non-value added activities.'

ABM is capable of producing parts of the product with the lowest cost process, design parts to minimize the manufacturing costs, modify equipment to reduce costs, increase prices of products priced below ABC cost and to drop unprofitable products. It is a powerful tool for process optimization and facilitates corporations in achieving manufacturing excellence.

Cost Reduction Strategy for a manufacturing Set-up[1]

The essential steps:

i) Identify the categories of raw materials, components, parts etc. which are used for manufacturing a product. E.g. resistors, capacitors, integrated circuits, transformers etc.

ii) Identify the suppliers for the above categories.

iii) Analyze annual buy for each of the category and their shares in total inventory costs.

iv) Analyze annual purchase from individual vendor for each of the category e.g. integrated circuit

v) Based on the above analysis, try to redistribute business between vendors to realize economies of scale.

[1] Manish Jain, Cost Reduction Strategy, Cool Avenues Com, April 13, Page no. 1 & 2

Role of Cost Reduction Team[1]

Normally a purchaser gets no time to move out from day to day firefighting and focus on cost reduction activity. Hence the foremost importance is to form a separate dedicated team exclusively for managing the cost reduction. It has to identify various opportunities for cost reduction, develop new parts or think of outsourcing of internal costs comparatively are excessive.

This team has to mind four areas of management viz.

a) Vendor consolidation (instead of unmanageable large number; it is better to restrict their numbers)
b) Value Engineering for Quality control
c) Assembly outsourcing e.g. Automobile & Electronics
d) Standardization

The effect should also be done to avoid 'Cash blocked inventory'.

While signing contracts of outsourcing following points are to be noted.

i) The product should be broken into independent assemblies.

ii) Drawings of the assembly are to be made and their critical functional parameters are to be defined.

iii) List of tooling and machinery required for making the assembly is to be defined.

[1] Manish Jain, Cost Reduction Strategy, Material procurement department, April 13, 2009, Page no. 2 & 3

iv) Fix a target cost of purchase of the assembly.

v) Vendor Development- while selecting vendors, necessary check up of conditions e.g. whether he has appropriate tooling and machinery and necessary infrastructure and production capacity along with quality controls. It should also be ascertained whether his financials are sufficiently strong enough so as to enable him to procure raw materials and execute the order on time.

Standardization

Standardization is the basic factor which is indispensable in cost reduction. It implies to reduce the variety of components used in manufacturing. In the standardization, Research & Development plays a pivotal role.

Benefits of Standardization

a) Reduction in variety of components to be handled, which in turn will reduce supplier base, increase on time delivery of components and increase in the efficiency of inventory management.

b) Set up time will reduce, since the number of components required to change the set up, will reduce.

c) Reduction in material handling and increased stock accuracy

Conclusion[1]

Each strategy of cost reduction has its own significances and hurdles. Before selecting a strategy, a person should be thorough about its benefits and road-blocks. Although strategies are simple, it requires great leadership to implement them.

[1] Manish Jain-http://www.coolavenues.com/know/ops/manish cost reduction,6.php

Perceiving opportunities in problems

The recent threat faced by Indian manufacturers in certain market segments from China (e.g. Indian Toy Industry) is the ground reality; and learning lesson for Indian Manufacturers. This reflects the Indian Industry's inability to compete in today's global business environment. If the same threat is converting into opportunity by building up business partnerships with them, it will be fruitful to both the stakeholders. A logical possibility is that many Indian manufacturers may be shifting to China, which offers advantages of reduced cost, tax free concession, tariff free special economy zones, a Worldwide market and availability of cheaper electricity and overheads, as well as, cheaper and abundant raw materials.

A modern industry at present times is ready to offer quality products and services at the right price and place.

Slow or negative growth rate in certain key sectors like steel, cement, fertilizers, textiles, engineering, energy, light truck vehicles and the near death knell of small scale industries; have lead to closures, mergers, acquisitions, bankruptcy and prove our chronic weaknesses. Most of the successful old economy giant organizations, who could not quickly adapt to the changing environment, are reported to be sick, slowly going to the death-bed mainly surviving on the oxygen of 'manpower reduction, VRS and downsizing'; the medicines often prescribed by western consultants. These are only the half hearted short term measures; but they are not useful to regain the past glory of their organizations.

The radical and long term therapy consists of strategic management of cost reduction for improving the productivity and profitability of the sick units. Cost reduction must be aggregative and exhaustive; e.g. Production and Designing costs, Purchase and Material Management Cost, Overhead costs of infrastructure, Labor and Personnel cost, Marketing costs, Selling and Advertising costs, Financial costs and costs of capital, Costs of business risk and uncertainty, Futuristic costs etc. will require unified consideration. Merely economizing costs of stationery and telephone, labor welfare budgets, special perks given to employees etc. will bring the company in a strange crisis and the treatment will be more dangerous than the existing sickness.

What company needs is to think about radical cost saving measures in all major cost areas. The main objective of cost reduction must be to regain health and competitive edge. [1]

Survival Strategy

During the crisis of a company's sickness, the company should systematically plan a survival strategy which consists of following issues.

a) Clear shared vision

[1] Indian Institute of Materials Management, Cost reduction through Business Partnerships- Page no. 1 of 4

b) Well set goals and objectives

c) Committed organization aligned with company's goals and vision

d) Global cost consciousness

e) Well structured policies and procedures to back up the same and to deliver the said objectives at minimum costs

f) Produce market quality products and services at the right place, price and time as per the customer's requirements

g) Key performance indices are to be identified e.g. data on Repeat orders, indicating brand/customer loyalty, market share and cost of service etc.

Need of Strategic Sourcing at Optimum Cost

One of the major costs in any organization is procurement cost of materials, fabrication and services, components etc. ranging from 40% to 70% of the total turnover. Next area is to keep updated 'scrap accounting' and monitoring disposal, establishing vendor chain management, is a key to achieve competitiveness.

The traditional Indian idea of sourcing from one cheapest source by way of quotations has lost relevance due to the following reasons:

i) Quotations can be fabricated.

ii) Lowest rates can be at the cost of quality

iii) Lowest cost vendor may not be capable of producing large amounts of materials because his inability to raise finance, employ large number of workers etc.

Therefore his supplies may be delayed or paralyzed. This undependability factor is more important than the lowest price bid he does.

iv) Vendor chain relationship should be developed on mutual trust and benefit.

vi) Reduce inventory carrying cost, inventory cost by reducing inventory replenishment period to few days by cooperation of offering "just in Time suppliers".

vii) Explore global sourcing units, as well as, scope for extension of markets. The role of internal Audit is not that of a spy or a detective; who is on fault finding mission; but that of 'in-house consultant' who helps line managers in discharging their functions efficiently and effectively as far as costs are concerned. [1]

[1] Indian Institute of Materials Management, Cost reduction through Business Partnerships- Page no. 2 of 4

Business Recession Strategy (Cost Cutting)

When Business is slowing down and there is economic recession, following options must be tried as 'Business Recession Strategy'.

1) Do continue with cost reduction but also look at profit improvement. Use the 'Business solutions profit equation' to help your efforts. Profit is a function of expense, loss and revenue. So look at your losses i.e. waste for opportunities to improve and examine your revenues in detail, for opportunities to improve them.

2) Re-evaluate your entire pricing structure. As costs go up, so must prices in order to maintain margins. The caution is to avoid alienating your customers and thereby losing too many sales. Test pricing, up and down in response of your customers demand.

3) Think strategically. May be your closest competitor may not be as flexible as you are. You can create business advantage when costs and prices are under pressure. Your suppliers may be more willing to partner with you in their own interest.

4) Look for acquisition opportunities. Your competitors in complimentary product lines may be looking to sell. Market consolidation is always a better option.

5) Consider investing. Invest in the new equipment, machinery or technology to reduce costs and improve quality.

6) Watch your cash flow like a hawk. Make sure your accounts receivable stay current and healthy. If you are having trouble, so are your customers.

6) Make sure to engage your employees in the process. Everyone must be part of your team for renovations, rationalization, cost cutting and quality improvement.

7) Be slow to hire and quick to fire new employees to keep only the best. 'A lay off should be a past resort'. Instead of firing employees, ask them to work more and improve their productivity. They will surely be willing to choose the latter option.

8) Talk to your banks, investors and other sources of capital. Take them in confidence by transparently revealing your present difficulties and future plans. Take their suggestions and solutions. Instead of dodging calls from your bankers and well wishers; you call them for lunch or breakfast. Get your costs and bottom line profits under control !!

Recession is not a problem…. It is an opportunity! [1]

[1] Business Recession Strategy, Author Steve C. Martin, Profits weekly Newsletter, Page 1 of 2

Five Key Levers to Ride the Storm of Global Slow down

During global slowdown of 2007, firms should look at proactively deploying five key levers viz. a) Revenue and margin enhancement, b) Cost reduction and performance improvement, c) Reassessing planned capital expenditure, d) Seizing new opportunities and e) improving employee performance management. This will enable firms to successfully navigate tumultuous times and position themselves for further growth.

Business portfolio needs restructuring. On the one hand, companies should try 'cross-selling and up-selling' to existing customers and should explore new channels and avenues. On the other hand, they should think of 'Price optimization techniques' on the basis of customer spends and estimation of demand elasticity vis-à-vis price. Furthermore, companies should also do 'the product-mix-optimization'; diversifying to more paying lines rather than less paying lines. They should also make entry into 'high margin categories and services'. For that newer distribution and communication channels such as retailing over internet, employing electronic out of home media and mobile advertising can be leveraged so as to reach the customer cost effectively. In-depth analysis of customer profiles helps in identifying unique customer segments that can be effectively targeted for sale of additional products and service.

Specific initiative yield major benefits which include raw material optimization, value engineering, overhead coast reduction, right sizing and supply chain optimization. When business is enjoying 'going good conditions'; nobody bothers for a harder look at internal operations and costs, generally it is avoided for the pain it causes. Empirical studies prove that companies can boost productivity and cut waste, as well as, costs by 6 to 12%.

A redefinition of the key Performance Indicators and existing performance management systems (KPIs & PMS) may be necessary. Rewards and incentives certainly will improve employee performance.

Seizing new opportunities like acquisition and merger will also be easier in times of recession.

Creating a sense of togetherness and belonging from Top management level to Bottom lines, can reduce the execution risk and can help companies navigate through difficult times.

[1] R.R.Bhinge (CEO) and Pankaj Gupta (Head consumer & retail) - "Navigating through tumultuous times".
Tata Strategic Management Group.

Cost Reduction: Cases

'Tata Strategic' was assigned to offer solutions for optimization of manufacturing cost competitiveness. It split the assignment into three parts viz.

a) Identification of manufacturing constraints by estimating demand and detected capacity bottlenecks.

B) Variable costs, inbound and outbound logistics costs, temporary manpower costs and structuring costs were identified and analyzed.

C) Finally, strategic options were generated for the short and long term and potential cost benefits were analyzed.

Savings potential worth Rs. 350 million was identified based on a revised product mix at each manufacturing organization location. The client happily could reduce the unwarranted cost as per the advice.

Cost reduction opportunities in the area of overseas transportation by competitive negotiations, modifying the payment structure and inventory control, as well as, routes optimization. The client obtained overall cost reduction of about 30%.

Cost reduction in a large state run Dairy Federation was also suggested by 'Tata Strategic'. Barring the cost of raw milk, the rest of all costs were studied such as manpower, logistics and conversion. Almost 30% surplus labor was identified. Some activities were outsourced. Inter-union milk movement was

redesigned using 'optimization software'. 15% logistics costs were reduced; 20% operational costs and 5% conversion costs were also cut down. [1]

The 4-A's of Cost Reduction Ideas[2]

A_1 – You must first have the ideas #- Large number of ideas are your opportunity resource pool.

A_2 – Sort the resource pool to find those that apply to your business situation.

A_3 – Sort the list again to find those that are achievable and worthy of effort. Optimum time management is also inevitable.

A_4 – Finally, you have to implement the opportunity to create results. Energize your profits with a list of valuable cost reduction and profit improvement ideas- Review how productive each space is for your business. How much revenue does it generate or support. Put that surplus space for another productive use. Encourage prompt and quick payments from your customers, reduce the credit limits and make your cash flow comfortable.

[1] 'Tata Strategic'- Cost reduction , Case profiles, Cost savings, Page no. 1 of 2

[2] Profit Wealthy newsletter, Cost reduction and Profit improvement tools Page 1 to 8

Avenues for Cost Reduction in Chemical Processing[1]

Major production cost in chemical processing includes color and chemicals, utilities, maintenance, wages and interest. A mill engaged in Bleaching, Dyeing, Printing and Finishing, the cost on colors and chemicals are comparatively higher than the utilities/Unit productions. Mills using coal as fuel for thermal energy have some relief on utilities particularly on steam and water cost.

Among the utilities, major cost happens to be thermal energy which is about 50% of the total cost.

Water is becoming scarcer these days and on the other hand 'Anti-pollution regulatory authorities' are tightening the nose of polluting industry by making the stringent regulations for effluent treatment. Thus both water and affluent treatment costs are rising very high and rapidly.

Therefore conservation/reduction in its usage is utmost important. Bombay Textile Research Association (BTRA) has taken a lead and continuously rendering the consultancy services to the mills producing cotton, polyester, polyester wool, woolen, woven or knitted fabrics. BTRA launched water conservation studies and effluent treatment expenditure studies.

1 B.P. Yadav, Avenues for cost reduction in chemical processing, Seminar on conservation of utilities in Indian Textile Industry,
November 26, 2002, Seminar Paper

After implementing suggestions done by BTRA Research Group, the selected 8 mills showed not only reduction of water consumption from 25% to 38% but also in reducing the cost of thermal and electrical energy. The suggested measures also helped the mills to reduce their 'effluent treatment costs' by 15 % to 25%.

A.K. Steel plans of cost cutting in global slowdown of December 2008[2]

Due to sudden and sharp fall in demand for company's products, company announced 'salaried employee cost reduction program'. There was 5% pay reduction effective from January 1, 2009. Pay reduction applicable to all, from top CEO to bottom line employees. It also introduced 'freezing of the Benefit plan for salaried employees and replaced it by a scheme of 'contributory retirement benefit'. It offered incentives for voluntary retirements. In case company finds stringency to continue, company announced that it will implement 'involuntary salaried job reductions'.

A.K. Steel produces flat rolled carbon, stainless and electrical steels, primarily for automotive, construction and electric power generation and employees 6500 men and women in U.S.

[2] Context- A.K. Steel plans salaried work force pay cut-2008

Various ways and means of cost reduction[1]

1. Cost Reduction by Design

   Product development determines 80% of product cost. The concept/architecture phase alone determines 60% cost. Cost is very hard to remove later after products are designed. Significant cost reductions by design for parts, labor, material overhead, and quality and product development: designing for lean production can maximize lean savings.
   Implement Design for manufacture ability (DFM), Design to lean and Design for quality.

2. Activities supportive to Low cost Product Development

   a) Co-locating Engineering with manufacturing ensures the best team work. Avoid distant outsourcing and off shoring.

   b) Choose local vendors which ensure early and active vendor participation in product development teams.

   c) Avoid low bidding

   d) Implement standardization and good product portfolio planning for focus.

[1] Half cost products, Cost savings, 14th July 2010, Page no. 1 to 7

e) Total cost measurements to qualify all costs affected by design.

f) Correcting counterproductive policies- New ventures and startups will be able to implement these principles easily and smoothly. Established companies will require extra efforts and trouble to bring things in order.

3. Lean Production cost Reduction

Lean production benefits include doubling labor productivity, cutting production throughout times by 90%, reducing inventories by 90%, cutting errors and scrap in half errors.

Activities supportive to Lean Production

a) Design product families

b) Concurrently engineer flexible processes

c) Implement standardization

d) Rationalize the products to eliminate the most unusual products with the most unusual parts and processes

e) Total cost measurements

f) Keep control of manufacturing in-house or with vendors/partners; avoid outsourcing for cost; avoid long and distant supply chains.

4. Overhead cost reduction

   Try 'Build to order' without forecasts and see the products are 'mass-customized on Demand'.

   Result-

   a) Inventory carrying costs can be eliminated

   b) Procurement costs can be reduced with automatic check on demand resupply

   c) Better responsiveness leads to more sales.

5. Standardization of Cost Reduction

   Standard part lists can be 50 times less than proliferated lists.

   Result- Standardized parts are easier to get. Economies of scale also result from large scale purchases.

6. Product line Rationalization Cost Reduction

   Focus on the most profitable products. Eliminate the 'loser tax' on cash cows to subsidize low margin products. Remove products that are losing money on a total cost basis. Reduce overhead costs of 'loser products'. Free up valuable resources to work on cost saving efforts in engineering operations and 'Supply Chain Management'.

7. Supply Chain Management Cost Reduction

   Supply chain simplification can greatly simplify supply chain management. Material overhead can be reduced by a factor of 10 for standard parts and materials. Automatic Resupply (Just in time) saves the cost of inventories.

8. Quality Cost Reduction

   The cost of quality can be 15% to 40% of revenue. Quality costs can be greatly reduced; in some cases reducing quality costs can double profits. Quality costs in manufacturing organization can be eliminated with 'Six Sigma' programs.

9. Total Cost Measurement to Support all Cost Reduction Activities

   Total cost measurements are imperative to encourage and support the above activities to rescue all cost categories.

   Other Valuable Tips

   1) Do not try to remove cost after the product is designed.

   2) Do not lower cost: short sighted attempts prevent real cost reduction.

   3) Do not use low bidding.

   4) Do not outsource or offshore manufacturing for cost.[1]

[1] Dr. David M. Anderson. www. Half Cost Products. Com,

Chapter No. 3

Chapter No. 3

REVIEW OF FACTUAL CASES OF COST-CUTTING DONE BY SUCCESSFUL GLOBAL BUSINESSES

(Based on Secondary Data)

Review of Factual Cases of Cost-Cutting done by Successful Global Businesses

Generally, Business Managers take their decisions about pricing, costs and profits on the basis of Accounting Revenues and Costs. They believe that if revenue exceeds cost, the firm is in good, and efficient conditions.

But recently, new generations of Business Managers trained in Managerial Economics, have realized the importance of optimality. Sheer surplus above cost, creates a deceptive complacency; in fact, attention should be given whether profit is maximized. If the firm obtains maximum revenue by minimum possible cost; the firm is capable of earning maximum profit which is the accepted indicator of efficiency of a modern firm.

In order to attain optimality, the firm has to take care of the 'MARGINAL ANALYSIS'; which is used in theoretical economics. Marginal Analysis shows that a firm can maximize its profit by equating its marginal cost to its marginal revenue and at that position a firm tends to get maximum revenue within minimum cost.

Case 1

For example, an advertising firm in U.S. realized that by equating its marginal cost to its marginal revenue, the firm could get maximum net benefit.

With each additional TV spot, the firm's total benefits (Sales or revenue) increases, but the extra benefit, i.e. marginal benefit declines. The reason is that each additional TV spot reaches fewer and fewer additional people and becomes less effective in inducing more consumers to buy the firm's product. The extra or marginal cost of each TV spot, let us assume, remains constant at $ 4000.

The firm while increasing additional TV spots, found that its Total Benefits went on 'increasing', (less than proportionately) and its marginal benefits went on 'decreasing'. [1]

[1] Dominique Salvator- Microeconomics- Publication Hadison Wesley- Year 1997- Part one- Page 13

Table 1 Advertising Industry Marginal Benefits and Costs of TV Spots

No. of TV Spots	Total Benefits	Marginal benefits	Total Costs	Marginal cost	Net Benefit = Total Benefit- Cost
1	$ 20,000	__	$ 4,000	__	$ 16,000
2	$ 34,000	$ 14,000	$8,000	$ 4,000	$ 26,000
3	$ 42,000	$ 8, 000	$12,000	$ 4,000	$ 30,000
4	$ 46,000	$ 4,000	$ 16,000	$ 4,000	$ 30,000
5	$ 48,000	$ 2,000	$ 20,000	$ 4,000	$ 28,000
6	$ 49,000	$ 1000	$ 24,000	$ 4,000	$ 25,000

Source- 'Ad Industry Benefits of a Recovery'- Wall Street Journal, February 8, 1993- P. B1 and "Target Micromarkets is a way to Success". Wall Street Journal – May 31, 1995 P.A,

Wall Street Journal has proved that Advertising firm's optimum position i.e. (Maximum Profit/benefit by equality of Marginal Cost to Marginal Benefit) is when, it gives four TV spots by spending $ 16,000/- (Each spot requires $ 4,000) and earning maximum benefit of $ 30,000 and less than 3 TV spots again bring less net benefit. (viz. $ 26,000 by 2 spots and $ 16,000 by one spot)

The firm does not stop after giving 3 TV spots, but takes a positive chance as to know whether it has reached its optimum position of MC=MR; because by the third TV spot, the firm's Marginal Benefit is far greater than its Marginal Cost. At this stage, the firm has not earned maximum satisfaction because it has not reached its marginal barrier. [1]

The concept of MARGIN represents the Key Unifying Concept in microeconomics and it applies to all economic decisions and market transactions. It applies to consumers in spending their income, (Law of diminishing marginal utility) to firms how many workers to be employed, to workers in choosing how many hours to work etc. etc. The marginal analysis has been the essence of Production, Consumption, Exchange, Distribution and Government Finance Theories. [2]

[1] Wall Street Journals of February 8, 1993 and May 31, 1995

2[1] Dominique Salvator- Microeconomics- Pub Wesley- Ed 1997- Part 1 Page 12

Case 2 Economic Inefficiencies of the Governments and their Consequences

In 1957, Communist Party Chairman Nikita khrushev proudly asserted that the Soviet Union Would bury the U.S. not with atomic warheads but with Superior Productive Power!

Instead in 1989, the Soviet Union and former Eastern European communist regimes collapsed as a result of massive economic failures.

Consumer essential goods were in acute shortage, they were shabby and they were very expensive. Automobiles, refrigerators, TV sets and other consumer durables were primitive by world standards. In computers and machine tools, Soviet Union was a decade behind the U.S., Germany and Japan. Its standard of living was less than third that of the U.S.

These massive economic failures were the direct result of the command economy. Economic decisions were centralized and they were arbitrary and forced on disgruntled people by the regime of dictatorship. Prices were administered; therefore there was no incentive to reduce them by revising or improving the cost and the quality. There were no incentives to enterprises, workers and the managers. [2]

[2] Dominique Salvator- Microeconomics- Publication Wesley- Ed 1997- Part 1 Page 10

Due to the lack of competition, market economy and critical evaluation of the performance of command economy, the Soviet Russia brought reduced outputs, hyper inflated costs, rising inflation, rising unemployment, rampant corruption of the commissars, huge budget deficits, unsustainable foreign debts. [1]

In post 1992 era, Russia has abandoned communist ideology by making constitutional provisions and has adopted reforms of privaitization, liberalization and globalization. It has adopted competitive market economy. It has allowed private enterprises and businesses. Prices and wages have been freed from Government controls, opening of the economy to competition both within and international; replacing state trading by private markets, right to private property and profits, started a capital market and privatized banks and the most important provision has been introduction of 'Cost Accounting System'. [2]

Specialization and Exchange

Two important things that greatly increase the efficiency of market economies are 'Specialization in the production and exchange'. By Division of labor and specialization, efficiency and output can be maximized at reduced costs.

[1] W. Easterly and Stanley Fischer- "What we can learn from the Soviet Collapse", Finance & Development Journal- December 1994 Page 2 to 5

[2] "Accessing the Reform Record in the Transition Economies". IMF Survey- January 9, 1995 Page 1 to 6

A person, a region or a nation can specialize in the production of those goods and services in which, they have comparative advantage.

A professor may be a very good typist whose speed of typing may be above average. But if he will devote all his spare time in academic pursuits, instead of wasting them in washing clothes or typing manuscript of his article, it will bring him more money and success. One hour of writing an article, may bring him Rs. 2000/- whereas, one hour if he would engage in typing, he will save Rs. 100/- being professional typist's fee but will lose net Rs. 1900/- by not allowing himself to produce another article. [3]

[3] Dominique Salvator- Microeconomics- Haddison & Wesley- Ed.1997 Page 16

Case 3 Internationalization of Economic Fraternity and Market

Due to comparative advantage and cost advantage, international specialization has taken place and modern market has been globalized because the goods produced as per the comparative advantage, happen to be inexpensive and qualitative.

All over the World, due to widespread economic reforms implemented, higher income consumers have started purchasing Japanese Toyota, Innova and Honda City, German Mercedes, Italian handbooks, French perfumes and champaigns, Hungarian clothes, Taiwanese calculators, scotch whisky, Swiss chocolates, Canadian fish, Indian Tea and Brazilian coffee.

The interesting fact is that, the products which belong to a particular country, not necessarily are made by all inputs, available in that country. There is a combination of one and more than one countries to produce a popular global brand. e.g. American IBM PC, mostly is manufactured abroad, and more than $1/3^{rd}$ of IBM revenues and profits are generated abroad.

The strongest competition and challenge faced by IBM today is not from the American Digital Equipment Corporation (DEC) but from Japanese Mitsubishi and Hitachi. General Motors, Ford and Chrysler face increasing competition from Toyota, Nissan and

Honda. U.S. Steel companies almost collapsed during 1980s as a result of rising steel imports from Germany and Japan where steel could be produced at a lower cost than America.

Let us take a concrete example of internationalization of production activity.

The total manufacturing cost of IBM PC was $ 860 in 1985; of which $625 was for parts and components made in other firms of U.S. and abroad. If all the components and spares, Would have been manufactured by IBM itself, the price of IBM PC would have been at least 50% more and IBM would have lost its competitive edge.[3]

[3] Dominique Salvator- Microeconomics- Haddison & Wesley- Edition 1997 Page 16

Let us study the detailed Break Up of IBM PC cost in 1985.

Distribution of Manufacturing Costs for the IBM PC in U.S. & Abroad.

Total manufacturing Cost	$ 860
Portion made abroad	$ 625
In U.S. owned other plants	$ 395
Monochrome monitor (Korea)	$ 85
Semiconductors (Japan)	$ 60
Semiconductors (U.S.)	$ 105
Power supply (Japan)	$ 60
Graphic printer (Japan)	$ 160
Floppy disk drivers ((Singapore)	$ 165
Assembly of disk drivers (U.S.)	$ 25
Keyboard (Japan)	$ 50
Care and final assembly (U.S.)	$ 105
Total	$ 860

Sources- "America's High Tech Crisis"- Business Week March 11, 1985 Page 56 &57 and

"Selling now in Tokyo"- The Thinnest IBM Portable- The New York Times- April 11, 1991 D1

Case 4 General Motors decides 'Smaller is better; by Cost Management'

General Motors, the largest company and automaker of the world, incurred losses of $ 2 billion in 1990 and an incredible loss of $ 4.5 billion in 1991! These losses were the result of a bloated Work Force and Top heavy Management, low capacity utilization, too many discussions and lack of coordination, too many models and high cost suppliers.

It used to take, on an average of 48 months (4 years!) to develop a new model, as compared with 38 months at Ford and 37 months at Chrysler and General Motor's efficiency in assembling vehicles was 34% lower than Ford's and 21% lower than Chrysler's. The data on Sales per employee of General Motors was the lowest, as follows. [1]

Total World Sales, Employees and Sales per Employee (1991)

Automobile Company	Sales in billion dollars	Employees in thousands	Sales per employee in dollars 1000
General Motors	123.1	756	162.7
Ford	88.3	333	265.4
Chrysler	29.4	123	238.8

Source: The Economist, May 2, 1992 page 78

[1] "Automobiles-GM decides smaller is better"- the Margin- November-December 1988- Page 29

As a part of its REORGANIZATION plan to increase efficiency and cost cutting, General Motors shed 74000 workers (50,000 blue collar and 24000 white collar) between 1992 and 1995. It also closed 21 plants, reducing capacity from 7.5 million cars to 5.5 million cars and trucks per year. The size of the car was too big therefore it faced 'decreasing returns to scale'. On the other hand, Ford's share of the U.S. Market increased to 26.5% in 1995.

Chrysler having only 10% share of the U.S. Market is happy because its moderated scale brings it full advantage of increasing returns and hence its Sales per employee has consistently remained the biggest. [2]

Technological progress is the result of 'innovations' which bring development of new and better production techniques to reduce existing costs to make an improved or an entirely new product.

[2] "GM plans to speed Vehicle Development and Reduce Costs 25 % by 1997' Wall Street Journal July 18, 1995 Page.A1

Case 5

How Ford decided on the characteristics of its model 'Taurus'!

Firms can learn about consumer's preferences by conducting or commissioning market studies to identify the most attractive characteristics of a product say a) Styling and
b) Performance for automobiles. This idea was developed by Kelvin Lancaster.

Ford used this approach in designing its 1986 Taurus Model. The model regained its status of the 'Best Selling Car in U.S.'- a position it lost to the 'Honda Accord' in 1989. Ford repeated this strategy in its brand new model of 1996 Taurus, at a cost of $ 2.8 billion. It also brought very good profits. [1]

Source- "Ford Puts its Future on the Line'. New York Times magazine, Demeber 4, 1985
Page 94 to 110 &
The Shape of a new machine', Business Week – July 24, 1995 Page 60 to 66

Case 6 International Convergence of Tastes

A rapid convergence of consumer tastes is taking place in the world today. Tastes in the U.S. affect tastes around the world and tastes abroad strongly influence the tastes in the U.S.

Coca-cola and Jeans are only two of the most obvious U.S. products that have become household items around the world. Pizzahut, Domino Pizza, McDonald's burger, Adidas sneakers, Walkman's personal stereos, Toyota and Honda cars, French perfumes, Texas instruments, Canon calculators, Zenith and Hitachi Portable PCs, Xerox and Minolta Copiers can be found all over the world from Canada to New Zealand and Latin America to Russia.

In his article (1983), "The Globalization of Markets' in the Harward Business Review, Theodore Levitt asserted that consumers from New York to Tokyo want similar branded products and the success of global enterprises depends on Standardized products and reasonable pricing around the world. With growing incomes and education levels, life styles among higher middle class are becoming very much similar. A new want due to working housewives for packaged food, of 'ready to eat products', has been emerged in recent years.

The tremendous improvement in telecommunications, transportation, travel and tourism, global job openings' the cross-fertilization of cultures and convergence of tastes can only be expected to accelerate. [1]

[1] Theodore Levitt- "The globalization of markets'- Harvard Business Review- Article published in 1983

Case 7

U.S. lost its leading position to Japan and Europe in metals, and it totally surrendered its electronics industry to Japan during 1970s and 1980s. U.S. applied its attention to stop its decline due to the international competitiveness. It has made special efforts to reorganize its industries and by 1996, the score card of 13 key American Industries reads as follows.

A	Pharmaceuticals
A	Forest Products
B+	Aerospace
B	Chemicals
B	Food
B	Scientific and Photographic Equipments
B	Petroleum Refining
B-	Telecommunications Equipments
C+	Computers
C	Industrial and Farming Equipments
C	Motor Vehicles
C-	Metals
D	Electronics

Source: "How American Industry Stacks up"- Fortune, March 9, 1992 Page 30

Case 8 The New Computer aided production Revolution & the International Competitiveness of U.S. firms

Since the early 1990s, a veritable revolution in production has been taking place in U.S. based on 'computer aided design – CAD' and 'computer aided manufacturing – CAM' which has greatly increased the productivity and international competitiveness of the U.S. firms. CAD allows Research and Development Engineers to design a new product or component on a computer screen, quickly compare it with different alternative designs and test the strength of the correct design. CAM can avoid many production problems, greatly speed up the time, reduce the cost and achieve maximum production efficiency.

This 'New Digital factory' an information edge marvel, which is responsible for a quantum leap in the speed, flexibility and productivity of U.S. firms because of its leadership and superiority in computer software and computer networks. For example, as a Motorola sales person specifies an order for a 'paper' for a particular consumer, the digitized data flow to the assembly line where production begins simultaneously and completed literally in few minutes! The customer can have a 'Customized paper' the next day!! This is the revolution of 'customized manufacturing' [1]

[1] Source- 'The Digital Factory'- Fortune, November 14, 1994 Page 92 to 110

CAD allows Chrysler to design and build its highly successful NEON subcompact car in 33 months instead of the usual 45 months. Similarly, scientist at caterpillar, the largest earth moving equipment builder in the world, can use virtual reality to test drive products; before they are built.

CAD can be used to design and simulate entire assembly lines and can be used to send production orders directly to supplier's machinery, so that, in a sense they become an extension of the firm's plant.

With the U.S. undisputed superiority in software and the Digital factory, it is unlikely that foreign competitors can easily copy and match the new American Manufacturing Genius anytime soon.[1]

[1] Dominique Salvator-Microeconomics- Haddison Wesley 1997 P. Page 199 & 200

Case 9

How Xerox regained international competitiveness

The Xerox Corporation was the first to introduce the copying machine in 1959, based on its patented xerographic technology. Until 1970, Xerox had no competition and thus had no incentive and reason to reduce its manufacturing costs, improve quality and increase customer's satisfaction due to its despotic monopoly.

Japanese firms entered the market with better and cheaper copiers and began to take over this segment of the market. Xerox underestimated this trend and concentrated in mild and high ends of the market, where profit margins were high. Xerox used large part of that profit to expand in computers and office systems, so remained quite complacent. In 1979, Xerox finally awakened to the seriousness of Japanese threat. Xerox was startled to know that Japanese competitors were producing copiers of higher quality at far lower costs and was on the forward march of capturing the lion's share of the market.

Faced with this life threatening situation, Xerox with the help of its Japanese subsidiary (Fuji Xerox), mounted a strong response that involved reorganization and integration of development and production, as well as, quality control efforts.

Employee involvement was great, increased inventories and the number of vendor suppliers was greatly reduced. Xerox was able to reverse the trend, maintained its market leadership and re invented itself into digital document company. [2]

[2] "Japan is tough but Xerox prevails"- New York Times- September 3, 1992 Page D1

Case 10 What is an American Car?

A "Buy American" movement swept the county during late 1990s. Detroit's Free Press reported that in a nationwide poll 51% of those polled, wanted to buy only American products, especially American Cars. The increased desire to buy American car has been stimulated, by the dramatic improvement in the quality of American Cars during 1990s.

But at present problem is that, it has become exceedingly difficult to determine which car is genuinely and purely American. Should a Honda Accord produced in Ohio be considered American? What about a Chrysler mini-van produced in Canada? Is a Kentucky Toyota or Mazda that uses nearly 50% of imported Japanese parts/components, American?

Some think that any vehicle assembled in North America (i.e. Canada, U.S. and Mexico) should be considered American because these vehicles use U.S. made parts. But the United Auto Worker's Union views cars built in Canada and Mexico, being foreign, take away U.S. jobs. The Union endorses Japanese owned plants located in U.S. as American because they provide jobs to American workers.

The fact is that, in order to fully minimize the product cost; industries have become interdependent globally. [1]

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[1] "Growing Movement to buy American" Debates the term. Wall Street Journal 24 January, 1992 P.A1

Case 11 Monopoly Profits in the New York Taxi Industry

In order to operate a taxi in many municipalities in the U.S., a medallion or license is needed. Many municipalities have stopped and restricted to issue new licenses; in order to retain the monopoly of original medallion owners.

The number of medallions in New York city has remained constant at 11,787 for more than a half century and the value of a medallion has risen from $10 in 1937 to nearly $ 170,000 today. It is about $90,000 in Boston and $ 25,000 in Chicago; where taxis are less scarce and earning opportunities are relatively less.

New York Municipality allowed a sharp increase in the number of Radio cabs during the 1980s, which can only respond to Radio calls and cannot cruise the streets for passengers. As a natural reaction, Radio cabs have restrained the monopoly of taxi license owners. The pull of competition in recent years have affected and restricted exorbitant rise in the selling price of 'medallions'. [1]

[1] "Driving a taxi difficult in the Best of Times, Gets tougher." New York Times- April 9, 1995 Page 41

Case 12 Score Card on American Industry

U.S. continued to hold supremacy till 1960s in almost all the Key industries of the World. It had enjoyed Grade A which implied a secure dominant position in the World.

U.S. had A Grade in Pharmaceuticals, Forest products, Civilian Aircrafts, computers, telecommunications, electronics, Automobiles and industrial equipments. It has lost 1/3rd of its Airbus market to Europe in 1970s. In chemicals, food and petro-refining, it still shares world leadership with the Europeans, in scientific equipment and telecommunications with Japan and Europe. In computers, it faces stiff competition from Japan. Out of eight key industries in which U.S. had leading position, at present U.S. has retained its dominance only in two key industries viz. Pharmaceuticals and Forest products.

The essence of this analysis is that economy of any country and economic condition of a firm cannot enjoy stability infinitely; because of dynamic changes which are continuous; every economy is vulnerable to the threats from superior economy/superior firm. What is essential in modern management is not complacency but constant vigilance and awareness of the threats. The profits refer to the revenue of the firm from the sale of the output after all costs have been deducted. The introduction of innovations is the single most important determinant of a firm's long term competitiveness. [1]

[1] Dominique Salvator-Microeconomics- Haddison Wesley 1997- Page 199 and 202

Case 13

To reduce costs, firms look far afield

In order to increase productivity and cut down costs to better compete, firms often seek creative insight in industries far afield from their own.

In a time of increased global competition, firms routinely scrutinize competitors, practice in their quest for innovative products and processes.

For example, when South West airlines wanted to improve the turnaround of its aircrafts in airports, it did not examine other airline's practices but went to the 'Indianapolis 500'
to watch how pit crews fuel and service racecars in a matter of few seconds. The result was that South West was able to cut its turnaround time by more than 50 %. Such drastic increase in productivity could hardly be accomplished by observing practices of other airlines.

The key to finding useful insights in seemingly unrelated fields is to focus on processes.

For example, a firm seeking to speed its production process might took at Domino's Pizza, an outfit that takes an order, produces the pizza, delivers it and collects the money- all in less than 30 minutes. A major gas utility firm discovered ways to greatly speed the delivery of its Fuel to customers observing how Federal Express delivers packages overnight.

Similarly, a firm delivering gravel learned how to greatly speed deliveries by having Truck drivers plug a card into a machine requesting the quantity of gravel to load – eliminating the need for the driver to get off the truck and waste a great deal of time filling out order forms, just as Automatic Teller Machines work at banks! [1]

[1] "To compete better, Look far afield." New York Times, September 18, 1994 Page 11

Case 14

Walmart's preemptive expansion marketing strategy

In the year 2009-2010 Walmart has been chosen as the most successful firm by its sales, profit, brand and worldwide network of more than 2500 discount stores[1]. It is the top ranking firm which has beaten automobiles, petroleum, aircrafts, computer, information technology etc. industries and instead of manufacturing, it has proved that Retailing can also become a grand business.

The sole secret of Walmart's No. 1 position is its continuous effort of cost cutting and sharing it with its customers and multiplying its sales turnover. It spends lowest costs on capital, inventories, logistics, warehousing, distribution and advertising etc. Its policy is well known viz. 'Every Day, Low Price' and buyers trust that Walmart will go on reducing the price but not the quality of products.

The Walmart's principal source of its strength is its excellent supply chain Management and inventory of almost one week and flow of goods from its suppliers, 'JUST IN TIME'.

[1] Source – Ranking published by 'Fortune Magazine'.(World top 500 companies)

Walmart, the discount retail store chain was started by Sam Walton in 1969, Walmart continued to earn profits when its competitors were making either razor thin profits or incurring losses. Instead of concentrating in big metros, Walmart undertook a challenging experiment of opening its stores in small towns by relying on its managerial efficiency, low costs and high turnover. Walmart has been ridiculed by local retailers by calling 'Merchant of Death' because a large number of competitor retailers collapsed because of the entry of Walmart.

Walmart makes marketing surveys and opens its chain stores so as to preempt the opening of shops of competitor retailers. Once Walmart opens in a town, no rival firm dares to open it's stores; because Walmart has earned tremendous goodwill and popularity among consumers belonging to various sections of the society. [1]

[1] "Can Walmart keep growing at Breakneck speed?"
New York Times, September 23, 1991, Page D1

Case 15

Coca-cola versus Pepsi War

On April 23, 1985, the Coca cola Company announced that it was changing its 99 years old recipe for coke. Coke is the World's leading Soft Drink and the company took an unusual risk in tampering with its highly successful product.

Company felt that changing the recipe may ward off the challenge from Pepsi-cola because new coke was made sweeter and less fizzy taste, aimed at reversing Pepsi's market gains. Coca cola spent over $4 million to develop its new coke and conducted taste tests on nearly 2 lakh consumers over a three year period; and did not declare that it will discontinue producing the 'Old coke'. 61% consumers approved the taste and quality of the new coke. Company spent over $ 10 million on advertising its new product.

When the new coke was introduced in May, 1985; it unexpectedly faced a violent consumer's revolt against the new coke. New coke flopped and company was compelled to bring back the old coke to pacify its consumers. The company called old coke by renaming it as 'Coca-cola classic' and simultaneously did not withdraw the new coke. The company could sell coke classic and new coca cola, side by side, and increase its previous market share and the dominant lead.

Inadvertently Coca cola discovered that its brand loyalty of its buyers to the 99 years old coke had remained strong. Another fact was noted by the company that market survey based decisions are at times, found wrong; because absolute opinions and comparative opinions differ. The new coke which was approved by 2 lakh consumers, without knowing that it is going to replace the old one!

That is why, market research based launched new products, have, by and large, the failure rate of about 50% in the U.S.

Coca cola introduced 'Frutopia' a line of fruit based drinks, new sports elixir Power-Ade and Generation X inspired OK soda while keeping process low to fight competition from Pepsi-its perennial arch rival! [1]

[1] "Ten years later, Coca cola laughs at new coke" New York Ti9mes- April 11, 1995 Page –D4

Case 16

De Beers Diamond Monopoly

In 1887, Cecil Rhodes created the De Beers consolidated Mines Company, which controlled about 90% of the total World supply of rough uncut diamonds with its South African Mines. Today, De Beers produces about half of the World's diamonds in its mines in Africa, Botswana and Namibia and still markets about 75% of the World's diamonds through its Central Selling Organization (CSO). Producers in Russia, Australia, Botswana, Angola and other countries sell most of their production to De Beers; which then regulates the supply of cut and polished diamonds to final consumers on the world market; so as to keep prices high.

When there is a recession and demand for diamonds is low, De Beers withholds diamonds from the market in order to avoid further price decline until demand restores. De Beers earns huge monopoly profits but shares it with the members of the cartel. It used to make sales worth $6 million in 1970s but in 1990s, it has crossed its sales over $50 billion. (It's function is similar to OPEC!).

It has retained its monopoly through the World Wars, 1930s depression, financial and currency crisis, hostile governments etc. When Russia along with Zaire attempted to sell large quantities of industrial diamonds on the market outside the CSO in the early

1980s, De Beers immediately flooded the market from its own stock piles, driving prices sharply down. Thus convincing the new comers to join the cartel and bring back the defectors in its monopoly fold.

In 1992, when diamonds were smuggled from Angola, De Beers purchased all of them by paying off 500 million, to prevent collapse of market price and its monopoly hold.

Recently, Russia demanded 1/3rd share of the sales of rough uncut diamonds from the CSO. But Russia is running out of diamonds to sell, in near future. Therefore, the monopoly of De Beers will continue infinitely; because of its management strategies and tactics.

Business is like a game and war and the players, who can use appropriate tactics are sure to win. [1]

[1] "How De Beers Dominates the Diamonds". The Economist- February 23, 1980 Page 101 to 102

Case 17

Dell Computer's Success in mail-order business

Dell Computers of Austin, Texas, a company created by 27 years old Michell Dell in 1984, ended the 1994 fiscal year with revenues of more than $ 3.4 billion, making it the 6th largest computer company in the nation. By offering a 30 day money back guarantee on next day, free on sight service through independent contractors for the first year of ownership and unlimited calls to a toll free technical support line; Dell established a solid reputation for reliability and after sale service.

Dell will even mail a $25 cheque to any customer that does not get a Dell Technician within 5 minutes of calling. Ordering a computer from Dell by mail is now like ordering a 'Prig Mac' at McDonald's – you know exactly what you will get.

By eliminating the middle person, Dell was able to charge lower prices than its larger and more established competitors. For example, Dell's selling expenses and administrative expenses are 14 cents for each dollar of Sales, compared with 24 cents for Apple and 30 cents for IBM.

Dell ships computers by mail by adding only 2% shipping charge to the sale price.

On receiving a mail order; Dell technicians simply pick up the standard components from the shelf to assemble the particular PC ordered. It is simple, quick and inexpensive. Thus Dell has developed a dominant strategy, to maintain it's upmanship in the market of PCs.

By doing so, Dell has become a kind of 'HIGHTECH WAL-MART! [1]

1 Dominique Salvatore- Microeconomics- Haddison & Wesley- Edition 1997- page 395

Case 18

Computer is in Mail by Nash Equilibrium

Until recently, traditional computer firms such as IBM, Apple, Compac and other always thought the customers were willing to pay a substantial retail mark up for the privilege of being able to go to a store and feel and touch the machine before buying it. Some customers still do the same.

But by reducing fear and uncertainty from ordering computers through the mail, Dell was able to convince a growing number of customers to order directly from Dell by mail in the U.S. Given Dell's dominant and profitable strategy, IBM, Apple, Compac and Zenith also quickly followed and set up their own mail-order departments.

Their dominant strategy of selling exclusively through retail outlets was known out by 'Dell; and so now, we can say that the computer industry is in a Nash Equilibrium. Dell still retains almost 50% of the mail order computer business. The Nash Equilibrium is a situation in which each player chooses an optimal strategy, chosen by other player.[1]

[1] "The Computer is in Mail" – Business Week, January 23, 1995 Page 76-77

Case 19

The Airline's fare war and the Prisoner's Dilemma

In April 1992, American Airlines, the nation's largest carrier with a 20% share of the domestic market, introduced a new simplified fare structure that included only four kinds of fares instead of 16 and it lowered prices for most business and leisure travellers.

Coach fares were cut by an average of 38% and first class fares were lowered by 20% to 50%.

Other Airlines quickly announced similar fare cuts. American and other Airlines hoped that the increase in air travel resulting from fare cuts would, more than offset the price reductions and eventually turn losses into badly needed profits because during 1990 and 1991, domestic airlines lost more than $6 million. Pan Am and Eastern Airlines went out of business and continental TWA and America West Filed for bankruptcy protection!

But the few cuts went on rising because of erratic cuts by TWA which stirred the 'Price-war' among Airlines. Northwest declared that one adult passenger can take one child free, by purchasing one ticket only! Other Airlines were compelled to announce almost 50% fare cuts.

But even though increased number of travellers brought some dollars; companies incurred heavy losses because the new low fares failed to cover the industry average cost. Thus the industry got confused whether to continue fare cut or whether to raise the fares matching the basic costs. Both options were equally bad! [1]

[1] Dominique Salvator- Microeconomics- Haddison Wesley 1997- page 399

Case 20

Voluntary Export restraints on Japanese Automobiles to the U.S.

From 1977 to 1988, US Automobiles production fell by about one third; the share of imports rose from 18 % to 29 % and nearly 3 lakh automobile workers in the U.S. lost their jobs.

In 1980, the Big Three (General Motors, Ford and Chrysler) Automakers suffered combined losses of $4 billion. As a result, U.S. negotiated an agreement with Japan, that limited Japanese automobile exports to the U.S. to 1.6 million units per year from 1981 to 1983 and to 1.8 million units for 1984 and 1985 will be acceptable to them. Japan agreed to restrict its automobile exports, so as to avoid more stringent measures by the U.S.

U.S. automakers used the time off about 4 years (1981 to 1985) to lower their 'break-even points' and improve quality. But the cost improvements were not passed on to consumers and Detroit reaped profits of heavy $ 6 million in higher price autos. The big looser, of course, was the American Public; because of excessive patronage and protection given to automakers.

The U.S. International Trade Commission (US-ITC) estimated that the 'Agreement' resulted in a price $660 higher for U.S. Automakers and $1300 higher for Japanese cars in 1984. It also estimated that Agreement caused a loss of $15.7 billion from 1981 to 1984 and

that 44000 U.S. auto jobs were saved at a cost of more than $1 lakh per auto worker; which was about 2 to 3 times more than the yearly earnings of a U.S. Autoworker.

After 1985, the U.S. did not ask to renew the agreement. But Japan unilaterally continued to restrain its auto exports (to 2.3 million from 1986 to 1991 and to 1.6 million afterwards) so as to avoid friction with the U.S.

Since the late 1980s and early 1990s, Japan has been producing an increasing number of automobiles in the U.S. itself, in so called 'transplant factories'!

By 1995, Japan was producing more than 2 million cars in the U.S. and had captured 20% market of the U.S. [1]

The increased efficiency of U.S. automakers; especially Ford and Chrysler, seems now to have arrested and even reversed the growth in the Japanese share of the U.S. auto market.

Thus competitive threat, is a disguised boon to improve the 'cost-efficiency' of the firms. [2]

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[1] "U.S. International Trade Commission"- A review of recent developments in the U.S. Automobile Industry- Washington DC, February 1985

[2] "U.S. Cars Comeback"- Fortune, November 16, 1992 Page 52 to 55

Case 21

Military Strategy and Strategic Business Decisions

According to William Peakock, the president of two St. Louis companies and former Assistant Secretary of the Army under President Carter, 'Revision making' in business has much in common with mini strategy and thus can be profitably analyzed using 'game theory'.

Throughout history, military conflicts have produced a set of Darwinian basic principles that can serve as an excellent guideline. To business managers; about how to compete in the market place. In Business, it is crucial for the organization to have a clear objective and to explain the same to all its employees. McDonald's success in the market has been due to following the same principle.

Both, business and warfare require the development of an 'attack strategy'. Competitions cannot be won by remaining passive. Furthermore, both business and warfare require unity of command to pinpoint responsibility. The elements of surprise, secrecy and security are common in both. For example, Lee Iacocca stunned the competition in 1964 by introducing the immensely successful 'mustang' car.

Finally, in business as in warfare, spying to discover a rival's plans or steal a rival's new technological breakthrough is becoming more common. For getting key persons from rival firms by 'Head Hunting' is also systematically conducted.

Today's business leaders must learn how to tap employee's ideas and energy, manage large scale rapid changes, anticipate business conditions five or ten years down the road and muster the courage to steer the firm in radical new directions, when necessary. More and more firms are making use of war game simulations in their decision making. [1]

[1] W.E. Peackock—Corporate combat (New York: Facts on File publications, 1984)

Case 22

Price War for the market of international Phone calls in Europe

State telephone monopolies still rule everywhere in continental Europe and they still charge more than twice as much as AT&T charges its American customers for transatlantic tele calls. Naturally, AT&T and British Telecom are creeping into European markets with lower rates. Furthermore, European corporations are bringing great pressure for revising present high rates. As a result, the European Commission decided in 1994 to open the inter telephone market to global competition.

On the other hand, governments have started privatizing their national telephone companies through stock sales. Major European Telephone companies are rushing to form alliances with American Japanese and other European companies. For example, AT&T with its 'World partners' British telecom and American MCI, French Telecom, DBT (of Germany) to tie up with American sprint Group and Unisource is the alliance of Dutch, Swedish, Swiss companies and Japan's NTT. [1]

[1] "Sky-high overseas Phone Bills may drop"- Wall Street Journal, September 20, 1994- Page B2

Case 23

Why Companies fail?

Nearly 1 lakh businesses failed in the U.S. during 1992. Normally, more businesses fail during recession, but even during periods of buoyant economic conditions, a large number of businesses fail. E.g. 50,000 businesses failed during 1989 when economy was in Top Gears.

Although there are many reasons for business failure and the details differ from case to case, general underlying causes can be identified. Failure to understand the core competency, lack of prudence to understand and anticipate competitors surprise moves to start price war by introducing a very successful and innovative technology, conceit and complacency, over confidence and casual attitude to maintain the 'status quo' and undertake new product lines in which the company does not have adequate experience and expertise; may be most common reasons of the failure.

Kodak diversified from its core Camera and film business into pharmaceuticals and consumer health products and failed! American Automakers allowed Japan to produce and sell; low priced small cars in U.S. market and were happy to specialize in the production of big/limousines and luxury cars; because of very high

margins of profit. But ultimately, they failed because of the limited scope and size of the big car market.

IBM the Giant computer company was unable to recognize the importance of PC market in the mid 1980s and Microsoft developed the software and Intel supplied the chips for its PCs and captured a vast market of common public.

If the firm is heavily indebted, its sickness continues for longer time and ultimately it fails because it's current profits cannot adequately repay the huge debt and its equally heavy interest increments. USG Corporation (Chicago based building product company) failed in 1992. Recently Enron also failed because of its financial crisis, which remained covered due to the deliberate fraud by using cosmetic and manipulated company Accounts.

It is often more difficult to keep a business great than to build it. [1]

[1] "Why companies fail?" – Fortune, November 14, 1994 Page 52 and 68

Case 24

Repeated Games and Tit-for-Tat strategy

It is also observed that two duopolistic firms facing prisoner's dilemma can increase their profits by cooperating.

Axelord found that in repeated games, the best strategy is that of Tit-for-Tat behavior which means: Do to your opponent what he has done to you. That is begin by cooperating and continue to cooperate as long as your opponent cooperates. If he betrays you, next time you betray him back. If he then cooperates, the next time you also cooperate by forgiving him. Axelrod found through computer stimulated experiments that Tit-for-Tat is the best strategy in repeated 'Prisoner's dilemma games'. In some cases, a firm finds advantageous not to cooperate. For example, if a supplier is near bankruptcy, a firm may find every excuse for not paying its bills to the near bankrupt firm, in the hope of avoiding payment altogether, if the firm does go out of business. [1]

[1] R. Axelord- The evolution of cooperation- New York basic Books, 1984

Case 25

Economies of 'Scope' of Multi-product Firms

In the real world, we often observe, firms producing more than one product rather than single product are at large Scale. For example, Automobile companies produce cars, vans, and trucks. Computer firms produce desktops and portables, universities produce Teaching, Research and Publishing of books and journals, Chicken farms produce poultry and eggs.

Economies of scope are present if it is cheaper for a single firm to produce various products jointly. Economics of scope exists if the total TC of jointly producing cars © and trucks (T) is smaller than if cars and trucks were produced separately by two firms.

Economies of scope may arise when products can be produced with common production facilities or inputs, thus lowering costs. Cars and Trucks can be produced with the same metal sheet; a small commuter airline may produce its cost by providing passenger and cargo services. Sugar factories can reduce total cost by using its molasses for producing liquors.

[1] J.C. Panzar and R.D. Willig- "Economics of Scope"- American Economy Review- May 1981

Case 26

Cost Minimization in the Short run and in the Long run

The above figure shows that in the short and long run (when L & K both will be varied), the firm can produce 10Q with 5 L & 5 K at the minimum total cost of $100…. (Here point H shows where Isoquant for 10Q is tangent to the isocost of $100). Point D represents the short run equilibrium of the firm, when its isoquant is tangential to the isocost of $80. In this case, the firm will get 4Q by employing 4L & 4K…. but in one long run when both L & K will be changed, i.e.

with SL & SK, the firm can produce 10Q which is a leap which is more than double.

That means, in the long run the firm can produce more than proportionately by the small additions in Capital and Labor. With just one unit of K & L, if added, the firm can produce 10Q which is greater than proportionate to previous production of 4Q.

In the short run, if the firm keeps its Capital K constant (i.e. 4) and employs 7 laborers i.e. 7 L; the firm can produce 10Q. But this combination has greater cost than the equilibrium combination of 5K plus 5L. To sum, long Run costs therefore are the minimum than the short run costs. Combination of 4K plus 7L requires cost of $110, whereas combination of 5K plus 5L brings the same quantity of output i.e. 10Q within minimum cost of $ 100.[1]

[1] Dominique Salvator- Microeconomics- Haddison Wesley Edition 1997 Page 224 and 225

Case 27 How do firms get new technology?

Following table provides the results of a survey of 650 executives in 130 industries on the METHODS that U.S. firms use to acquire NEW TECHNOLOGY.

From the table, we see that the most important method of acquiring product and process innovations is by independent research and Development by the firm.

The other methods of acquiring process innovations, arranged in order of decreasing importance are 1) Licensing technology, publications or technical meetings, reverse engineering, (Devising different methods of producing similar product), Hiring employees of innovative firms, patent disclosures (i.e. from the detailed information available from the patent office and develop similar technology or product by not infringing on the patent) and information from conversations with employees of innovating firms.. (who may inadvertently disclose secret information)

For product innovations, Reverse Engineering becomes the next best option after the Top ranking option of independent Research and Development. Licensing becomes the third best option, followed by hiring employees and technical meetings.

In both product and process innovations, Three options have the maximum preference and they are i) Independent Research & Development ii) Licensing and iii) Reverse Engineering. [1]

[1] R.E. Levis-"Appropriability; R&D Spending and Technological Performance". American Economics Review –may 1988-page 423-428

Chapter No. 4

Chapter No. 4

CASE STUDIES

(Based on Primary Data)

Case Study 1

The Successul Launching of the World's Cheapest Car viz. 'Tata Nano' at the Targeted price of less than $3000

To quote Ratan Tata's observation, "In India, a middle class family often travels by scooter in the death-defying fashion, the father drives with his son on the floorboard/petrol tank in front of him, the mother seated pillion, cradling her infant daughter in her arms since cars for young middle class families are far out of reach." When in late 1970s, Maruti car was launched, its price was rather affordable to upper middle class people and it became quite successful because of its petrol-efficiency, speed, stability, low maintenance and the most attractive feature of its price. In last 25 years, the price of Maruti went on rising upto about Rs. 3 lakhs; therefore a large segment of the social class of people marginally between middle class and upper middle class could not afford to buy Maruti which in the past three decades virtually had become People's car in India.

Ratan Tata made a judicious assessment of the people's needs and declared that $50 billion Tata Conglomerate accepts the challenge of designing and manufacturing technically, as good as, world's

cheapest car at a price of $2500 approximately. Its price should be around Rs. 1 lakh; which may be marginally higher than the best racer motorcycles and less than all the models of Maruti, Hyundai, Nissan and Honda etc. which are available at going price range of Rs. 2.5 to 4.5 lakhs. Original idea of Ratan Tata was that a family which moves together on a scooter will find it safe and convenient to reach distant places in a metro city; the size being compact, it will also assure convenience for parking and moving on a crowded roads.

When this task was assigned to the Dept. of Designing, the engineers had thought of following options; so as to be within the comfortable margin of the cost target of Rs. 1 lakh.
The options were following:

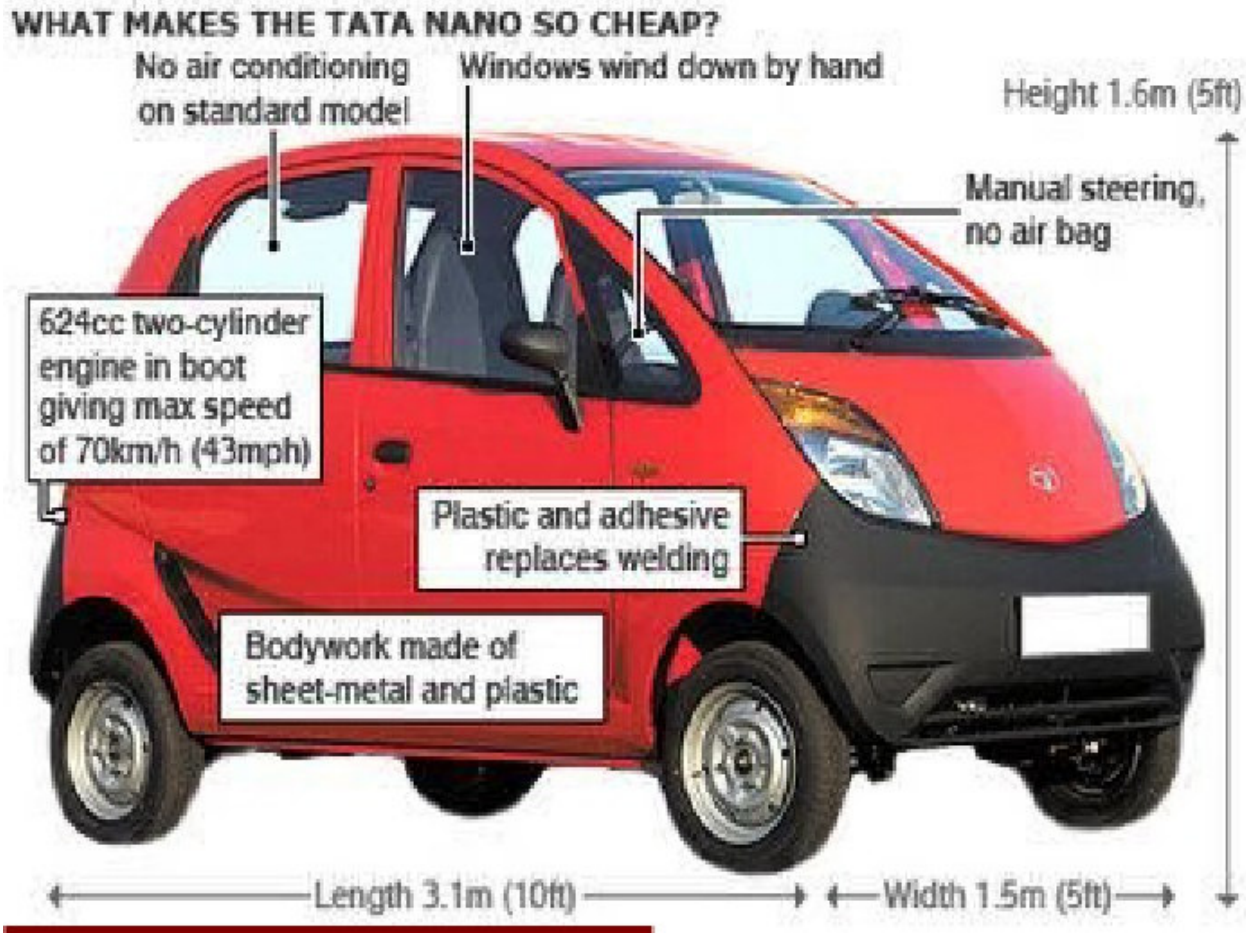
a) A scooter with two extra wheels at the back for better stability
b) An anti-rickshaw with four wheels, instead of 3 wheels
c) A three wheeled car like a closed auto-rickshaw
d) A four wheeled car made of engineering plastics
e) Rolled up Plastic curtains in place of windows
f) Openings like auto-rickshaws from the side
g) A four wheeled open car with safety side bars

All the options had to be set aside because the prominent designer of 'Nano', Shri Wagh interviewed a number of prospective

buyers, vendors, dealers from different sections of the society, and got a feed back of their needs, liking and requirements. The consensus was in favor of the 'form of a car', providing 'Status'; along with safety, sturdiness and sleek look! Drivers and owners of two wheelers and three-wheelers are normally looked down upon in India.

Ratan Tata identified the three essential requirements for the new vehicle. It should be low-cost, adhere to regulatory requirements and achieve performance targets such as fuel-efficiency and acceleration capacity. It should provide safety and status.

The design team initially came up with a vehicle which had bars instead of doors and plastic flaps to keep out the monsoon rains! It was closer to a quadricycle than a car and the first prototype had bigger engine. The body had to be changed because Ratan Tata, over six feet tall himself, tested it to be easy for tall people to get in and out of the car. On the 10th of January, 2008 at the 'Auto Expo, Delhi', Ratan Tata stepped out of the driver's seat with ease, which made a great visual impact!



What shook the automobile world most was the fact that the designers seem to have done the impossible: the sleek, sophisticated Nano did not look flimsy or cheap(!) , it appeared to be the World-class stylish and cute car. It was adjudged as the International Car of the year in 2008 by the World's automobile industry and obtained admiration and esteem from the automobile engineering experts. Nano's birth was prolonged due to the protests and agitations of Nandigram farmers, who were not willing to give their lands to left front government in West Bengal. Majority of

farmers did not oppose the land acquisition in the initial stage, later on political rivalry crept in and the entire issue got a disappointing turn. Tatas had to wind up their installation and took them far away to Uttaranchal state; which incurred huge losses and indirectly pushed up the budgeted cost.

The ideas of cost cutting were once again vigorously tried because no one believed that Tatas would ever be successful in maintaining the cost level upto Rs. 1 lakh as per their commitment.

The first thing which was given priority was to make use of 'Robotics' i.e. automation in order to maintain the high and precise quality of product and its consistency. This choice of appropriate technology, reduced more than 40 percent costs which conventional methods require.

The design has to question the need of each and every component and also the minimum requirements of its functionality. Therefore Tatas opted for the 'concept of disruptive technology' which was clearer than obsolute technology. The guiding factor was that the cost has to be minimized for each component, get maintaining its basic functionality.

The alternatives were A) Reduce consumption of heavy and costlier material B) Alternate suppliers to get same material at lower prices C) Use alternate materials. With this objective, the designing job was outsourced to Italy's Institute of Development in Automotive Engineering. But Ratan Tata made minute changes from time to time in their standard designs. For example, Italian Designers had

designed two blade windshield wipers. Ratan Tata insisted on one single wiper in consideration with relatively narrower width of Nano. He wanted 'Manual steering' instead of 'Power steering' which was just redundant considering the size of Nano. In the frontal side, he kept the petrol tank, the spare wheel etc. and he preferred to install the engine at the rear dicky. Instead of cast-iron engine, he chose aluminum for engine, which reduced the weight and became rust proof. Instead of 800cc or 1000cc, he wanted 624cc two cylinder engine which per se becomes petrol efficient. (When Maruti 800 gives an average consumption of one litre petrol for 20 kilometers, Nano positively gives around 24 kilometers per litre average in city drive and about 27 to 28 km per litre on highways. Engine has automatic cooling system by cool air instead of water pump, radiater and its paraphernelia. The engine body work is made of sheet metal coated with plastic. The body parts are joined by adhesives rather than welding.

The suspension and the chasis is as sturdy as any other Tata car like Indica V2 etc. Use of tubeless tyres are introduced. The width is around 5 ft. The length of Nano is 10 ft. and the height is 5 ft plus. This height factor has given more than adequate leg space for drivers, front seat and backseat occupiers. One does not become tired or gets swollen legs; the common experience of travelling in small cars like Maruti 800 etc. The ideal speed which Tatas recommend is 70km per hour but a large number of Nano drivers/owners vouch that it can maintain stability on road at a speed even between 80 km to 100 km per hour. It is not only ideal for city drive and parking but it is also the most economical and safe car on pretty long distance. The Aluminium engine provides

higher thermal conductivity than cast iron. Superb control over emission and smooth acceleration along with 'air cooling system' improves the petrol consumption average. It has an advantage of Front and Rear suspension (McPherson strut in front and coil spring and prasillng crm in rear.) It has an amazing pick up to ascend in ghat roads comfortably in third gear and on graduall climbs even using the 'Top Gear'. The seats can be adjusted as per the height, seat belts, strong seats and anchorages.

Technical Details of Nano

1) Nano Engine is 4 stroke, water cooled, and multipoint fuel injection system.
2) Number of cylinders 2 in line
3) Stroke-73.5 mm x 73.5 mm
4) Capacity 624 cc
5) Maximum Engine output- 35PS at 5250 +/-250 rpm as per IS.i4599
6) Firing order 1-2
7) Coolant: 50: 50 (Ethylene glycol)
8) Clutch – outside diameter lining 160 mm-Single plate, dry friction
9) Suspension- Front/Independent. McPherson struts
10) Rear Independent semi portable arm with coil spring and hydraulic shock absorbers
11) Brakes- Hydraulic
12) Total Weight- 600kg
13) Tyres - Radial Tubeless.

Marketing Economics

It will be commercialized in whole of India, mostly targeted to the middle class and lower middle class people. Tatas will sell its ultra cheap new car through its own retail and electronics megastore outlets, as well as, recognized auto dealers. It will also be sold through outlets like Westside and Croma. These outlets will display the Nano and also take bookings. Nano will not be big on advertising. There will be no TV campaign, only innovative use of print, radio and other media, particulary the web. It believes in 'word of mouth' of the actual owner and the user of Nano. Nano uses facebook, orkut and other websites. In short, it will be the most 'cost effective' and 'innovative', so that Nano becomes synonymous with anything 'small, cute and brief'. Tatas always believe in 'excellent after sales service' in order to push up the marketing and the sales. They take the most earnest and prompt steps for removing the doubts and difficulties of their customers by providing anti-fire kits when 2 or 3 Nanos had caught fire and the newspapers gave a lengthy coverage of those exceptional mishaps. As a result, Nano's domestic and international sales are steadily rising.

Case studies on cost cutting / saving through use of Smart Cards – A brief note on what are Smart Cards.

Before we get into the actual case studies done by the author of this thesis, let us understand what smart Cards; are –

Right now, inside your wallet, you probably have a couple of credit cards, an ID card, an ATM card and maybe a few other plastic cards. These plastic cards have become a very important part of our life. Consider a few scenarios where we use plastic cards these days:

- To identify ourselves.
- To obtain cash from the banks.
- As credit cards.
- Conventional Telephony.
- Access Control.
- Loyalty Programs.

Most of these plastic cards are usually magnetic stripe cards. In spite of their tremendous popularity, magnetic stripe cards suffer from one crucial weakness. Data stored on them can be easily read and modified by someone with access to the right kind of equipment. As a result, confidential information like PIN Number or a password can not be stored on them and a transaction host (POS device/ATM) will have to go online to verify the PIN and this in most European and Asian countries is time consuming and costly.

Enter Smart Cards. The development of smart cards along with rapid advances in cryptography has resulted in a solution to the

above-mentioned problem. This article will introduce the reader to the various aspects of the Smart Card.

Smart Card Classification

Smart cards are the youngest members of the plastic card family. A Smart Card is defined as:

"*A plastic card, usually similar in size and shape to a credit card, containing a microprocessor and memory (which allows it to store and process data) and complying with ISO 7816 standard*"

History of Smart Cards

Many people consider smart cards a recent invention. Nothing could be further from the truth. In 1968, German inventor Jurgen Dethloff along with Helmet Grotrupp filed a patent for using plastic as a carrier for microchips. In 1970, Japanese inventor, Kunitake Arimura, applied for a similar patent. Smart Cards were introduced in Japan in the same year. In 1974, Frenchman Roland Moreno registered his smart card patent in France.

Given that the majority of smart card research initially went on in Europe, it is not surprising that Europeans are among the largest users of smart cards. Europe currently accounts for nearly 80% of the smart card market. France and Germany have been leading the world in terms of introducing various applications on smart cards.

Smart cards are already being used the world over for a variety of purposes and in future they will become even more pervasive.

However the real usage of smart cards started in India only from the year 2000 onwards.

Uses of Smart Cards

Smart cards currently exist for a vast array of applications. However, the expected growth in the industry will not be merely due to growth in these segments, but also due to the addition of the Internet and electronic commerce with their myriad of uses.

Current Applications

A smart card, as mentioned above, is a portable computational device with data storage ability. As such, they can be a very reliable form of personal identification and a tamper-proof, secure information repository. The main possible applications of smart cards are the following:

Payphones

Outside the United States there is a widespread use of payphones equipped with card readers rather than p; or in addition to p; coin recognition and storage. The main advantages are that the phone company does not have to collect coins, and the users do not have to have coins or remember long access numbers and PIN codes.

Smart cards have the further advantage over magnetic stripe cards of being reloadable, and allowing advanced features like phone banking, automatic memory dialing and on-line services.

Mobile Communications

Smart cards are used as identification device for GSM digital mobile phones. The card stores all the necessary information in order to properly identify and bill the user, so that any user can use any phone terminal.

Banking & Retail

Smart banking cards can be used as credit, direct debit or stored value cards, offering a counterfeit- and tamper-proof device. The intelligent microchip on the card and the card readers use mutual authentication procedures that protect users, merchants and banks from fraudulent use. Other services enabled by smart cards are advanced loyalty programs and electronic coupons.

Electronic Purse

A smart card can be used to store a monetary value for small purchases. Card readers retrieve the amount currently stored, and subtract the amount for the goods or services being purchased. Groceries, transportation tickets, parking, laundromats, cafeterias, taxis and all types of vending machines are only some of the purchases that often do not reach amounts to justify the hassle of

using a credit card (a cash card reader does not require a permanent phone connection with a host computer). Radio-read smart cards will allow the free flow of people through transportation systems, avoiding the need of ticketing machines or validation gates.

Health Care

Smart cards allow the information for a patient's history to be reliably and safely stored. Health care professionals can instantaneously access such information when needed, and update the content. Instant patient verification allows immediate insurance processing and refund. Doctors and nurses themselves can carry smart card-based IDs that allow secure, multi-level access to private information.

ID Verification and Access Control

The computational power of smart cards allows running mutual authentication and public-key encryption software in order to reliably identify the bearer of the card. For higher security needs, a smart card is a tamper-proof device to store such information as a user's picture or fingerprints. Smart cards can be used also for network access: in addition or in alternative to user IDs and passwords, a networked computer equipped with a smart card reader can reliably identify the user.

Case Study 2

Enormous Cost Cutting in Security System of a 'Diamond Industry'

'Venus Jewellers' happen to be the topmost company not only in Surat but the whole country, which does 'diamond cutting' for its clients abroad like De Beers and other Belgium companies. The company is owned and managed by 'Patel Group'. Its annual turnover is more than Rs. 1000 Cr.

The company employs 2000 highly skilled but uneducated (company has a marked preference to uneducated labor than educated one) Labour who happen to be stable throughout their life time career. The majority of workers are from such families, whose fathers and grandfathers have also served the same company for years together. Genetic factor of hereditary skill has been also perceived by the owners of the company.

While cutting diamonds, 'uncut rough diamonds', if the job is done by machines, it brings colossal waste in terms of rupee costs, because the dust and the particles also bear tremendous waste in terms of costs worth more than Milllion. Therefore in the industry of diamond cutting, it is mandatory to cut diamonds manually by human labor by operating small machines.

Venus Jewellers factory is run throughout three shifts, because the factory has a total number of 700 machines being a limited investment in overheads of installed machinery. As a result, the

factory management calls only 670 workers per shift as 30 machines, on an average per day, require maintenance and repairs. 670 workers report for work per shift and the total number of workers required during 3 shifts is about 2000. Diamond cutting and grinding machines are manufactured in India, as per the specifications given by manufacturers because machines require a grinding stone along with smaller grinding stones which are required for shaping a rough diamond into a 'prism'. In the last stage, polishing is very essential which is done totally with manual operation.

The factory used to employ very very trustworthy, sharp, experienced and dependable security guards; 20 per shift, average salary of them was in the bracket of Rs. 40,000 to Rs. 80,000 per month! These security guards personally know each and every worker intimately because workers come from their own local community and belong to the families, which are engaged in the employment of the factory for past four generations. The workers also get special incentives depending upon the number of stone cut and incremental 'carrot value' of them.

Since the workers being uneducated and having very fabulous monthly incomes and vulnerable to vices like indulgence in gambling, alcoholic addictions, womanizing and luxurious spending. Some of them also succumb to the pressures of temptation, greed and stealing of cut/uncut diamonds at the end of their shifts; due to the prospective 'windfall gain' of more than lakhs of rupees; per a small piece, stolen.

Every worker has a schedule of nine hours per shift; one hour is required for entry and reaching his spot of work, one full hour is required for exit and one hour is required for lunch and tea breaks; thus 25% of the working hours are lost. After entry each worker has to go to the store; where he gets rough uncut diamonds along with polishing powder for cutting or the incompletely cut diamonds deposited at the store while making the exit, on preceding day.

At the end of the shift, the worker is required to go to the store for depositing the complete or incomplete assignments and then can make the exit. The factory with huge expenditure of CCTV system costing Rs. 12 lakhs each had noticed CCTV systems are not suitable and dependable to the diamond industry because the size of cut/uncut diamonds is microscopically small and while grinding and polishing work is on, the CCTV screens get blurred due to the dust particles, which are very light and sticky, settles on the screen affecting the visibility of CCTV screens.

In spite of the installation of CCTV systems and the razor sharp vigilance done by the security guards in all the strategic places of the work site; there used to be stealing and pilferage of cut and uncut diamonds, which used to be around 10% of the total manufactured volume and was worth Rs. 50 crores per annum.

This author of the Ph.D thesis was working in Honeywell Auto India Pvt. Ltd. prior to 2005 and came to know about the marketing prospects of providing very dependable and efficient security system. He therefore personally visited the work site and became fully knowledgeable about the then existing security system and the

pitfalls in it. He then made proper notings of the proposed alternative security system which was mostly automatic, reducing the number of human guards and using 'the smart card system' which is 'all-proof' and brings 100% perfection in the security work.

Every worker was issued a 'smart card' being the authentic identity card. On the card, there were names, addresses, phone numbers along with photos and finger prints of all five fingers. The card was embedded with a chip, which used to read and confirm the details of the identity proof. The sticky polishing powder used to blur the fingerprints, therefore it was mandatory to read and approve minimum three fingers every time at the entry/exit.

For entry into the factory site and exit, there were separate 'Turn style Rotating Iron Doors'. After the entry given by the smart card, if the worker does not reach the store within ten minutes, there used to be automatic alarm and all the outlets of the factory used to be closed. Similarly, if the worker does not reach within 11 minutes from the store to the work site, there used to be automatic alarm and the security used to catch hold of him.

The entire store was closed and inaccessible to the worker because it used to have a frontal wall of heavy but transparent glass leaving a 'basin-shaped' outlet having embedded by a sensor cum-reader. As soon as, the worker used to insert his smart card, he used to get the delivery of his assignment of cut/uncut diamonds plus polishing powder and the guidance regarding the allotted number of machine /workplace belonging to a particular floor. If the worker makes a mistake in reporting to his assignment, there used

to be automatic alarm and used to be spotted by the security. While retiring from a day's work, every worker was compelled to go to the store, deposit all his belongings of cut/uncut diamond and the remaining polishing powder and used to obtain the final exit by inserting his smart card.

The use of sensors, readers and automatic machines was found to be far more helpful in curbing the malpractices of a prospective nexus between security guards and workers-quite natural as human behavioral weaknesses and preventing the pilferages. When smartcards and automated security were not introduced, the security guards had become too much arrogant and greedy by constant threats of leaving jobs on the condition of raising salaries, because of their indispensability. The new security system automatically checked and reduced their blackmailing and over pampered roles and their behavior was toned down to reasonable limits and their efficiency also increased because their job stress was reduced due to only 'selective vigilance' that they were supposed to do by attending the 'alarms' only. The number of security guards which used to be more than eighty; (20 per shift plus a reserve force of extra 20 guards) at present, is reduced to only 30+ (10 per shift plus 5 as reserved). Thus company saves more than Rs. 2.7 crores per annum. It has not expanded its CCTV security system and is happy to save a huge additional expenditure; which factually happens to be only of 'cosmetic use' like any scarecrow!

Tata Honeywell company required actual expenses amounting to Rs. 8 lakhs but sold the security package at Rs. 10 lakh to Venus

Jewellers; which for a company having turnover of Rs. 1000/- cr, was just a paltry and negligible amount! The theft and pilferage worth Rs. 50 Cr. Was almost reduced to not more than Rs. 10 Cr, therefore company could save its losses worth over Rs. 40 Crores within a cost of just Rs. 10 lakhs!!

Tata Honeywell which had launched this 'security product' by only creative and innovative skills; sold it at higher price packages not only to other diamond jewellery units but by making approximate and tailor-made and suitable modifications for other industries, Honeywell expanded its turnover to Rs. 300 crores from just Rs. 10 crores within a couple of years only. The percentage of profitability in 'this type of knowledge-powered service products', obviously is incomparably higher than that of the Brick and Mortar manufacturing industries.

The company undoubtedly raised its status, reputation and prestige by becoming the premier and pioneering company in this new field of Business.

Venus Jewellers will positively be for ever grateful to Honeywell because they could save very very huge amounts of costs of their traditional security system by the radical transformation brought by automated security system relying on smart cards, sensors, readers, automatic opening and shutting of doors and timely alarms, if anything abnormal happens.

Prior to introduction of 'smart card', the company was compelled to increase the security guards more than sixty and had to employ a separate team of about 20 very very trustworthy guards for keeping watch on the sixty working guards.

Guardless ushering and exit was the most appropriate solution. Each and every door of entry and exit had a magnetic lock and even the lift used to operate automatically for taking the visitor to a specific floor by using the smart card. 'A smart card reader' purely electronic instrument started taking the data and verifying the authenticity of the user. Thus the new system saved not only huge expenses on employing security guards, but it also prevented all untoward and fraudulent practices of the employees of the Diamond factory.

Case Study 3

Cost Cutting by Using 'Smart cards' of the H.R. Dept of TCS, Hyderabad

Tata Consultancy Services (TCS) is the topmost IT company of India which employs the largest number of employees in every establishment in the country.

TCS Hyderabad, probably is the giant among them which has employees over and above 70,000!

Human Resource Management Wing specially takes a lot of special effort to keep the employees very happy and in contended spirit by offering special facilities like free accommodation, free electricity, facility of swimming pool, gym and badminton courts, subsidized medical aid, free schooling, free air conditioning of the residential quarters , free internal telephone, 5 percent discount on 'Tanishque Jewellery' and 'Titan Watches', 2 percent discount on purchases from retailing malls by showing the smart card, perks of Rs. 1200 p.m. for the lunches in the canteen and extra Rs. 200/- for vending machine to buy tea, coffee, snacks and soft drinks etc.

Previously, TCS had issued coupons to its employees for lunches and refreshments. These coupons were required to obtain the facilities of canteen and library. For refreshment, the company had given odd size tokens of one rupees, two rupees and five rupees, which due to their number and sizes could not be easily put in the valets of the employees. While entry and exit, there used to be long

serpentine queues because the attendance and time were recorded by 'punching system', which was manually operated at the entrance/exit gate of the factory. HR Dept used to require a huge number of clerical assistance to update and record the Leave Account of the 70,000 employees.

Every alternate day the canteenwala used to receive more than 1 lakh coupons. He was compelled to employ five clerical assistants for receiving and counting the coupons and had to spend around Rs. 30,000 per month which was a serious waste of his money for getting purely unproductive work. For keeping refreshment accounts, he had to employ 2 extra men and another 2 men in library. The canteenwala was instructed to submit all the coupons on the 15th of calendar month and was given the payment on 30th of every month; after verifying the due amounts, H.R. Department was required to employ extra assistance for counting the vouchers received on 15th of every month.

Their counting was supposed to be over by 30th of the month; so as to release the payment to the canteenwala. This system invariably failed because the counting of coupons and settlement of bill used to take too much time (imagine 50 to 20 lakh coupons over a period of fortnight) and often was delayed. In the course of time, the backlog of 2 months of delay in releasing the dues, seriously caused a cash flow crunch to the canteenwala and he used to suffer the burden of interest on his borrowed funds. Under such circumstances, his demand for raising rates per lunch could not be denied by the management.

When rates were raised, either management or employee was required to suffer since the amount of perks allotted for lunches was fixed to Rs. 1200 per employee. In the initial stage, the employees were asked to bear the additional payment above Rs. 1200 of perks allotted to each employee. That created displeasure among the employees; which also was not palatable to the Tata's special 'employee centric welfare' policies.

When H. R. Department was on the look out for finding an appropriate solution for this problem, Tata Honeywell marketing group approached them. They studied all the loop holes and weaknesses of the existing system which fully had relied on manual operations.

Tata Honeywell introduced the 'Smart card', for entry and exit, leave account and for using it at the time of taking lunch, refreshments and library service.

The smart cards were having a memory of 1 MB in which e-cash of Rs. 1200 per month per employee was inserted at the beginning of each month. Whenever the employee went to the canteen or at refreshment centers, they showed their cards to the reader placed at the canteen counter and appropriate amount was deducted from the smart card and added to the database of the canteenwala. With this, the exact amount to be reimbursed to the canteenwala was known to the accounts department on a daily basis. The same used to happen at the vending machines.

Some part of 1 MB memory in the smart card was earmarked for library function. Whenever, the employee went to the library and borrowed books, the librarian would enter the number of the books in a computer which is connected to a smart card reader/writer. The employee was to show his card to the reader/writer once the librarian entered the number. The information of the books being borrowed would then be stored in the computer, as well as, on the smart card. Whenever the employee returned the books, the number of the returned books would be removed from the smart card.

The electronic reader used to verify the authenticity of the user of the card and recorded the specific use of the card along with the date and time. So was the case of attendance at the entrance gate; automatically the exact attendance and leave account was also easily available.

The accounts of canteen, vending machines and library could be settled on day to day basis. Human labor of counting voucher became unnecessary. Canteenwala and the H.R. Department could save huge amount of salaries over Rs. 2 lakhs per month. There was no backlog of payment, therefore the canteenwala voluntarily reduced the rates, but as the perks remained the same, employees could enjoy more refreshment items by his indirect savings. Overall result was, due to full gratification, employees' productivity increased.

The employees were specifically happy because they were not required to carry varied coupons of different denominations and odd size tokens used for vending machines. Earlier the employees would loose the unused amount of Rs. 1200 which they could not use in the month. This prompted the employees not to bring lunch from home and have lunch in the canteen itself. In spite of the quality control was done in the canteen, it could nowhere match the quality of home food.

This was because TCS management used to change the color and logo on the coupons every month to avoid malpractice by the canteenwala. With the smart card, this also got eliminated as the remaining balance would stay in the smart card itself which could be used by the employee anytime during his employment years. By the introduction of smart card, an employee received a full amount of Rs. 1200 in terms of credited money in the card and was not afraid of loosing a part of his perks in case of non use of his coupons within the given time limit.

Going forward, TCS instructed their neighborhood malls for accepting their employees smart cards and grant them a special discount of 2 percent of the total bill amount; because company bargained that it assured the mall by providing a steady number of about 1 lakh customers per month. The malls would provide the data regarding two per cent discount to the TCS management on a weekly basis and get the amount reimbursed by TCS management on a weekly basis. The neighborhood malls accepted these terms with great pleasure and as a result, the wives and the family

members of TCS employees were very much delighted by TCS's special concern for them.

It produced a 'win-win' situation to all, canteenwala, neighborhood malls, employees of TCS and their families and TCS itself.

It also helped to reduce the 'attrition rate' at TCS Hyderabad which is currently the lowest in IT sector, (less than 4%) while attrition rate of Infosys is 10%, Wipro 15%, Cognizant 17%, Tech Mahindra 14%. The immediate and effective opposition spontaneously comes from the spouses of TCS employees, if they plan to leave TCS and join other company for getting a higher salary. TCS salaries are 5 to 7% less than the salaries of other IT companies; but still the attrition rate happens to be the lowest; only because of the Tata Groups Employee Welfare Policy, the assurance of the job security and the emotional and human bond of affectionate family relationship.

Case Study 4

Reduction in Cost, Time and Stress of the Visitors by 'Electronic Security'
(A New Alternative to Security System at BOMBAY HOUSE-HQ of TATAS)

Bombay House which is located at the plush locality of Ballard Estate in the neighborhood of 'Government Mint' and 'Royal Asiatic Society' accommodates the head offices of

1. Tata Sons
2. Tata Power
3. Tata Consultancy Services (TCS)
4. Tata Consultancy Engineers (TCE)
5. Tata Tea
6. Taj Group of Hotels
7. Tata Indicom
8. Tata Telecommunications
9. Tata Oil Mills Limited (TOMCO)
10. Tata Steel
11. Tata Motors
12. Titan
13. Tata Rallies
14. Tata Power etc. and
15. Tata Trust viz. Dorabjee Tata Trust, Naval Tata Trust, Simone Tata Trust, Ratan Tata Trust etc.

Bombay House is a very old majestic building with 5 stories. The construction is done by European design made up of selected masonry cut stones. Every floor has around 20 special cabins meant for CEOs, Chairmen of Board of Directors, Top Management etc., and adjacent 20 office cabins for their secretaries; in all 40 cabins. In the entire building, the total number of Top Management cabins is 100 along with 100 cabins for their secretariat offices.

Dorabjee Tata Trust, Ratan Tata Trust, Naval Tata Trust are regularly visited by hundreds of people and families on every working day. Similarly, very very important visitors such as Chief Executives of Tata Allied Companies, Business and Industrial Tycoons, Top Level Bureacrats, Managing Directors of Financial Institutions and Banks, Top Stock Brokers, Chief Executives of Public Sector and Private Sector Giant Companies which get various contracts like construction and installation and many others have to call on the top bosses of various Tata Group Apex Offices, their numbers also exceed many hundreds. As such, the average number of visitors is around one thousand. All these visitors reach Bombay House by seeking official appointments. But when they reach the office, even at early morning hours, there is a long queue of visitors already waiting their turns near reception office.

The reception office has a small area of twenty feet long and ten feet wide and it can accommodate only about twenty visitors in that room. The other visitors have to stand in queue which goes out of the reception room; on the entrance stairs and the footpath adjacent to the building on the road outside.

Founder director of Tatas have made a strict rule that "every visitor/guest is equally important"; therefore every visitor has to wait in queue; as per the principle of 'first comes first served'. There is a small room adjacent to the reception where around twenty guards sit.

Prior to introduction of 'Smart cards' and 'Automatic magnetic locks'; the security guard used to usher the first visitor of the queue up to the concerned cabin of the visitor and he used to wait outside the cabin, till the return of a visitor in an average of 21 minutes of call. The guard used to once again escort and bring the visitor back to reception counter and used to carefully 'See off' the visitor's departure. In the meanwhile, other security guards used to take the second visitor to the concerned cabin and same exercise used to follow. Baring one hour lunch break and half an hour of tea break, the actual time allocated for visitors had to be around six and half hours. On an average, twelve to fourteen visitors per cabin used to be entertained during a day.

The total number of them used to be around two hundred only; the rest of the visitors standing in a queue, were called back again on next day. More than 2/3rd of the visitors were denied the calls and they were compelled to try, time and again, by depending upon chance and luck. At the entrance, there used to be strict and thorough security checkup and then they were allowed to enter into the reception office. There was a separate team of security guards to execute the security checkup. The other team of guards was detailed to usher (an escort) the visitors upto the cabin; in order to insulate the security to the top bosses of Tatas. This system was

ridiculously disgusting. All the VIP visitors used to get annoyed and insulted by the stress caused by that system. The funny thing was that they had to stand alongside with all strata of people who used to join in the same queue for sorting out their problems of regular flows of their assigned charitable remittances.

The whole system for entertaining the visitors had turned to be dismal both to Tata Bosses and the visitors, as well, because the bosses could not meet the VIP visitors and take prompt decisions and actions, in the interest of their companies; which virtually amounted to colossal losses to their establishments.

'Guardless ushering' was the most appropriate solution for sorting out the problem. Tata Honeywell studied the existing system of ushering and escorting of the visitors by the manual labor of security guards. There were ten usherers at the monthly salary of Rs. 40,000. Their combined yearly salary expenditure was around Rs. 57 lakhs. There were senior supervisors who used to keep watch on the usherers at the monthly salary of Rs. 1 lakh per person. Therefore Bombay House used to spend another Rs. 60 lakhs on the existing system, as the security guards had to be continuously monitored and checked because of the high profile nature of occupents at the Bombay House. In all, its security system used to require a sum greater than Rs. 1 crore per annum. The system had proved to be a serious flop one.

Tata Honeywell proposed an alternate plan of ushering and escorting of the visitors by using the 'Smart card'; a smart card reader (electronic instrument) and by fixing magnetic locks to each

and every door of staircases, lifts, common passages and cabins on all the floors of the building.

After finishing the routine security at the visitor's desk, the receptionist used to enter the name of the visitor, the floor number, the cabin number, the person to whom the visitor desires to meet and used to allow to proceed of his own without the ushering of the security guards. The sensor/reader at the door of the lift used to read the details from the smart card and automatically allowed the visitor to enter. After his entry, the lift would take the visitor to the floor on where the cabin of the person to whom he wanted to meet was present. After reaching the allocated floor, the lift used to open. The visitor then used to walk on the common passage upto the door of the cabin number assigned to him. A smart card reader/purely electronic instrument/as per new arrangement used to read the data from the card; check the validity of the card and the door would be open if the data was valid. After the visitor's entry, the door was automatically closed and locked. If any unauthorized person tried to enter or by mistake authorized person on that floor tried to enter the wrong cabin, an alarm used to make the security cabin alert downstairs, near the reception counter. All the adjacent doors used to get locked and unauthorized person used to get stuck in the passage, itself.

While making exit from the cabin, visitor was supposed to show his smart card to the reader, (which was also on the backside of the same door). The reader used to check the authenticity and the door would open and after the visitor's exit, it would close automatically. By showing the smart card to the lift door, the visitor would use the

lift for reaching the ground floor and make final exit from the premises of Bombay House.

Staircases were closed by magnetic lock, so as to prevent their use for going to unauthorized floor. In case of wrong entry of unauthorized person, the alarm sounded at the security cabin. After fire alarm, all the doors of lifts would get locked and lifts were suspended and not allowed to be used. All the doors of cabin, passages and staircases would get automatically locked and the security guards could then investigate any unauthorized entry.

Thus the new automatic security system, without involving manual security became not only the full proof security, but also it brought overall efficiency and optimum utilization of time. It saved nearly 60% of the office time which was required for manual ushering and escorting. The bosses of various Tata group companies now could entertain more than 20 to 30 visitors, per day, which means 300 % rise in the 'quality time utilization'. The greater the number of such negotiation deals; more is the turnover of Tata and greater profits. The satisfaction quotient of the visitors also radically improved. Prior to the new reception system; visitors were completely unsure whether they will ever meet the Tata bosses within a day after calling continuously for three to four days! It was almost speculative and uncertain. Both the Tata bosses and the visitors having business relations with various Tata group companies; 'Visiting Bombay House' was an experience of threatening nightmare! But with the new system, it became a smooth and delightful experience.

Tata Honeywell required about Rs. 7 lakhs for the cost of 'software development' and about Rs. 7 lakhs for the purchase and fixing of magnetic locks and electronic card readers. Being an allied company viz. Tata Honeywell, the company offered the installations of the new system on concessional rates for Rs. 15 lakhs; by keeping a profit margin of only Rs. 1 lakh. When Bombay House was extremely delighted by this automatic visitor management system, the other company offices of Tata group of companies gave many orders to Tata Honeywell. By mouth to mouth publicity, Tata Honeywell could multiply its business by 10 times more, within only one year by raising the price of packages and the number produced.

Tatas as clients also became happy, by trimming down the number of security guards by more than 60% and save the salary expenses of Rs. 60 lakh per annum. That expenditure was never a big problem to Tatas; but loss of goodwill and courtesy to visitors was a more serious problem which was sorted out by the new visitor management system.

Case Study 5

Cost Cutting at ONGC by the Use of 'Smart cards'

The number of existing and retired employees of ONGC are more than three lakh persons; a very large figure next to Indian Railways; among the public sector industries. All of them, working and retired are covered by the 'Health scheme' which provides all the necessary medical facilities to the employees and their families.

The H.R. Department of ONGC had enormous work of making plans of transportation by ships, helicopters etc. so as to transport its employees to the places of 'Rigs'. It used to detail particular employee on a particular Rig so as to enable him to know by which ship he was supposed to board or by which helicopter he was supposed to lift him from the shore to the Rig. Planning of duties of such a big number was a tremendously difficult job. The service book of the worker not only used to keep the accounts of his salary, special allowances, the number of days of actual work on a Rig, the number of days 'off duty'; the leave account, the exact names and numbers of workers on duty at Rig, the information regarding any mishap/accident and the exact report about the casualities etc. etc.

All these things were done at 'ONGC Bhavan', Bandra and at 'ONGC Gandhar' office in Gujrat. Due to manual and clerical operations, there used to be long delays and total chaos; in the routine working of the H.R. department.

The nature of routine duties of every employee also happens to be very complicated. Because every worker can stay on the Rig in deep sea only for 21 days, after 21 days of heavy duty; he has to be given 21 days off and he was allowed to go to his native place of family residence. Another variance used to cause confusion because every worker who used to work on 'Land duty' for 3 months would get complete rest for one month.

Every Rig approximately can accommodate only 400 to 500 workers as the Rig is in deep sea, hence normally cannot be made larger than 100 meters diameter. ONGC has to provide all the facilities of food, bed, medical aid etc. of seven star hotel amenities. The temperature on the Rig is abnormally humid and hot so the working conditions are very tough and hazardous.

After enjoying 15 days 'off duty rest', a worker has to return to Mumbai at least six days in advance to know his details of his transportation due to the chaos caused as mentioned above. Thus a worker used to return to Mumbai six days in advance; therefore he used to forfeit the enjoyment of six days of duty rest. After his return, he was supposed to report to ONGC Bhavan and used to get instructions about the name of the particular ship or the helicopter, their time and date which were supposed to lift him from the Mumbai shore to the Rig. This whole planning used to require three days within which he was supposed to stay somewhere near ONGC Bhavan, and ONGC used to bear all his hotel expenses of lodging, boarding and transport etc. After getting exact plan of reporting, the worker was asked to go to the shipyard or the helipad as per his schedule. After reaching the shipyard, the worker used to get

'his passage certificate'; after elaborate verification of his service book, his assignment done by H.R. Department of ONGC Bhavan. The clerical staff of the ship used to send the information to ONGC Bhavan about the persons reported and the persons moved by the ship in the sea. Similarly, the helipad would send the information to ONGC Bhavan about the persons reported and the persons moved by helicopters to the Rig. Three days were required to reach this information to ONGC Bhavan; from the port and the helipad. The worker used to require about seven hours to reach the Rig in the ship which is to carry him or about an hour by helicopter. He was supposed to wait for another hour or so for actual lifting to the Rig by the crane from the ship. From the next day; his 21 days duty at the Rig used to begin. Then the staff at the Rig used to convey the message to ONGC Bhavan; that a particular worker had completed his 21 days duty. Again the instructions of his return journey by ships/helicopters used to be passed to the Rig staff. The transit used to require three days, therefore Rig staff used to communicate the report in advance i.e. on seventeenth/eighteenth day of his duty. If the instructions from ONGC Bhavan were delayed, the worker used to get three times of his salary, if his stay exceeded more than three and less than seven days. After the time lag of communication, he used to proceed for his 'Off duty rest'.

For getting doctor's treatment and purchase of prescribed medicines, he was required to show his service book, while reporting at the ship, as well as, getting boarded on helicopter he was required to do a lot of paperwork and obtain passes. All these obstacles used to induce malpractices and abnormal favors, by paying the bribery price of them.

ONGC used to spend lakhs of rupees on its clerical staff for planning to send employees to the Rigs for 21 days duty and to ask them to return for 21 days Off duty rest. Due to the large number of more than 2 lakh workers; this work used to require huge costs but even then, there used to be serious snags, delays and confusion du to the manual operations involved.

The need for obvious solution was felt by 'CMC' – the biggest software service working under the public sector. CMC has a reputation of being one of the few professionally competent companies. CMC being a public sector company receives special concession of 10 percent rebate and gets payment of the 'Lowest Bid Amount' offered by any private sector company.

CMC approached Tata Honeywell for helping them to prepare a 'Software package' and the preparation of Smart cards along with the equipment of 'Card Readers' etc. CMC finished the work of entering the record by producing a software for the same. Tata Honeywell gave them the 'solutions' by producing the package essential for operations and use of the Smart cards.

The Smart card became such a fantastic solution that ONGC was extremely satisfied. The card became successful in removing all the delays, costs, and confusions etc.

ONGC could save crores of rupees in the transit delays, in which it had to bear three times the salary of the employee, the workers could easily get planned information in advance about the ship and helicopter etc. and smoothly could report to the Rig after enjoying

fully the 'Off duty days'. The workers also could purchase medicines and get the treatment from the doctor promptly by showing his card. ONGC HQ got the detailed data about the names of employees at the Rig, the names of the casualities in cases of mishap etc. The malpractices of seeking special favors were automatically stopped. ONGC especially was benefitted by avoiding wasteful costs caused by inefficient manual planning and accounts. The computerized operations enhanced its efficiency in multiple times.

ONGC employees work for explorations and drilling, as well as, extraction of crude oil and its refining. Every Rig has a shape of Christmas Tree and is deepest at the bottom of the sea.

While refining of the crude, we get 'natural gas' plus 'nafta'. When 'nafta' is cracked, we get Polypropelyne, high density poly ethylene, plastic, nylon, CNG and LPG gases. By heating crude to 200 degrees celcius, we get kerosene and white petrol. At the temperature of 480 degrees celcius, we get petrol, whereas at the temperature of 800 degree celcius and more, we get Diesel, High Density Diesel and Engine oils. A very High Density Diesel is used in furnaces and lastly we get tar.

Since Diesel requires too much heating, its price is more expensive than petrol all over the world. But Indian crude has a large content of wax, wax is to be separated therefore that cost is certainly greater. However, Diesel output in India is four times more than that of Petrol, therefore use and sale of diesel is encouraged by Indian Oil Companies by granting subsidized pricing

of diesel. Reliance therefore could not compete with Indian Public Sector Oil companies viz. Indian Oil companies, Bharat Petroleum, Hindustan Petroleum because they receive subsidies from the Government. Since in recent years, petrol prices are linked to World market prices and move up during winter and fall down in summer because of supply conditions; at present, petrol prices are changed from time to time. Reliance had made a countrywide network of its petrol-pumps; after the linkage of Indian Petrol prices to world market prices; (No regime of administered prices). Reliance once again has started selling petrol in their pumps. Reliance, recently also has explored a new stock of natural gas and intends to start a refining unit of its own. At present, out of four existing crude mines, Bombay High and 'Gandhar' near Dahej are supplying the bulk of petro products.

The Smart card system has, no doubt, brought a welcome 'Order' in planning, detailing, transporting, communicating and calling back the workers from Rigs to their 'Off duty' destinations, providing prompt medical facilities to them and their families, settling their leave and salary accounts by computerized operations carried out by the 'Software packages and the Smart cards'. It has saved huge costs of ONGC and removed the problem caused by chaotic manual operations of work-planning of its H.R. Department.

Case Study 6

Huge Cost-saving by Optimum Deployment of Human Resources in IT Business

Indian IT companies like Wipro, Infosys, ABB, Siemens, Emerson, Mahindra, Accenture, Cognizant and TCE etc. have been getting fabulous business for producing the appropriate tailor-made software packages according to the needs and instructions of World's giant hardware companies like Microsoft, IBM, Oracle, SAP, Google etc.

There are mainly three sources of IT Business.

A) Projects – The project is assigned by the client if he finds the bid and terms of contract quoted by the Indian IT company (are) acceptable to him. After the completion of the project, the fixed amount of contract is paid and the deal is finally settled. Sometimes, the client also gives a sumptuous advance before the final settlement of the bill.

B) Job Assignment – The client gives a contract to Indian IT companies for carrying out a specific job within the time limit. Payment is done o the basis of per hour. Payments are done by the client fortnightly on the basis of Time and Material quality per hour. Deductions for wasted time and errors are done by the client at the time of fortnightly payments.

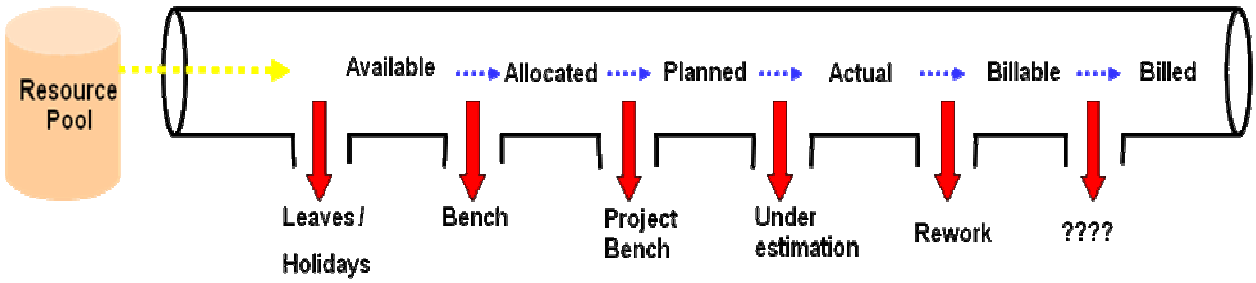
C) Service Requests – The clients such as DHL courier service- the world's biggest supply chain manufacturing company makes specific requests for availing services of the Indian IT companies. The payment is done on the basis of Time and Material quality per hour. The serious problem emerges when client companies are closed for 2 weeks in Xmas in U.S., U.K. and Europe; 2 Golden weeks of Thanksgiving in Japan in January, New year celebrations from end of January to first week of February in China and hence, there is complete stoppage of the communication between client and Indian software companies.

Patron companies like Microsoft, Oracle, SAP etc. give assignments of parts of the whole programme to Indian IT companies. That part is supposed to be developed by our personnel. Billing is done by Indian companies after the job is finished or fortnightly billing is also entertained as the work proceeds. The patron companies deduct the respective amounts on account of wasting of working hours and the quality of the work. (If there would be errors, they deduct the amount per error). Normally billing is done on the basis of one working hour of the IT Engineer/BCS etc. and the rate is fixed in terms of dollars per working hour.

The central and common problem of all Indian companies is that, Indian companies do not get the full amount of billing; because there is a serious lapse in exact deployment of the worker, planning and coordination require for optimum utilization of labour resources and communication gap between 'Delivery Head' and 'Project

Manager' in detecting the idle human resources whom work is not allotted promptly.

The main leakages in full utilization of human resources occur due to the following reasons and the areas.



There is a potential revenue leak at each stage

The case study of Wipro alone, reveals shocking information and fact that as against, its total billing to its clients which is equal to $7.25 billion; Wipro receives only $3 billion; because the clients deduct the billed amount on the basis of wasted hours and the quality of the work. Thus by and large, Wipro has to bear the loss of about 60% in its routine billing. This loss is very unfortunate and unacceptable to the principles of management. The loss occurs only because of the failure of perfect human resource management.

Let us know the reasons of these losses due to lack of vigilant personnel management. Since 1995 onwards, IT companies are continuously getting 'Outsourcing' orders and the buoyancy has sustained for a period of more than decade except Mid August 2008 up to "December 2009, a very small period of almost 1 ½ years when conditions had become quite frustrating. From January 2010, a new and stronger wave in favor of IT industries in the country has re-emerged. Demand for IT personnel is continuously greater than the supply at a point of time; therefore IT companies have been recruiting hundreds of IT men/women by offering very high salaries and cannot afford to be very serious and demanding about the 'quality' and 'capacity' of the young entrants. They are required to make compromise with the existing available quality. The 'attrition rate' in the IT industry also is very high; therefore companies have been pampering the IT men, by giving additional perks and allowances, so as to prevent their 'job-hopping'.

The entrance examination and selection interview have become virtually a farce; because the H.R. Department relies only on one book which has objective questions on logical thinking, simple and basic mathematics and aptitude in computer use applications. Those who score six to eight marks out of ten; are selected, others are rejected because they are either more or less intelligent than the normal avarage B Grade candidates!

H.R. Department uses flexible compromise of appointing computer engineers, MCS etc. by priority but accommodates even persons having BCS or other diplomas in computer training. The number of

employees in prestigious IT companies like Wipro/TCS/Infosys etc. normally exceeds 20000 per unit.

Since the number of projects also exceeds hundreds; there are equal number of teams whom the project work is assigned. It is nearly impossible to manage planning and coordinating the work assigned to such a large number of workers; who are not working at a machine but at the computer; therefore there is basic difference between brawn and brain and computer operators happen to be 'knowledge workers'.

Within a period of 2 to 3 years, a new entrant is promoted to the position of a 'project leader'; within another couple of years, he is promoted to the position of project manager. Experience of 8 to 10 years enables a person to become 'delivery head', who is supposed to be a coordinator and liaison between top bosses and the project managers, below. A large number of IT personnel, consists of teenaged, quick tempered and immature young men. A project manager naturally is inclined to ask surplus labor force; extra and above, the normal requirement; because as the work proceeds and he finds paucity of men; he cannot readily gets them and his work suffers. Therefore he is interested in 'Retaining large sample workforce than required' as a safety measure. This practice is followed by all project managers; therefore 20% to 30% extra workforce is employed and included in billing.

This extra force does not get any work. They just sit at the bench and nobody bothers to allot them some work or the other and keep them productively engaged. Between two projects; there

is often a time-lag, when actual work is not there, the persons continue to be engaged with that bench; without getting any work assignment. They are not transferred to other projects or benches because nobody is authorized to make such deployments. These Teenaged project managers, who lack in experience of making correct estimates of normal costs and the contingency costs arising due to unprecedented circumstances, are asked to make quotations of their 'lump sum billing' to the client party. They are so much concerned to get the contract and are nervous with a thought of losing it; they often underestimate the quoted amount of the remuneration for their project. They also do not take into account of average number of days when the worker does not report for work; either for its casual or sick leave. They also do not make estimation of the total percentage of absenteeism of their team. The result is that their bills are refused by the client company and they are paid less by deductions for wasted hours and the unsatisfactory quality of the work.

Furthermore, there is a very serious communication gap between project leader and project manager and again between delivery head and project manager. The only competent person The delivery Head - who is supposed to get information about the actual persons working on different benches and projects and is supposed to detail a person on other bench and project; cannot perform these coordinating tasks; because of the 'communication gap'. It has been found very frustrating fact that there is a total communication gap between project manager and a client from abroad and vice versa therefore compliances of changes told by client are either not carried out; or the status of work carried out by the project

manager often does not reach the client. This gap affects the actual billing because the client has every genuine reason to reject the claim as the work is not satisfactory, as per his instructions.

In software IT industry, Manpower is the most crucial and important factor and the biggest component within the total cost. "Leakages in optimum manpower utilization add to huge losses to the IT companies which are worth hundreds of crores rupees.

During 2008/2009, the author of this research study was working as a vice president of a IT company viz. Compulink Systems Limited which used to provide services for cost reduction in problematic industries. When Wipro approached my firm; we accepted the offer and started developing a program of "Service execution management" – which we named as "WHIZIBLE".

In Whizible package, there are eleven modules by which entire program is available at centrally located server. It can be referred and used time and again by connecting through internet. When project plan is ready, allotment of various tasks are assigned to the concerned executives, developers, programmers, team leaders etc. of various departments. If any minor or major change is brought in the existing program, it is exhibited on the server; which becomes convenient to follow it smoothly. By this program, data regarding how many persons are on leave or absent, how many of them are working on different benches, how many persons are sitting idle without clear assignments of work, how many persons are actually working on a project bench and how many of them are in surplus reserves, without any work assigned. This complete information is

visible to all from time to time, by updating done in it time and again. Due to this solution; the communication gap between Delivery Head and the Project leader, has been removed. Delivery Head can immediately take decisions of deploying the idle and surplus labor, whenever it is needed very urgently.

The Marketing and Sales Department became fully aware and confident of actually available manpower; therefore could bring a larger number of 'Work Contracts'. By making full utilization of manpower, greater number of contracts could be completed within the scheduled time and the amounts of 'Billing' being the principle source of company's income, started increasing. It was made mandatory on the part of every employee to fill the Daily Timesheet; therefore it became easier to find out instantly the difference between the income and the cost. If Loss was detected for a day or two; immediately corrective actions could be taken to prevent loss and earn profit. Prior to the introduction of 'Time Sheet'; the worker used to take nine hours for finishing the job which was allotted for six hours. When the work was rejected by the client due to errors; the concerned worker was asked to rework on it. There was no check and regulation of Time Variable, therefore a worker used to take too much long time for finishing it. The client company deducts the part of the amount of billing required for rework. Under the new program, the worker was compelled to enter the Time sheet for Rework; thus it was easily recorded and deductions of his remuneration, could be done promptly.

Due to 'Whizible package' ; the losses of Wipro amounting to about $400 billion; reduced by net 10%; i.e. $40 billion the company could earn additional profit along with the routine profit. Due to this package, invoice of every project used to be forwarded to the client company by 16th of every calendar month; and Wipro used to receive the payment from client on every 30th day of a calendar month. Every project manager now can forward his billing invoice through the common software; addressed to the respective clients. Due to this solution; the delays in receiving payments were avoided and the company started enjoying comfortable cash flow to meet its current costs.

The rough estimates of the losses due to wrong managment of human resources were as follows:

A) Wipro could have done revenue worth Rs. 773 Crores in 2003-04. Actually due to inefficient utilization of available human resources, the actual revenue was Rs. 533 Crores only.

   Looking at the above WIPRO management initiated a process to find a solution to take corrective action and reduce the losses. Wipro case study is as given in Annexure 1 A.

   The high level benefits Wipro received from Whizible is as follows.

B) Losses on idle labor at benches were about Rs. 132 Crores. By the use of 'Whizible' they were reduced by Rs. 20 Crores.

C) Losses of Project bench were around Rs. 48 crore. By the use of 'Whizible' they were reduced by Rs. 23 Crores.

D) Changes in work-Losses used to be around Rs. 29 Crores; By the use of 'Whizible' they were reduced by Rs. 10 Crores.

E) Rework- Losses due to rework were about Rs. 31 crore. By the use of 'Whizible' they were reduced by Rs. 16 Crores.

F) The total gain of Wipro by using the package of 'Whizible' was about Rs. 69 crores. (20+23+10+16 = 69 crores).

The Compulink Company could earn Rs. 15 crores plus within seven years of its working.

Because of the success of Compulink's Whizible solution, Compulink got many more similar clients and could raise its status of Rs. 2 lakh p.a. turnover company to Rs. 20 crores turnover company!

The funny thing to note is that Wipro is reputed as a company of international repute; to provide solutions to the client but was clueless as to find appropriate solution for its inefficient and inadequate utilization of available human resources. Thus a 'Solution-giver' company had to become a 'Solution taker' one; and a small company like compulink could become a savior of a Giant company like Wipro!

Annexure 1A

CASE STUDY OF

USAGE of Whizible at WIPRO

Client Info

Wipro technology is one of the leading provider of integrated business, technology and process solutions on a global delivery platform.

Wipro Technologies is a global services provider delivering technology-driven business solutions that meet the strategic objectives of our clients. Wipro has 75+'Centers of Excellence' that create solutions around specific needs of industries. Wipro delivers unmatched business value to customers through a combination of process excellence, quality frameworks and services delivery innovation .Wipro is the World's first CMMi Level 5 certified software Services Company and the first outside USA to receive the IEEE Software process Award.

Wipro's Service portfolio includes:

- Business Intelligence & Information Management
- Enterprise Application Services
- Infrastructure Management Services
- Business Process Outsourcing
- Consulting Services
- Testing Services
- Product Engineering Services
- Enterprise Technology Integration
- Total Outsourcing

Business Challenge

With more than 1,00,000 IT professionals spread all over the globe and 75 odd centers of Excellences deploying a diverse range of practices and process, Wipro faced a unique challenge in Service Execution Management .While the need for process and service execution automation was a foregone conclusion, choice of a single integrated solution wasn't. Wipro's Information Systems division implemented SAP for contract administration and continues to build in-house solutions for process and service execution.

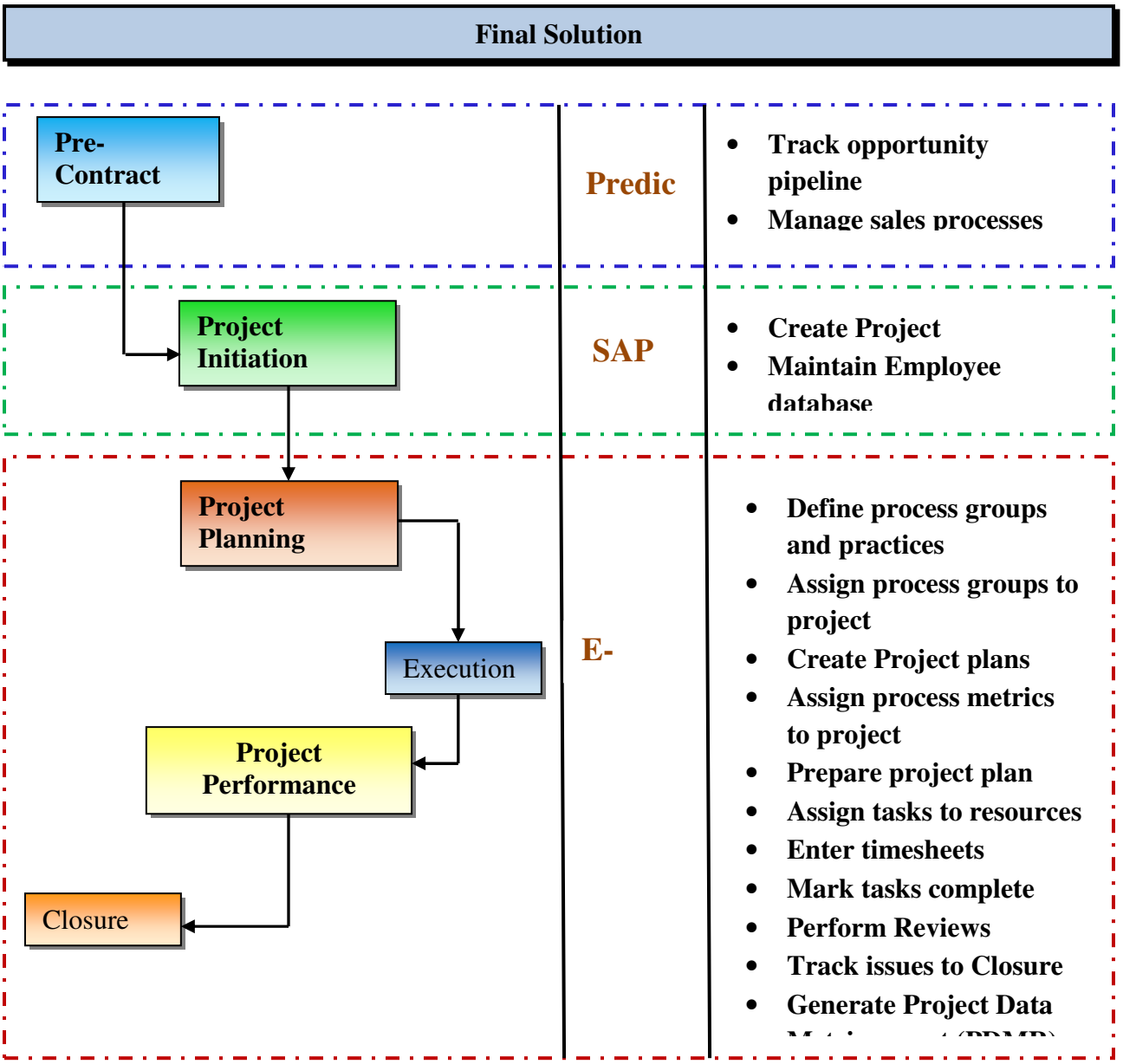
In 2004, bid management was executed in home grown tool called Predict. Post contract projects initiation phases were mapped to SAP product Module, while a host of other tools, provided the functionality required for Service Execution and Project performance reporting .IPAT, an in-house tool provided for only the capture of project performance date but didn't have the support for processes themselves, such that this data could be generated in the course of execution. This dichotomy fuelled the need for single integrated solution and let to discussions between Wipro and Glodyne – a leading provider of Service Execution Management product and services globally.

Solution and Approach

Whizible, now Christened E-cube in Wipro– Enabling Excellence in Execution within Wipro, Offered almost 80% of the base functionality and execution infrastructure services, required by Wipro. Although remaining 20% of the gap looked daunting at an estimated 30 person years to complete, Glodyne could demonstrate that they could be bridged in less than half the time estimated by using Whiz TM framework .Backed by Glodyne flexibility to work in a on-site/off-shore model and extensive implementation experience, Wipro was convinced of a complete solution, which would be available in time to support global rollout.

Both parties, entered into an agreement in August 2004.

E-Cube System was conceived as part of an integrated solution, consisting of Predict, SAP projects and Whizible. This solution is represented in the next sheet:



Joint teams of Wipro and Glodyne faced unique challenge of developing E-cube and rolling it out in parallel. There are many process models followed by Wipro - Development, Maintenance, Testing, Conversion, EAI, ASIC, Board, Agile, EAPM Metrics, Managed Service to name a few .Each process group needed functional support from E-cube to support its own specific needs

and metrics, before the tool could be rolled out .At the same time, there were other non-functional requirements, which needed support in E-Cube for it to be operational .These requirements includes:

- Interface to SAP and Effort Billing Systems
- Off-line Timesheet to Support users, who did not have access to Wipro LAN or internet to access E-Cube application.
- Authentication against Wipro Active Directory server
- Audit Trail requirements ,as per Wipro Security policies

Non functional requirements were critical to rollout, whereas functional requirements (support for process models) could be added as rollout progressed to those areas.

Based upon the situation at that time, an aggressive implementation plan was prepared by the implementation teams and the whole implementation was completed as per the schedule given below.

Phase 1	Complete Initial Solution • Implement Non functional requirements • Implements Common functional requirements • Provide supports for development and Maintenance models • Glodyne Team Moves on-site (Bangalore)	Nov 04 - Sep 05

Phase 2	Rollout to First set of 3,000 users • Provide support for Hybrid and models • Establish E-cube support Help-Desk • Rollout to initial 3000 users • Glodyne Teams offshore ,expect Application support team	Oct 05 - Mar-06
Phase 3	Rollout to 10,000 Users • Make Architectural Development changes (Web servers and Database server ,PDMR server and QRB server) • Carry out Scalability improvements • Provide Support of testing ,ASIC, Board, BI&DW and EAPM process models • Enhance Project performance reporting • Rollout to next set of 7000 users	Apr 06 - Dec 06
Phase 4	Rollout to 25,000 users • Fine tune solution • Enable Dashboards and Organization visibility • Rollout to next set of 15,000 users	Jan 07 - Mar 08
Phase 5	Functional Enhancements • Frame work enhancement • Agile Implementation • TEUI Implementation • SAP Enhancements	Apr 08 - Mar 09
Phase 6	Functional Enhancements • Lean Model • Suspense approval work flow • CSAT Implementation • SAP TMS Implementation	Apr 09 - Mar 10

	• MSP addin Implementation • Program Governance	
Phase 6	Functional Enhancements And 9x Upgrade • Account Risk Register • 9x Upgrade (E-cube on top of Whizible New feature and UI change) • MSP project integration New Approach for Wipro	Apr 10 - Mar 11
Phase 7	Functional Enhancements • Open sources changes	Apr 11 - Mar 12

Case Study 7

Cost Reduction Devices viz. Programmable Logic Controller (PLC) & Distributed Central System (DCS) for improving & maintaining the production quality of HPCL

Before 1991, Public Sector Refineries used to depend on manual operations to maintain the quality, consistency and the purity of every petroleum product. There used to be 'hand operated controlling knobs' which used to be operated by several men appointed for that work; the cost of which used to be not only very high but, there was overall lack in precision in adjustment of the knobs from time to time. The result was that petrol used to be mixed up with diesel and other impure substances.

While using such mixed petrol, the carburetors of the cars used to get choked by the carbon dust and the cars used to face 'break downs' due to the blocks in smooth supply of petrol. Everyone who has used cars during pre-reform years i.e. since 50's to 90's must have experienced this problem and mechanics always used to suspect about the choking of the carburetor. Mixed petrol was the major cause of breakdowns of Fiats and Ambassadors.

After reforms, high tech world class cars and foreign cars have driven old Fiats and Aambassadors out ot the market. All the new cars like Maruti, Suzuki, Honda city, Hyundai, BMW, Chevrolet, Ford, Toyoto etc. badly require pure petrol or pure and best quality diesel. Since petrol market in India also got linked to global market and global companies, as well as, private companies like Reliance were allowed to open their petrol/diesel supply pumps; the public sector companies like Indian Oil, Bharat Petroleum and Hindustan Petroleum were seriously threatened by the competition; in giving best quality petrol; because their monopoly status was threatened.

The public sector companies suffered a crisis of their very survival; hence they had only 2 options left viz

a>either improve their quality of petrol/diesel or

b>to close their production ; by losing their customers and their market.

The main problem was Indian Public Sector Refineries used to receive supply of crude from various sources like Bombay High, Gujarat, Andra Pradesh and Assam,etc. After an interval of every 4 days, crude used to reach refineries and they used to require different temperatures as per the quality and the source of their supply of crude therefore standard temperature control; common for all, was not feasible.

Following variations in temperature control for getting various petroleum products are mandatory.

Sr. No.	Description	Temperature in Farenhiet
1	White petrol	50 to 90
2	Gasoline or ordinary petrol	90 to 220
3	Nafta	220 to 315
4	Ordinary Kerosine	315 to 450
5	Light gas Oil or Diesel	450 to 650
6	Heavy Diesel	650 to 800
7	Tar	Residue after 800 and above

Since the range is very wide; precisely appropriate temperature cannot be maintained and altered by manual operations. In order to overcome this main difficulty, two things were absolutely essential viz

1. That tuning up the required temperature by main "distributed control system" and
2. The precise measure of the purity of the refined output

Since 1983 onwards "computerized programmable logic controller (PLC)" and "analog controllers" were used in the functioning of "distributed control system. "PLC's were distributed in different units/plants/processes for managing their respective controls at micro level. All these PLC's were centrally integrated and the main control used to be done from a "blast-proof control room"; and a giant controller was used to control the various processes through

the PLC, automatically. It used to give output signals to various PLC's and analog controllers.

The system was made foolproof. In case the giant controller fails from the control room, the rest of PLC's and analog controllers which are spread over the whole plant could independently continue to operate and control their own units and processes.

In case any emergency arises, " emergency shut down system" automatically gets activated and shuts down the boilers and the heaters and the complete plant in predefined sequence. Such a probability is 1:10,000! As a safety measure, every refinery is also well equipped with a cooling tower, too.

HPCL approached Tata Honeywell Co. for supplying the entire Distributed Control System with PLC's and various types of sensors to detect precisely the various parameters of the purity of the product such as temperature, pressure, viscosity, humidity, and the world class quality.

Tata Honeywell team led by the author of this research study visited HPCL refinery site and studied the minute details of the required solutions to its problems. In this field Tata Honeywell has competition from Yukogawa and Foxboro. We came back and proposed a solution which was accepted by HPCL. HPCL then sent out the RFP to all vendors and we won the order after successful bidding and then developed the whole system for HPCL for operational efficiency.

Our Research and Development introduced a 'Distributed Control System' equipped with n number of PLC's and analog controllers, plus the sensors to measure and judge various parameters of the purity and we wanted the whole system should work automatically and precisely by removing the costs and errors of human operations.

In the year 1992-93, Honeywell gave the first 'distributed control system' viz DCS under the brand name of TDC 3000! It was bought by the company at the price of Rs. 15 Crs. The company was very happy because it could produce the world class quality petro products. In the year 2001-02, Honeywell introduced a better and more efficient model of DCS: TDC 3000 II and sold it to HPCL at the price of Rs. 35 Crores.

HPCL was immensely benefited by this control system because its production per annum used to be worth greater than Rs. 10,000.00 Crs. The cost: benefit ratio to it was Rs. 35:10000 or Rs. 3:1000 by spending Rs. 3/- company was getting the quality petrol worth Rs. 1000/-. Due to the quality of HPCL; the sales turnover of the company went on increasing from 10,596/- Crs., in 1993, To Rs.13,329/- Crs in 1995 to Rs. 52,605/- Crs. In 2003 to Rs. 76,920/- to Rs. 112,098/- Crs. and above.

TDC 3000 became a hit product in the entire market of petroleum companies. It became popular in the entire market of petroleum companies. It was purchased by Bharat Petroleum Corporation, Indian oil corporation, Baroda, Vishakhapatnam, ONGC etc. In the year 1992-93, Tata Honeywell was a small company

having a business turnover of only about Rs. 20 Crores; it became a monopoly giant worth Rs. 2000 crores within 10 years by multiplying its business and market.

TDC 3000 has created record success in India as Honeywell with a clientele to Worlds giant refineries of ARAMCO, EXXON, Chevron, Shell etc. has done world-wide business and has become number one control system in the Oil and Gas sector of the global refineries, in the world.

Case Study 8

Huge Cost Reduction done by Software developed by Ecoaxis for diagnosis of 'Boiler Health Intelligence'

Ecoaxis a firm emerged in 2004-2005; as a small firm providing complimentary 'After sales Service' to Pune's Giant Factory viz. Thermax which produces Giant, large and medium boilers and sells them to its various clients like large power projects, chemical factories, sugar factories, refineries, paper and pulp industry etc.

Thermax happens to be India's top ranking firm in the Boiler Industry. In recent years, five and seven star hotels, hostels, hospitals etc. also have started using boilers for saving electricity. Thermax also has extended its market and clients abroad in countries like Nigeria, Saudi Arabia and south-east Asian countries.

The boilers have different sizes, according to the needs of heating and producing steam which make generators work for production of electricity. They vary from six meter size upto sixty meters. Sugar factories require a boiler of ten meters long whereas power plants require them of the size of 45 to 50 meters; Refineries require very big viz. boiler of 50 to 60 meters, length.

The boiler has following parts; for example, a sugar factory boiler is 10 meter long, its drum is $2^{1/2}$ meters wide, it has one

meter open space, two meters long fire chambers followed after $1^{1/2}$ meters ash collector.

In case of power plants, there are two drums containing water and placed one above the other at a distance of aprox 15 to 25 meters. These drums are connected with tubes through which water circulates between these drums. The whole area with drums and tubes is covered from all sides by metal sheets and a vacuum is created of about 20 meters wherein a giant fireball is produced to heat the water in the tubes and the drums. Once the boiler is superheated, it throws steam which is without one molecule of moisture and the steam activates and rotates the turbine. The turbine moves the generator on and power is produced. Sugar factories make use of their own sugarcane baggasse and save lots of costs paid to electricity boards. The hotels & hospitals which require thousands of units of electricity per day, also can save their energy costs by installing their own boilers.

In the course of the daily use of boiler, the smooth working of the boiler gets disturbed due to faults created by 'Wear and tear' of the boiler assembly. At time, a complete breakdown is also possible and because of the failure of boiler the entire production process of concerned industries become inoperative: till the team of technicians from Thermax visit the site and make necessary repairs and maintenance.

At the time of sale, Thermax assures its client 'After sales service' throughout the life of a boiler by charging four percent of

the sale value of the boiler. The clients also are happy and welcome this offer of 'After Sales Service'.

Normally, after a breakdown; the boiler becomes once again operative within a time gap of minimum three days to maximum twenty days. The clients using these boilers suffer huge losses in crores of rupees in conditions of breakdown.

On an average, after a breakdown of the boiler a sugar factory faces a loss of Rs. $1^{1/2}$ crore per day; 500 Mega Watt power project has a loss of Rs. 20 crores per day, chemical factories suffer from a loss of Rs. 50 crore per day and oil refineries loose Rs. 105 crores per day. No body wants any breakdown because it is unaffordable! Under such circumstances, Thermax also faced a lot of embarrassment and loss of dignified reputation and client's goodwill, as well.

A young technocrat who had worked in Thermax and was fully conversant about the entire product assembly and process and knew the loopholes and vulnerable areas, had started a small firm which was interested in developing the entire diagnostic software package of Boiler Health Intelligence with embedded system of controllers and sensors which record the status of each component of the plant assembly. He approached Thermax company and offered his services for sharing the responsibility of 'After Sales Service' assured by Thermax to its clients. Thermax gave him the 'break'.

Ecoaxis produced a 'Distributed Control System', by fixing sensors to different components of the plant assembly; by taking into consideration of all parameters of the 'healthy status of a boiler' like heating temperature, fire ball condition, content of molecules of moisture, swoot or carbon monitoring; Gun status, conditions of various valves, humidity, pressure, status of belts, the condition of motors, conditions of Turbine, power generators etc. It made assembly of sensors which read and report about the healthy or problematic status of each of them.

The whole software package identifies the existing faults or likelihood of occurrence of fault in near future, the exact therapy and timely action required for preventing a major fault and consequent breakdown, which parts are to be replaced, etc. This software sends the complete diagnostic reports and therapies recommended to the main service center at "Thermax HQ in Pune, minute after minute, round the clock, throughout the year.

Thermax Main Service Center started taking prompt preventive action in advance of the likelihood of a breakdown and minimized the days of total breakdown by about 80 percent. Clients therefore could save hundreds of crores of rupee losses and became satisfied with this new service.

Thermax by indulging the satisfaction quotient of their clients raised their maintenance charges up to eight percent of the value of the boiler assembly and clients were ready to bear them delightfully.

Thermax at present, gives two percent of the value of boiler assembly to Ecoaxis; for availing the latter's diagnostic and therapeutic services.

A win win situation has been the result because now the clients are happy by reducing their heavy losses, Thermax the producer company gets six percent of the value of the boiler assembly.. (increment of 2% extra) and Ecoaxis gets a permanent and very charitable patron who grants a huge price for its diagnostic services.

Prior to 2005, Ecoaxis had a turnover of Rs. 20 lakhs per annum. At present, it has become Rs. 100 crores worth company and its progress has remained very rapid during the last three years.

Case Study 9

Energy cost saving by automation in the building complexes of Taj Hotel, Mumbai / Appollo Hospital, Mumbai, Manipal Hospital Bangalore and TCE, Mumbai

Construction of new buildings – at present – are done by total energy saving plan prior to the finishing of them. The problem of energy saving is seldom faced by them.

In case of old heritage buildings, like the one in front of gateway of India Old Taj Hotel or TCE building, Appollo Hospital at Mumbai and Manipal Hospital in Bangalore; Energy saving plans were not done because energy was cheaply available before 60 -70 years. Since there is absence of automatic gadgets for controlling the supply and use of electricity, and since not only electricity unit charges have sky rocketed but due to longer hours of 'load shedding', the costs of energy by using 'inverters' have gone up by 'crores of rupees'.

In the year 2003-04; the author of this PhD research study was working with 'Tata Honeywell Limited'.

The Managing Director of Taj Hotels, Mumbai made a query by approaching Tata Honeywell; whether they would be in a position to make 'total energy saving plan by automation' and solve the problem of overhead expenses of the hotel.

I was detailed to visit Taj Hotel and study the existing conditions and essential measures by which wasteful abuse of electricity could be avoided.

Our team made thorough examination of the 'heritage building' and found that the building was constructed fully by cut stones. The windows were old fashioned and they had only one layer of glass window panes. The glasses were white; therefore they used to radiate more heat from outside in the room therefore A.C. cut off temperature had to be set at 15 Deg C instead of normally required 22 Deg C for maintaining a comfortable room temperature. It used to consume greater electricity units. We proposed to use reflective window panes with a light blue tinge and recommended two layers of glass for windows – one outside and by keeping 3 inches of vacuum another layer from inside. The result was that outer layer of glass pane may remain heated during midday but it could not radiate heat inside the room, because of the second layer of glass shield designed by us.

Our team introduced automatic room temperature control at the desirable room temperature of 22 Deg C. After turning on the A/C, once the room temperature is lowered down to 22 Deg C, there was automatic arrangement of stopping the A/C; till such a transit period, when room temperature moves up to greater than 25 Deg C and above. Once again automatically A/C of the room would be turned on and brings down to the optimum temperature of 22 Deg C. There are huge and many corridors in Taj; which also need air conditioning. If a particular floor adjacent to a corridor; nobody occupies any room; still the A/C used to be on and it was of

nobody's use! A room boy- by chance- makes a round; he used to switch off the button of the A/C.

There are many rooms on every floor of Taj building and the building has 5 floors. With partial occupation or no occupation; all the rooms of a particular floor used to get air conditioned by the central system of its switching on. Our Team recommended that each room and each corridor should have separate automatic control of 'Switch on and switch off' which could be operated by 'movement detectors' and embedded sensors. By the new system, which our team introduced, in case a person enters a room, his movement and presence were detected by the sensors and the lights and A/C used to be on: in case of his exit; the A/C and the light used to switch off automatically. In case of any visitor reaches a corridor, the A/C of the corridor and lights used to be on and after his exit it used to be switched off.

The very bright lights in the corridors used to continue burning even after 10am; during the broad day light. We introduced automatic dimmers which used to be automatically on after 8am up to 5 pm and during the rest of the hours, bright lights used to resume. Power consumption of 'dimmers' is less than 60% of the normal lights. We recommended a 'common boiler' instead of hundreds of separate geysers; which started supplying hot water throughout the day and night. That also reduced the heavy consumption of electricity.

To sum up, our new system introduced automatic control done by PIR sensors, movement detectors, centralized A/C system,

Centralized Lighting System by fixing dimmers. The wasteful consumption thus was totally removed.

Prior to the 'energy saving by automation' introduced by us, Taj Hotel expenses per year, per floor were as follows.

Ground Floor	Rs. 72 Lakhs
Ist Floor	Rs. 1.2 Crores
II Floor	Rs. 1.15 Crores
III Floor	Rs. 1.37 Crores
IV i.e. Top floor	Rs. 0.98 lakhs
Total	Rs. 5 Crores 42 lakhs

After the installation of the 'Automatic Energy Saving Plan', the expenses per floor reduced as following.

Savings of Electricity expenses per annum

Ground Floor	Rs. 19.5 Lakhs
Ist Floor	Rs. 30.0 Lakhs
II Floor	Rs. 31.0 Lakhs
III Floor	Rs. 37.0 Lakhs
IV i.e. Top floor	Rs. 27.0 Lakhs
Total 144.5 i.e. Rs. 1 Crore 44 lakhs & 50,000 only	

Roughly our energy saving plan could reduce electricity expenses of Taj Hotel by about 23%.

Terms of completing our contract were also quite novel, interesting and very comfortably acceptable to Taj Management. The terms were following:

A) Tata Honeywell- partly belonging to Tata fraternity quoted and assured that we would save net Rs. 1 crore 45 lakhs from your yearly electricity expenses. Therefore Taj Hotel should reasonably pay that assured amount in advance! Our company actually required almost Rs. 1 crore 15 lakhs for refurnishing double window panes, lighting, fixation of PIR sensors and movement detectors, alterations in switches, wiring, equipment, plumbing material for Hot Water Supply etc. etc. So without spending a paisa from our own account; we could finish our job and got estimated profit of about Rs. 29 lakhs.

B) Our condition No. 2 was also acceptable to Taj Management that in case instead of Rs. 1 Crore 45 lakhs savings; suppose Taj Management actually saves Rs. 1 Crore only; Tata Honeywell will return Rs. 45 lakhs, because it is ethically bound to bear the responsibility of uncovered amount of savings. Taj Management very delightfully accepted it because it was assured of the total amount of energy cost saving of Rs. 1.45 lakhs.

C) Our third condition was also reasonable which was readily accepted by Taj Management. Taj Management was supposed to directly make payment of material, fixtures, alterations, equipment etc. to our suppliers upto the limit of Rs. 1 Crore 20 lakhs and Taj Management will give Rs. 25 lakh for our labour cost of installation, in all Taj Management has to pay advances of Rs. 1 Crore 45 lakhs.

D) Our fourth condition was that whatever Energy Savings will be due within the second year; after the installation of our automated energy controls; the Taj Management will give 50% share of the extra savings over and above the amount of Rs. 1 Crore 45 lakhs per annum. The Taj's actual savings of energy happened to be Rs. 1 Crore 63 lakhs i.e. 18 lakhs over and above the target; therefore 50% share of that bonus savings plus Rs. 1 Crore45 lakhs of our consultation fee which we had deferred to receive after completion of 2^{nd} year; in all, Tata Honeywell received an amount of Rs. 1.45 lakhs plus Rs. 91 lakhs!

E) From third year onwards, it was decided to share the net total energy cost savings equally. The actual savings amount stood to be Rs. 1 Crore 54 lakhs. Therefore Tata Honeywell received Rs. 77 lakhs.

F) From fourth year up to 10^{th} year, Tata Honeywell went on receiving half amount of net savings and could earn Rs. 6 to 7 crores with a period of Ten years.

It became a win-win situation not only to Taj Management, Tata Honeywell but also to MSEB because since the board is facing acute power-shortage and encouraging energy-saving, could save that energy and provide it to other clients.

Taj Management happily gave Honeywell similar contracts of all its hotels in the country. Tata consultancy (TCS) also gave another contract. ITC hotels, Apollo Hospital etc. also became new clients of Tata Honeywell.

In case of Apollo Hospital during the year January 2004 to December 2004, average Electricity bill per annum used to be Rs. 8 Crore 24 lakhs.

Honeywell gave the same solution and could save Rs. 2 Crore 95 lakhs. It had paid advance of Rs. 2 Crores; of which equipments required Rs. 1.70 lakhs and Rs. 30 lakhs for labors required for installation. After the second year; Tata Honeywell got Rs. 2 Crore 90 lakhs. After the third year Honeywell received half share of net electricity savings and earned about Rs. 7 Crores.

Due to the customer's satisfaction and word by mouth, Tata Honeywell received contracts of energy saving of 26 very big properties.

Tata Consulting Engineering Company located on MG Road behind Kauveri Emporium which has 5 floors and many Halls of the area of 40000sq.ft. each; found colossal waste of energy cost. It has occupied a building on 99 years lease for annual rent of Rs. 1

lakh, but TCE has to bear and pay the monthly electricity bill. In large size hall, suppose there are about 100 tables and occupancy rate of tables is even about 20 to 30% , the entire hall used to remain air-conditioned and lighted. Tata Honeywell recommended separate lighting and A/C arrangement per table per cabin and installed sensors and movement detectors and introduced the automatic control of switch on and off depending upon the presence of a person working at a table. After the exit of last person from the hall, automatically A/C and lights used to get off!

After installation of our control system, TCE could save about Rs. 2 crores ((Its normal bill price to installation used to be about Rs. 6 ½ crores). By similar contract done with TCE on the pattern of Apollo Hospital and Taj Management, Tata Honeywell earned about Rs. 8 crores within 10 years.

Tata Honeywell has been a pioneer in launching the movement of 'cost savings' and many companies at present have developed special interest and concern in reducing the wasteful costs and raise their profits!

Case Study 10

Reduction in costs by removing communication Gap and Applying Six Sigma Methodology for minimizing errors in Manufacturing and Engineering.

Tata Honeywell buildings controls division used to take contracts of providing complete building automation for huge industrial and commercial buildings.

The implementation team used to prepare initial layout and plan of the proposed automation system to be used on the drawing received from the architects of the industrial and commercial buildings. This plan was handed over to the field team consisting of engineers and diploma holders having some background of construction and expertise on automation systems. After the visit to the local site these engineers used to make changes as required in the plan which many times were major changes as the site conditions would be quite different from the drawing given by the architects. Unfortunately these changes were never communicated back to the HQ where the 'centre of excellence group' team used to be stationed who were supposed to control the work proceedings. Generally the field team used to consist of persons having no sound and perfect knowledge and were having average competency.

This field team used to send us information regarding the installed and repaired material and the extra material to be ordered and supplied by our dealers but the information which they used to send, used to be vague and imperfect.

On the basis of their reports, COE team used to approach the dealers for supplying the automation material; on behalf of our client.

This author of the Phd. Thesis, that time had the privilege to work as head of the COE team. Because of wrong information received from our field teams, our orders used to be wrong and the client used to complain for the billing of 30 % unwanted material. If the installations used to be changed as per the latest amends done by architects; the entire material used to become scrap and additional costs used to be incurred on fresh orders of supplies. Client used to refuse to pay for such costs, and the company used to suffer losses. As a result, the bosses used to criticize the COE team.

The main cause of the crisis was that there was unpardonable laxity in keeping updated communication between field team and the COE team; as well as' client and the COE team. Also at the same time while doing the assessment and benchmarking for Malcolm Baldridge business model for COE processes; it was observed that the COE team in Honeywell buildings control division was taking 30 % more resources.

At the same time, I had read literature about Six Sigma methodology and the success story of Mumbai's daily Tiffin service (Mumbai Dabba Walla) and their record of maximum efficiency in avoiding errors.(less than 3 in 10 lakhs probable errors possible!). I decided to apply six sigma technique to improve the processes being used by COE.

As per six sigma method, we gave following solutions to make our system 'error proof'.

A) Client / customer interaction directly with COE group, by use of Personal Computer and per minute, per day communication channel readily open.

B) We prepared (COE) standard data sheets, G.A. drawings, cable layout, Panel layout etc, and they were given to the field team. If any slight change was to be made, the field team had to communicate and justify to the COE team and COE would make the changes and mail the revised document to the field team. In this way all the changes were documented, vigilant control was maintained and all other agencies like suppliers were notified in time of the changes which avoided huge losses, due to supplies of unwanted material by our dealers.

C) We formed another team of 'Quality Assessment Group" which consisted of few experienced and senior members of COE team. We made it mandatory to obtain the formal approval of 'QAG' group, without which no order could be given to the vendors / dealers.

D) We also started informing the customers and dealers of our standards of 'reputed material' for every job to our clients and dealers.

E) As per our study through six sigma we had noticed that one of the main reason for errors was also that our sales persons would submit the Bid documents directly to the customers

without getting the same checked from anyone and that would have a lot of errors which resulted in great losses to Honeywell. Hence we asked our sales persons to route the bid documents through COE and QAG for their approval. Also the sales persons were given the instructions to follow the 'standard templates' only.

By applying Six Sigma methods for bridging the communication gap; the results were the following.

1) 30 % of COE team engineer's labour time was reduced. We had 27 engineers working in COE; by six sigma method, we actually started requiring only 19 engineers to manage the work as liaison between field team, client, dealers and Co. bosses. Eight engineers were transferred to another unit and our company saved lakhs of rupees spent on their salaries and overheads, (Approximately Rs. 22 lakhs on Salaries and Approximate Rs. 18 lakhs on overheads).

2) 30 % to 40 % of the automation and building material which used to be excessive, (more than required) used to be rejected by our clients. Our company used to bear annual losses of Rs. 1.8 Crs, after our solution, losses were reduced to only Rs. 18 Lakhs, because there was net improvement in preventing the errors, by perfect communication, system.

3) Our projects of automation of industrial housing and commercial complexes became successful and cost-effective, because the cost could not cross the estimated and guided limits.

4) The satisfaction quotient of our clients rose by more than 21.75 %.

5) We got 'Repeat Business' by net increment of 52%.

6) COE team led by me got 'Green Belt Certificate' for applying successfully the six sigma methods.

What is Six Sigma and standard practices of finding correct solution?

We used the DMAIC model to tackle any managerial problem. D stands for define, M stands for measure, A stands for analysis, I stands for improve, plan, and potential solutions and C stands for control mechanism.

As per this logic, we initially understand the client's problem. They make assessment of the correct and vulnerable areas of a working system, later we diagnose the root causes of the problem and accordingly we suggest value added steps and potential results. Control mechanism makes critical assessment of work done and maintains the consistency of raising the quality perpetually.
We used number of tools and techniques to understand the customers problems (Customer Requirement Questionnaire was used – Sample is as shown below)

customer requirements				
Customer :	**Outputs**			
Operations Head / BU Head	1. Panel Wiring Drawings 2. Data Sheets 3. Cable Schedules			
	4. GA and Installation Drawings. 5. Layout Drawings			
	6. CARE 7. CAE 8. SDU 9. Graphics.			
Requirements :	**Measures**	**Importance to**	**Customer**	**Priority**
		Customer	**Satisfaction**	(Importance X
		1=Nice to have	1=Very Satisfied	Satisfaction)
		2=Important	2=OK-Could be better	
		3=Critical, Must Have	3=Unhappy.Needs Improvement.	
			Notes : We have given rating as per todays customer satisfaction level.	
Cost - Manhours required.	Error Free Devarables - Number of errors.	3	2	**6**
	Stardard prepared for above mentioned outputs.	3	3	9
	Tool prepared for using the above mentioned standards.	1	3	**3**
Delivery	On Time Delivery	2	2	4

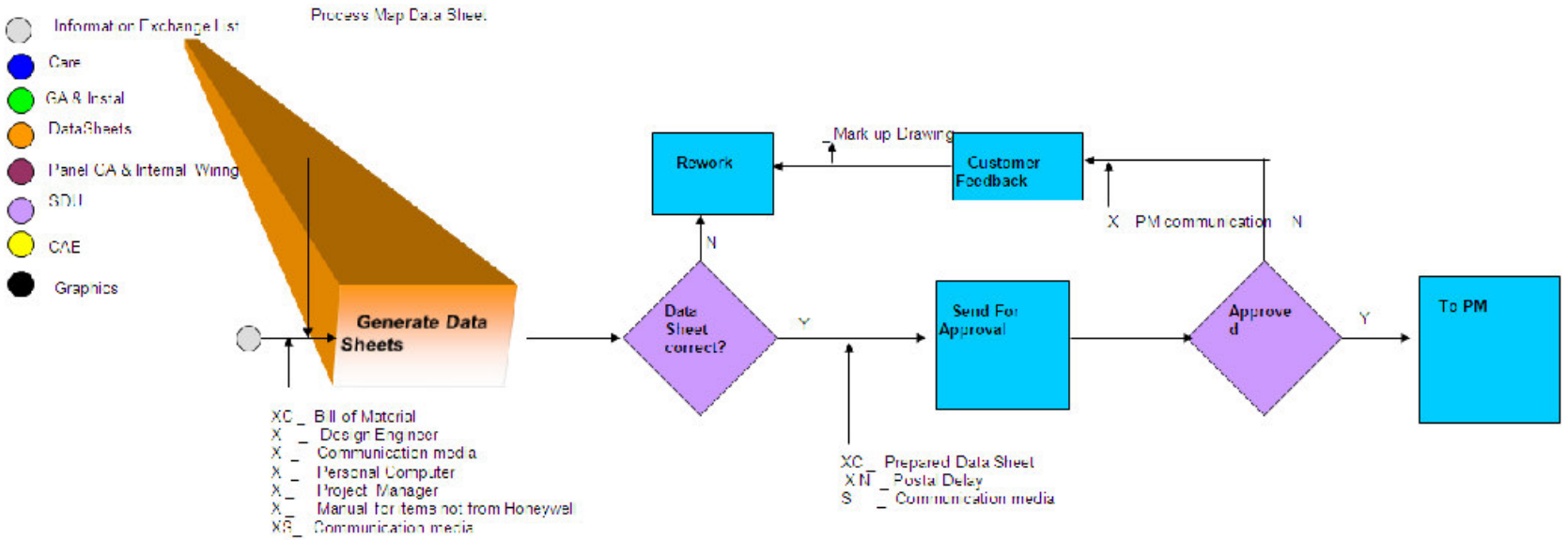
What is this coustomers major complaint? What issue would they want us to work on?

1. No standards followed (everybody follow's his own methods)
2. Many errors in documents produced
3. Lot of time & money spent on preparing documents at site

The current processes were mapped for various acyivities being performed in COE to find out the hidden factories viz,

1. CARE
2. GA and Installation Drawings
3. Data Sheets
4. Graphics
5. CAE
6. SDU
7. Layout etc
    a. Sample of the same is given overleaf.

(N.B. – COE means Centre of Excellence Team)


Process Map Data Sheet
Information Exchange List
Care
GA & Instal
DataSheets
Panel CA & Internal Wiring
SDLI
CAE
Graphics
Generate Data Sheets
XC _ Bill of Material
X _ Design Engineer
X _ Communication media
X _ Personal Computer
X _ Project Manager
X _ Manual for items not from Honeywell
XS _ Communication media
Data Sheet correct?
N
Y
Rework
Mark up Drawing
Customer Feedback
X PM communication N
Send For Approval
XC _ Prepared Data Sheet
XN _ Posta Delay
S _ Communication media
Approved
Y
To PM

Further various tools and techniques were used in the measure and analyse phase as

1. SIPOC – Suppliers, inputs, process, output and customer sheet
2. Cause and Effect Matrix
3. Failure Modes and effect Analysis – FMEA etc
4. And Finally the Action and control plan was made as shown overleaf.

Please see Attached PDF Named SIPOC

Please see Attached PDF Named C & E

Please see Attached PDF Named FMEA

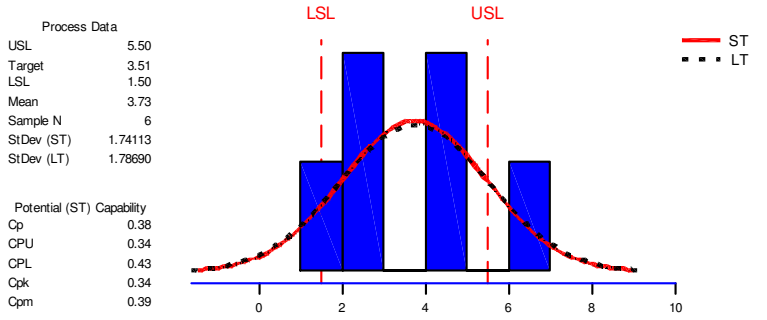
Please see Attached PDF Named FMEA

Please see Attached PDF Named Action Plans

Please see Attached PDF Named Action Plans

In case of our company, the standard deviation in our General Arrangement (GA) Drawings was about 3.02; we brought it to 1.75. Lesser the standard deviation, greater the sigma, it is a better condition.

FAS - Process Capability Analysis for GA Drawings - After Six Sigma



Process Data	
USL	5.50
Target	3.51
LSL	1.50
Mean	3.73
Sample N	6
StDev (ST)	1.74113
StDev (LT)	1.78690

Potential (ST) Capability	
Cp	0.38
CPU	0.34
CPL	0.43
Cpk	0.34
Cpm	0.39

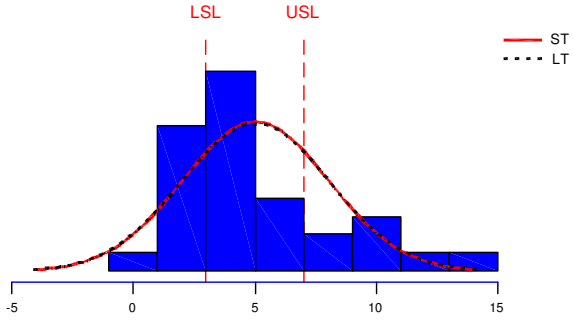
Overall (LT) Capability	
Pp	0.37
PPU	0.33
PPL	0.42
Ppk	0.33

Observed Performance	
PPM < LSL	0.00
PPM > USL	166666.67
PPM Total	166666.67

Expected ST Performance	
PPM < LSL	0.00
PPM > USL	0.00
PPM Total	0.00

Expected LT Performance	
PPM < LSL	0.00
PPM > USL	0.00
PPM Total	0.00

FAS - Process Capability Analysis for GA Drawings - Before Six Sigma



Process Data	
USL	7.00000
Target	5.02000
LSL	3.00000
Mean	5.02742
Sample N	31
StDev (ST)	3.02128
StDev (LT)	3.05164

Potential (ST) Capability	
Cp	0.22
CPU	0.22
CPL	0.22
Cpk	0.22
Cpm	0.22

Overall (LT) Capability	
Pp	0.22
PPU	0.22
PPL	0.22
Ppk	0.22

Observed Performance	
PPM < LSL	290322.58
PPM > USL	225806.45
PPM Total	516129.03

Expected ST Performance	
PPM < LSL	251095.21
PPM > USL	256911.53
PPM Total	508006.74

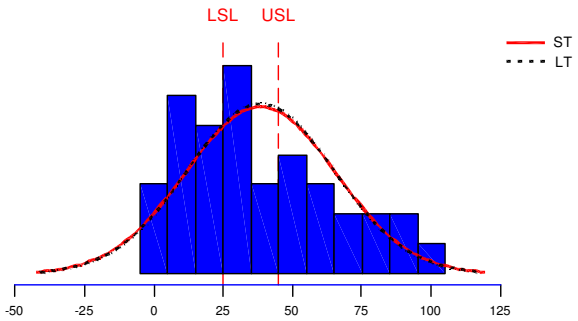
Expected LT Performance	
PPM < LSL	253226.64
PPM > USL	259010.12
PPM Total	512236.77

Our layout standard deviation was horrible, being 26.7; by our intense efforts we brought it down to 16 as shown below,

FAS - Process Capability Analysis for Layouts - Before Six Sigma

Process Data	
USL	45.0000
Target	38.5000
LSL	25.0000
Mean	38.5092
Sample N	38
StDev (ST)	26.9829
StDev (LT)	26.5483

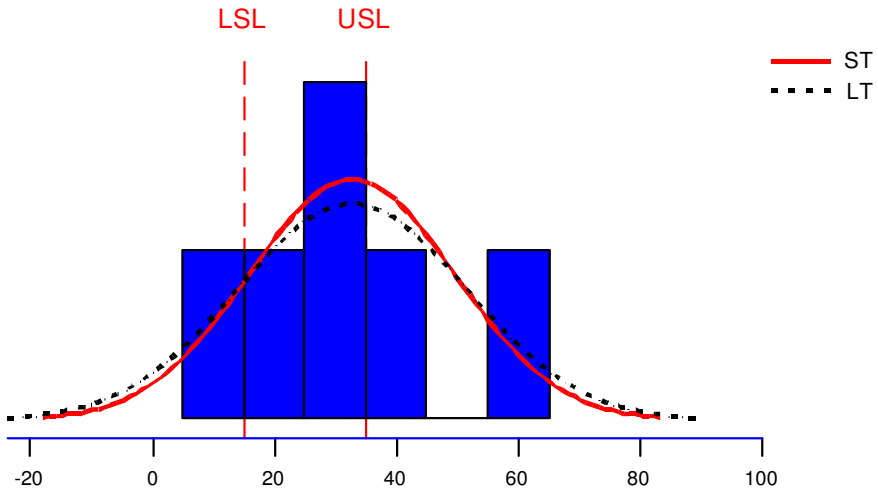
Potential (ST) Capability	
Cp	0.12
CPU	0.08
CPL	0.17
Cpk	0.08
Cpm	0.13



FAS - Process Capability Analysis for Layouts - After Six Sigma

Process Data	
USL	35.0000
Target	26.9500
LSL	15.0000
Mean	32.7733
Sample N	6
StDev (ST)	16.9060
StDev (LT)	18.8247

Potential (ST) Capability	
Cp	0.20
CPU	0.04
CPL	0.35
Cpk	0.04
Cpm	0.18



Overall (LT) Capability	
Pp	0.18
PPU	0.04
PPL	0.31
Ppk	0.04

Observed Performance	
PPM < LSL	166666.67
PPM > USL	333333.33
PPM Total	500000.00

Expected ST Performance	
PPM < LSL	0.00
PPM > USL	0.00
PPM Total	0.00

Expected LT Performance	
PPM < LSL	0.00
PPM > USL	0.00
PPM Total	0.00

in case of panel wiring, the standard deviation used to be about 10. After applying techniques of six sigma, it came down to 1.8 only! The standard deviation in case of data sheets also was high up to 7, which was again reduced to 1.8.

We started using "MINI TAB software package" for finding out the standard deviation figures and we could get them within seconds. Our quality assessment group became successful by using six sigma techniques and MINI TAB software; for reducing our percentage of errors to probable errors.

In Tata Honeywell, the engineering services division used six sigma methodology for the first time and brought down the percentage of errors up to four sigma. But ideal and topmost sigma happens to be six that means the error free work reaches 99.9997% (in simple language, 3 error in every 10 lakh opportunities to make errors). Going from six sigma to seven sigma, entails huge expenditure which is not advisable because its cost benefit ratio becomes unfavourable.

Motorola Company was pioneer in using the technique of six sigma for the first time in the world but General Electric company actually derived maximum benefit from the usage of six sigma.

In short, what sigma level is to be achieved by any particular industry will depend on the market environment and the level of competition. Depending on how good your competition is and what is acceptable quality to the customer should determine how much

higher the sigma you should achieve in your companies operations as given below.

A) 5 sigma company means 230 errors in 10 lakh opportunities to make errors.

B) 4 sigma company means 6210 errors in 10 lakh opportunities to make errors.

C) 3 sigma company means 66,810 errors in 10 lakh opportunities to make errors.

Tata Honeywell building controls division, sigma used to be 1.8 (means roughly 1 lakh errors in 10 lakh opportunities to make errors) which was raised to 4.3 sigma by our persistent efforts of applying six sigma methodology for achievement of better control. (6.6 errors within probable 1000 errors).

This was good enough, because none of our competitors in India, had attained it!

I personally was very fortunate to learn this outstandingly successful managerial technique; not from the books only, but by learning by doing!!

Case Study 11

Case Study of Tata Honeywell Product XL 28

After 1995 there was a sporadic rise in construction of very huge buildings and sky scrapers required by five and seven star hotels, IT parks, corporate houses, Hospitals and industrial buildings as well as residential complexes. Paint shops, tea industries, textiles, food industry badly require maintaining the temperature and moisture at their shop floors. All these industries find heating ventilation and air conditioning controls as a mandatory infrastructure for maintaining the quality of their products and services.

Consequently, there was a fabulous rise in the aggregate demand of HVAC Controls in India and not a single Indian manufacturing unit was capable of supplying the world class controls to them.

American Honeywell company was the giant among them which used to produce two different systems by name XL 50 and XL 100 with facility of 22 Input / Output. XL 100 complete installation of HVAC control systems of a small building used to be sold at Rs. 5,50,000/- and XL 50 used to be sold at Rs. 4,87,000/-. Even a small shop used to buy it and a large industrial complex used to buy multiple units of the same systems as per their needs.

In order to gain the competing edge Johnson Controls favored the business out processing and it started getting its HVAC controllers manufactured in China because the overhead cost and the labour cost in China were comparatively lower than Honeywell's cost of production which was carried out in Germany. Because of the comparative cost advantage Johnson Control could very well afford to sell its HVAC control system at Rs. 4,00,000/- which was a perfect substitute to the products of Honeywell.

When Siemens and Johnson Controls two companies captured almost 80 % of market share because they were selling their HVAC control systems at Rs. 4,00,000 when Honeywell was selling at Rs. 5,00,000/-. Because of this great price difference, industries preferred Siemens and Johnson control systems and Honeywell could hardly obtain a two percent share of the total market. A giant company like Honeywell who had great name and reputation as well as vast global marketing network faced miserable failure only because of the lack of competitive cost efficiency. This proves that market is more sensitive to the price advantage rather than glamorous name and reputation.

The actual cost of all these three variants of HVAC were Rs. 5,00,000/- of XL 100, Rs.4,37,000/- of XL 50 and Rs. 3,50,000/- of Johnson Controls / Siemens and both sold with a profit margin of about 10 %. Siemens and Johnson controls, both companies established their duopoly in the market of HVAC control systems and made very grand business turnover during 1995 to 2000 AD. During 1999 – 2000 the researcher of this project (Myself) was in-charge of Engineering and Technical support group of Tata

Honeywell and was assigned the task of being a technical interface between Honeywell USA and Tata Honeywell. During that period, Honeywell had a very grand business turnover of 27 billion dollars as against the meagre turnover of Tata Honeywell being just about 20 million USD. This researcher started a very innovative activity by launching a monthly technical magazine, covering only technical articles which used to be devoted on innovative modifications and original research. The magazine was published under the name of "Technowell". Three colleagues from my department used to assist me. The quality of the magazine was of the international standard and therefore the parent company Honeywell USA not only recorded its appreciation but Honeywell very graciously included the best of the articles on their intranet. As a very good rapport was built up between the researcher and the parent company this researcher approached Honeywell technology head from Australia and requested him to get the Honeywell controllers manufactured in China. But he rejected this suggestion and posed a different challenge to me surprisingly by telling me to develop the product by yourself and market it from India. The reason was that he found my suggestion rather impracticable because Honeywell had most of its clientele exclusively in advanced countries and did not want to stake its business reputation by having collaboration with China because of the mediocrity and low technical quality of Chinese manufacturing. He was a great admirer of my articles and editorial ability of Technowell and therefore he suggested me to develop the product by myself. He relied on my ability to suggest alternative solutions in conducting of various programs by which he was himself benefitted because he got the appropriate solutions to his technical problems and being my superior, he assured me that he

will not create any obstacles in smooth conduct of my research and unofficially will protect me if any objection would be taken from the top management.

Honeywell USA had already established a R&D unit in Bangalore and Tata Honeywell Company which had a very meager business of 20 Million USD, was naturally not given any weightage for its proposal of making a new product in completion with the existing products of HVAC. Since Tata's, as well as Honeywell both companies showed neither eagerness nor interest in entering into competition against Siemens and Johnson controls, surprisingly the business unit head of my department sponsored the project.

The challenge which was now opened to me became a great turning point in my life. When I seriously decided to carry out this project I made introspective assessment of my strength and weakness both. My strength was my intense will power and my weakness was my lack of knowledge of embedded technology which is must for producing controllers like HVAC controllers which require combination of two or more technologies together. Fortunately I was in Pune Hadapsar unit of Tata Honeywell and University of Pune had started a six months course in embedded technology. My immediate boss gave me permission to join the course and I used to very regularly attend all the lectures and practicals from 7 AM to 2 PM on all working days and then used to resume my work in Tata Honeywell unit in Hadapsar from afternoon to 11 PM. In the year 2002 after finishing the course I devoted my fullest concentration on developing the desired HVAC controller. My immediate boss was very gracious enough to grant the necessary funding for the

expenses incurred in research and development of the same. By the end of 2002, my product was ready and we found that my product and solution could easily be produced within about Rs. 1,09,000/-.

Luckily as I was busy in producing this system, Larson and Tubro had given an assurance to purchase Rs. 1 Crore worth HVAC controllers for their huge complex in Madhapur a suburb of Hyderabad. That became a great booster to me and my team, to make the best product by tuning the modified software and finding out appropriate solutions to the complaints made by our patron client viz L & T. One complete year was required for stabilizing the sustaining quality of the product and by 2004, our product attracted a very large clientele consisting of Hyderabad Vidhan Bhavan, then Taj group of hotels, Appollo chain of hospitals, Tata Tea, ITC Grand Maratha and other ITC hotels, Tata Motors, TCS, Cipla, Wayeth and Venus Jewels etc.

Our first client L & T gave us a profit of net 36 Lakhs rupees instead of the loss of Rs. 12 Lakhs which we had anticipated because of the diffidence whether the product would be readily available on time. If my product would not have been ready my immediate boss was supposed to supply XL 50 controller system at the price lower than its market price.

After the successful completion of our first order from L & T; and as our unit earned a net profit of Rs. 36 Lakhs, within the first order itself, we could enter into a "price-war" against our very strong competitors viz Johnson Controls and Siemens. Both were charging around Rs. 4.3 to 4.5 Lakhs for the complete system including

installation and implementation of the HVAC system; but the actual cost of their products was approx 3.9 lakhs as their production was done in china. The third competitor in the market was U.S.A Based Honeywell which was forced to charge Rs. 5 lakhs because it's production cost was approx Rs. 4.5 to 4.7 lakhs as the production was done in Germany.

When we realized that our cost of the substitute XL 28 system installation of HVAC happen to be not more than Rs. 1.9 lakhs; we offered the price of our product lowest viz Rs. 4 lakhs when our competitors were charging around Rs. 30,000.00 to Rs. 50,000.00 more than us. Naturally the buyers gave us the top preference and within a year and half, we captured the market share of 55 %. As per the process of Game theory and prisoners dilemma, our competitors also reduced their prices to Rs. 3.5 lakhs, assuming that our unit would be crushed thinking, we would run into losses if we came down to their value (considering 10 % of margin of profit). In retaliation, our marketing executives who were given autonomous discretion to reduce the price upto Rs. 3 lakhs; (still with a profit margin of 50 % plus); started quoting at Rs. 3 lakhs. The competitors also reduced it to Rs. 3 lakhs, by taking a risk of bearing temporary losses in order to drive us out of the market.

Since we had a very comfortable margin of profit we further reduced our price to Rs.2.8 lakhs and continued to supply the systems to a large number of clients. Eventually, our market share remained more than 55%. This price war continued for about 2 years; but after facing considerable losses, both the competitors raised the price to its cost plus pricing level. Our unit took the

opportunity of raising our price almost equal to their price and thus restored our huge margin of profit. Our unit also got clients from software parks, governments, industrial buildings, residential complexes, health care industries, etc. And earned more than Rs. 300 crores. By today, Honeywell India Automation Ltd. Happens to be the market leader of HVAC systems.

I was one of the most crucially important person, who was instrumental for the business success of Honeywell Automation India Ltd; and the root cause of the success was my innovative and creative thinking of reducing the redundant and wasteful cost of production.

During 2000 to 2004, our Research and Development Team got sumptuous funding because of the growing profits of the company. With the help of my colleagues, I introduced nine hardware products (embedded controllers) and six software products of which "GAMES", (generic attendance monitoring and execution system) was the most successful software product like XL 28 embedded controller.

To mention a few of them which made roaring business success where

1. Repeater panel for fire alarm

2. MMI (man machine interface) for XL controller

3. GAMES – software program package sold to 70-80 companies

4. Energy meter – supplied to ML tower at Mahape, Navi Mumbai, various complexes in Delhi and Gurgaon, STPL (Government Software technology Park) at Hinjewadi, Pune, Government Software Technology Park in Andheri, Mumbai; which was the first biggest IT park of India.

   The tenants of these buildings are hundreds in number and their separate billing, as per their consumption of electricity was to be done by our program. In addition to their consumption, they were also supposed to be charged for the usage of common electricity facility in proportion to their consumption. Therefore large and small; AC buildings and non AC buildings, all these differences were sorted out and billing was made in fair and just manner. The tenants became happy, the owners saved their botheration and expenses to work out seperate billing. The energy meter and this software combination has brought amazing success to our unit. At present, there are more than 100 clients for this service.

5. Auto PID (proportional, integration, derivative, control) – This is an instrument which stabilizes the temperature and humidity which are essential in health care especially pharmaceutical, textile industry, tea industry, paint shops, tire cord industry as well as in 7 star hotels. We generated new markets by introduction of this product.

All these additional products have contributed to our companies earnings by more than Rs.10 crores ; within a couple of years only.

This case study therefore highlights the crucial role of the research and development and innovative efforts for reduction ofwasteful costs; which happens to be the backbone of sustainable success of a production unit in modern economy, in which free and intense competition has been approved during the era of economic reforms.

Before closing the study, Iwould like to categorically mention the areas where I applied the "cost reduction efforts".

1. In our modified and indigenized HVAC system, we completely eliminated heating functions; which take a huge toll on production costs and our reason was in India, except some parts of Jammu and Kashmir, Himachal Pradesh, Uttaranchal and Darjeeling temperature in winter also does not drop below 2 to 5 degree Celsius. Most of our clients have their industries and residential buildings and corporate houses etc. in the rest of India.

2. Honeywell controllers have wireless communication in addition to wired communication as it is mandatory to have both the communication supports in advanced countries; but in India, wireless is not dependable due to lack of tower signals and uneven

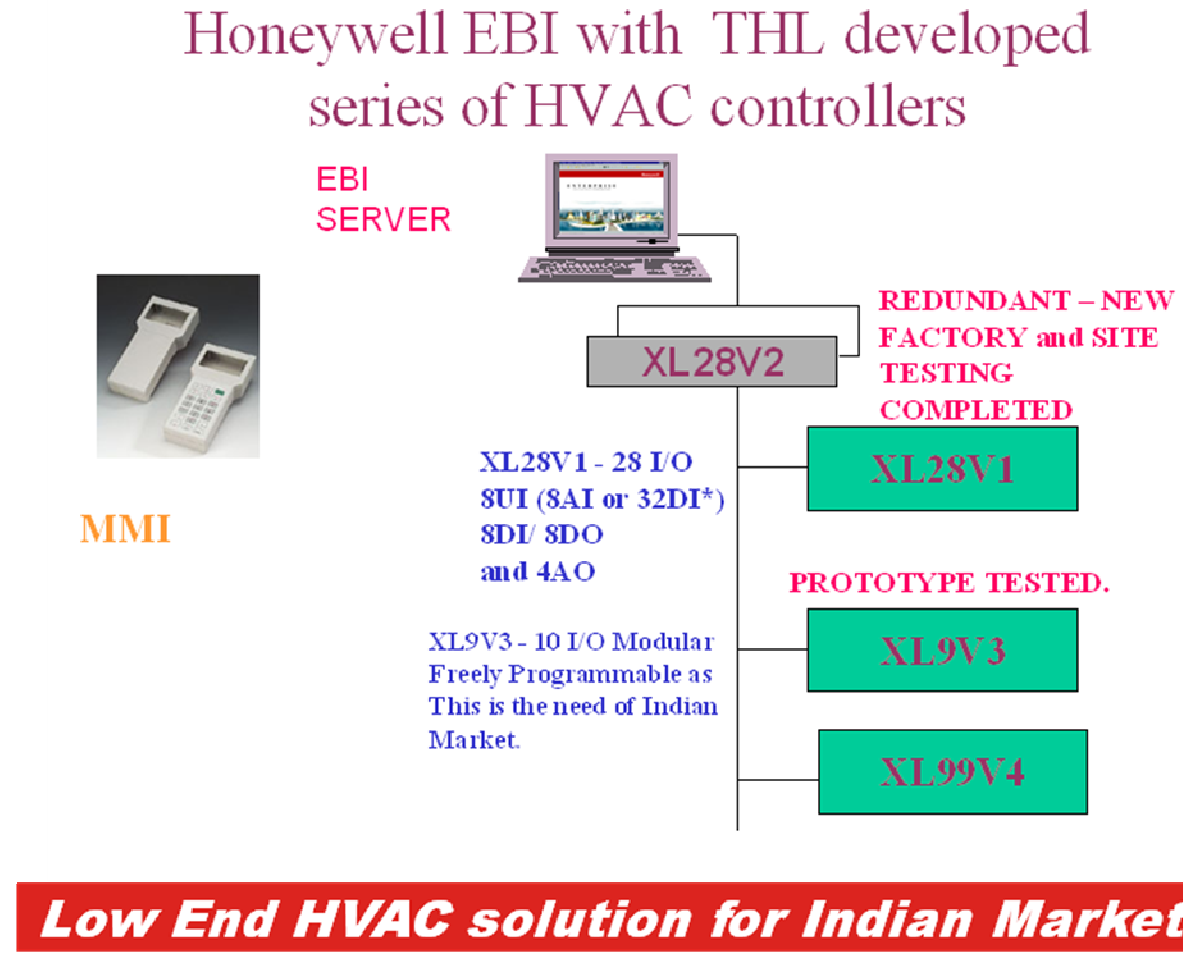
topography; and so instead of wireless, we relied on wired communication, which is "cable to cable" communication, being not only reliable but extremely economical, too.

3. Honeywell has used Texas instruments microcontroller for XL 50 and for XL 100, they have used "Intel's" microcontroller which are extremely powerful and expensive. I selected a small and inexpensive microcontroller wiz MSP 430 manufactured by "Motorolla" as it was adequate for my requirement. This reduced my production cost.

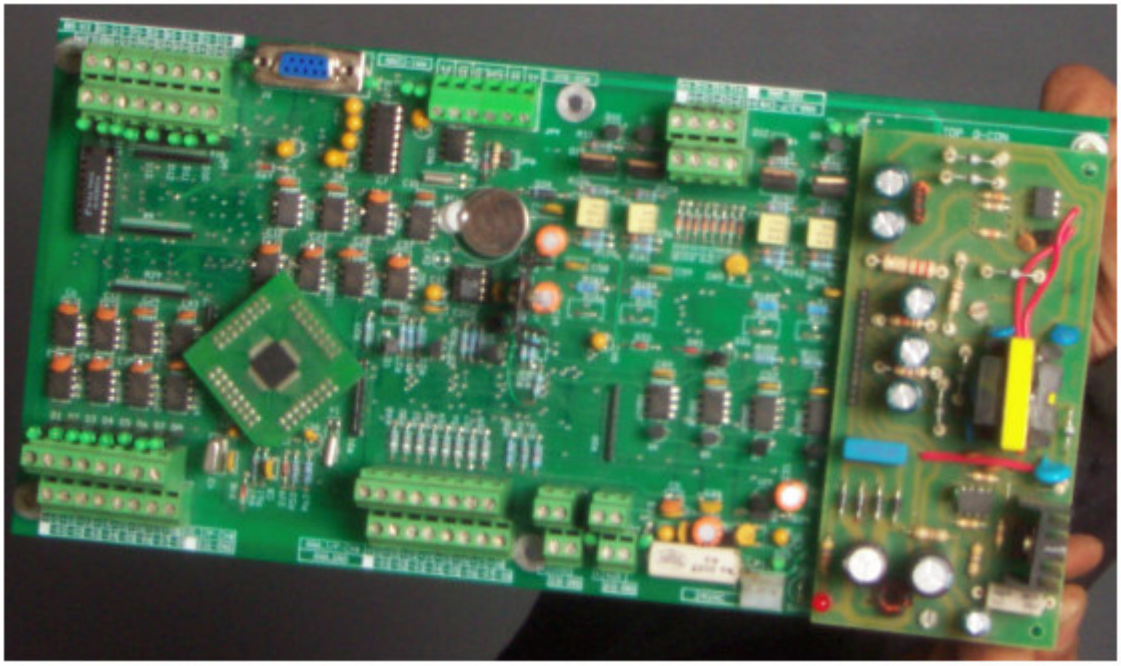
4. Instead of various communication protocols i.e. languages, which were a part of Honeywell controller, I preferred to keep only one language in the program wiz MODBUS. Due to the combined effect of these decisions, I could reduce the net production cost of our HVAC system to Rs. 1.9 lakhs, which was incomparably very low compared to the cost of our competitors which was Rs.3.9 lakhs, made in China. Our product cost made in Hadapsar, Pune-India was about half of that of our competitors.

This became the KEY to our success!

Typical System Architecture of XL 28 HVAC System.



XL 28 Controller without Enclosure.



Chapter No. 5

Chapter No. 5

Main Findings and the Conclusion

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A) Notable findings from Chapter 2 (Theoretical framework)

1) Adam Smith argued that competition would tend to establish the 'natural price' which is equal to the sum total of all costs plus marginal profit involved in the production of any commodity or service. Thus 'Cost of production'-according to Ricardo- happens to be a synonym for the 'value' or 'Price' of a commodity.

2) Marshall found this explanation as 'one sided' i.e. based on only supply side. According to Marshall, value of anything will be determined by the interaction of both sides of Supply and Demand.

3) 'Cost effectiveness analysis' has been recently developed in the theory of managerial economics.

4) According to Schumpeter, innovations reduce the existing levels of costs, increase the ['productivity and enhances quality of the products'.

5) The role of new technology is to go on reducing existing cost and raising productivity and quality.
6) By reduced (cost) price and improved quality, a company can expand its market share and profits. Thus profit is inversely related to Cost. Greater the cost, other things remaining constant, profits will decrease; by reducing the cost, other things remaining equal, profits will increase.

7) The profit is the reward for entrepreneur's innovative ability.

8) Innovations comprise 'new' product, 'new method' of production, exploring a 'new' market, introducing 'new' production process, new machine, new energy, new inputs and changes in production organization. Innovation is the mother of the technological advance. Research and Development department has become indispensable in the survival and success of firms for long run. Trying innovations after innovation is a continual managerial process.

9) Then tangency of Isoquant and Isocost gives guideline for a firm to produce optimum output within minimum cost and providing maximum, revenue/profit.

10) Modern Managers may not find it practically easier to follow the concepts of Marginal cost and opportunity cost in their business decisions but it is very essential that they have to become knowledgeable and well-versed in developing their

theoretical 'Cost consciousness' and output giving maximum profit within minimum cost.

11) In most difficult times of recession; the decisions and actions taken promptly for integrated cost reduction; are indispensable for the very survival of the firms.

12) Along with other goals of modern firms, managers of present times should give extraordinary consideration to profit Goal, share of the market goal and sales expansion Goal in order to maintain the competitive edge of their units and for achieving these three edge goals, cost cutting, productivity raising and quality improving are essential.

13) In recent years 'knowledge' has emerged as the main contributor to market leadership, business success and profit; because knowledge multiplies the existing productivity and can reduce existing level of production costs by multiple times, too.

B) Findings from Chapter 2 (Factual cases of cost-cutting done by Renowned global businesses)

1) Recently, new generations of Business Managers trained in Management Economics, have realized the importance of optimality. Sheer surplus above cost, creates a deceptive complacency. Marginal Analysis of the discipline of Management Economics proves that a firm can maximize its profit by equating marginal cost to its marginal revenue. Thus on one side, a firm should expand its sales and its market share and on the other hand, it should subsequently develop the vision of 'Minimizing the production and sales costs'.

   An Advertising firm could maximize its profit by $ 30, 000 by equating its MC of $4000 to its MR of $ 4000 by spending $4000 each for four TV spots. (Wall Street Journal 8 February, 1993) vide Case No. 1 of Chapter 2.

2) Since Economy of USSR was totalitarian, prices, costs and demand were 'administered' by the heavy hand of force, economy was not allowed to exercise free enterprise, private property, individual initiative and to face any competition from within and without, all the products and services became exorbitantly expensive, the quality of Automobiles, refrigerators, TV Sets, Consumer Durables and Consumer Essential goods were 'primitive' by world standards. In computers and machine tools, Soviet Union was a decade behind the U.S., Germany and Japan and its standard of living was less than third that of the

U.S. Therefore Soviet regime collapsed as a result of serious economic failures. The moral of this case study is that for achievement of 'World class efficiency', Technological Superiority and Product Quality; free economy made open to market forces of competition. In the interest of every individual enterprise, people endeavor to maximize their profit, by minimizing cost and maintaining the quality, too. Large number of the most efficient firms of the world belongs to free market economies. (Vide Case 2-Chapter 3)

3) In liberal globalized market of present times: "Survival for the fittest" is proved because of the worldwide popularity of American airplanes, Japanese cars, German steel and chemicals, Italian handbooks, French perfumes and champaign, Hungarian clothes and hats, Taiwanese calculators, Korean ships, Scotch Whisky, Swiss chocolates, Canadian Fish, Indian Tea and Brazilian Coffee. Because of the princliple of comparative cost advantage: 'internationalization' of both production and consumption have taken place. E.g., American IBM PC is not American, it is manufactured abroad and its more than 40 percent revenue is generated abroad. So is the case of Microsoft so is the case of Honda Cars manufactured in U.S. (Read IBM PC break up of total cost Case 3).

4) Among the Three Giant Automobile Companies of U.S., General Motors had the Top Position having maximum sales worth 123 billion dollars in 1991. But because it had employed more than 74000 workers, its sale per employee was only 162 dollars as against that of Ford being 265 dollars. It therefore became 'cost

conscious' and decided to increase efficiency and cost cutting by closing 21 plants and about three thousand of laborers. (See case No. 4)

5) Firms have to make systematic research of knowing consumer's preferences as advocated by Kelvin Lancaster. Ford used his advice in designing its 1986 Taurus Model and gained the status of 'Best Selling Car' in U.S. It lost its popularity due to competition of 'Honda Accord' in 1989. It therefore worked hard to redesign a new model of 1996 Taurus and regained its top position. Thus Market Study is equally important as 'cost cutting'. (See case no. 5)

6) Due to globalization, very rapid convergence of consumer tastes has taken place in one world today. Tastes in the U.S. affect the tastes in the rest of the world and converse is also true because Americans have developed tastes for Indian Vegetarian food recipes, Ayurvedic and herbal medicines and cosmetics, Yoga etc. Coca-cola, Jeans, Pizza, Burgers, Tea shirts and Reebok shoes etc. have become consumer essentials all over the world. Telecommunications, Movies, TV channels, Mobiles, Internet, Computer PCs, travel and tourism, transportation and global job openings have promoted convergence of tastes and common 'Life style' all over the world. (Case no. 6)

7) In dynamic and vibrant global economy; no country or MNC can retain its supremacy for long time, because of the constant threats of international competitive business efficiency. E.g. U.S. lost its leading position to Germany and Japan in steel and other

metals, it had to totally surrender its electronic industry to Japan during 1970s. At present, it has sustained its supreme position in 'Pharmaceutical Industry'; because of its enviable and un-matching strength for investing in Research and Development. (See case no. 7)

8) By 1990s, U.S. brought a grand revolution in production by introducing computer-aided-design and computer aided manufacturing by CAD & CAM techniques. It could reduce production costs and production time by amazing proportions. 'New Digital factory' which is responsible for a 'Quantum leap' in the spread, flexibility, cost reduction and productivity. E.g. Motorola company can now produce 'Customized paper' within minutes, as per the specifications given by the customer and delivers him the same on next day. 'Customized Manufacturing' has been adopted by all the leading corporations of the world. (Read case 8).

9) As long as 'Xerox', the pioneer enjoyed monopoly: never gave any thought to its productive efficiency. When it was challenged by the competition of Japanese firms which produced better and cheaper copiers; it went into collaboration with Fuji Xerox and made the latter, its subsidiary to obtain the 'cost advantage', within a short time, it regained its top position! Thus complacency is not desirable in Management; Modern Manager has to be constantly alert about intensive cost efficiency. (Case no. 9).

10) "Be American and buy American" slogan became very popular because of its sentimental appeal. In objective terms, a number of U.S. products and services, are being outsourced or being manufactured in U.S.; by its foreign subsidiary companies. (Case no. 10)

11) 'Radio cabs' have amazingly restrained the monopoly of Taxi License Owners of New York. As a natural reaction, people make an effort to find out a close or semi-close substitute to every monopoly, product and service. (Vide case no. 11)

12) No country remains the most advanced and prosperous forever and no country remains poor and backward for longer period of time. 19th century belongs to British Empire, 20th century first half belonged to America, 2nd half was shared by U.S., Japan & Germany, some Middle East and South East Asian countries. By 21st Century, China has emerged as threatening superpower in World Trade and manufacturing. It can be proved by American 'Score card'. (Vide Case no. 12)

13) Firms have to study the competing moves of their rivals.

South West Airlines of U.S. wanted to improve the turnaround of it's aircrafts and studied 'Indianapolis 500' for watching how pit crews fuel and service race cars in a matter of few seconds. The result was that it could cut it's turnaround time by multiple times.

Domino's Pizza takes an order, produces the pizza, delivers it and collects the money all in less than 30 minutes. By following that example, a gas service in U.S. greatly speeded it's delivery to customers and increased it's earnings and profits.

14) Walmart's pre-emptive expansion marketing strategy.

By 2009-10, fortune magazine chose Walmart as the most successful firm of the world on the basis of it's sales, profit, cost-cutting and worldwide network of more than 2500 discount stores.

The sole secret of Walmart's number 1 position is it's continuous effort of cost cutting and sharing it's profit by reducing the prices to it's customer's and thereby multiplying it's sales turnover, by providing 'lowest price' in the market. Walmart makes exhaustive market survey so as to preempt the opening of shops of competitior retailers's. Once Walmart opens in a town, no rival firm dares to open it's store because 'People trust that Walmart Price would be the lowest and quality of the products and services will be the best'. It shares it's costs of inventory, transport, finance, marketing or sales cost and also the labour, with it's customers.

15) Coca-Cola Vs. Pepsi War.

Because of very strong competition of Pepsi, In April 1985, Coca-Cola decided to change it's 99 years old recipe for coke and wanted to make new cola, sweeter and lighter; so as to reverse Pepsi's gain. It spent a fabulous amount of $ 4 million for developing a 'New Coke' and conducted taste tests on nearly 2 lakh consumers. When it was introduced in May, 1985, it unexpectedly faced a violent

consumer's revolt against the new coke and the new coke flopped in the market and company was compelled to bring back the 'old coke' to pacify it's consumers. Company named the same old coke as 'Coca-Cola classic' and it made a grand business. But the new coke also became as popular among children, ladies and older people, as Pepsi and brought a second source of earnings and retained it's first position in the market of soft drinks.

16) De Beers Diamond Monopoly.

When there is a recession and the demand for diamonds is low, De Beers withholds diamonds from the market in order to make the supply artificially limited and avoid further fall in price.

When in 1980s, Russia along with Zaire attempted to sell large quantities of industrial diamonds at lower prices; De Beers immediately flooded the market from its own stockpiles at cheaper prices and eliminated Russian competition.

De Beers has also taken initiative to constitute a cartel of its fellow diamond producers namely, 'Central selling organization' and virtually commands a monopoly share of 80 to 90%; just like 'OPEC' in case of petrol.

17. Dell' success in mail order business of PCs

Dell, a smaller company than IBM, Microsoft, Apple eliminated the middlemen, distribution channels etc. and charged lowest price to its buyers by mail-order delivery! Ordering a computer from Dell by mail is like asking for pizza of Domino-you know exactly what you will get! Due to this innovative idea, Dell could reduce its selling and administrative expenses upto only 14 cents for each

dollar of sales (i.e. 14%); whereas Apple spent 24 cent and IBM 30 cent!! So Dell could become World's 6th largest computer company in the U.S. Dell is also very efficient 'after sales service'! Dell technician reaches the customer's place within 5 minutes of calling!

18. A Case of 'Nash Equilibrium'

Giren Dell's dominant strategy, IBM, Apple, Zenith etc. companies also quickly followed the same method by just imitating it in 1994. Computer industry is in a condition of a 'Nash Equilibrium'; every company's share in the market has become almost constant but Dell- being the original pioneer- still retains almost 50% of the mail order business.

19. American Air Lines Fare War

During 1990 and 1991 domestic airlines in U.S. suffered from heavy losses due to 'hike in air fares'. In April 1992 American Airlines introduced simplified and concessional fare structure and could induce more passengers to use them and restricted the losses. But there was a unmindful war of 'price-cuts' which ultimately brought them huge losses. The moral of the case study is that lowering the price should have the 'floor limit' of the actual cost. Otherwise companies face bankruptcy.

20. Voluntary Export Restraints by Japan as a Savier of U.S. Automobile Companies

From 1977 to 1988, U.S. Automobiles production fell by 33 percent. The share of imported cars rose from 18% to 30% and nearly 3 lakh Automobile workers in the U.S. lost their jobs.

In 1980s, the Big Three (GM, Ford & Chrysler) suffered a combined losses of $4 billion.

As a result, U.S. negotiated an agreement with Japan, that Japan should voluntarily restrict its auto exports up to 1.6 million units per year during 1981 to 1985. Japan agreed to restrict as per negotiation, so as to avoid more stringent measures by the U.S.

In recent years, Japan has been producing an increasing number of automobiles in the U.S. in 'so called transplant factories' and saves money of American buyers (due to lower prices) and retains jobs to American Auto Workers!!

The competitive threat is a disguised boon to improve the 'cost efficiency' in post 1990s. American Car makers reduced the costs and prices too.

21. The need for 'Attach Strategy' in modern Competitive Business (Corporate Combat)

In both business as in warfare, strategy, tactics, spying are essential. Stealing a rival's technological innovation, or seducing the Key person in a successful rival unit by 'head hunting' , employing a top manager in charge of R & D of a rival firm etc. and conducting a futuristic planning for 6 to 10 years ahead are not only essential but beneficial also.

22. Price War of Market of International Calls in Europe (or mobile companies)

AT & T of U.S. and British Telecom have crept into European Markets with lower rates than those charged by National Government Telephone Monopolies. In 1994, European Commission decided to open the inter telephone market to global competition. As a result, government started privatizing their national telephone companies. Thus because of privatization and competition, telephone rates went on becoming cheaper. So is the case of rates per second charged by BSNL, Idea, Reliance, Airtel in India in recent years; have been reduced due to competition.

23. Why Companies fail?

Nearly 1 lakh business firms failed in the U.S. during 1992. More than half lakh businesses failed during 1989 when American Economy was buoyant and in top Gears!

The major causes can be identified as follows:

a) Failure to understand the core competency
b) Lack of prudence to understand and anticipate competitors 'surprise moves'
c) Lack of innovative technology
d) Lack of flexibility for conducting diversification of industries
e) Personal conceit and complacency
f) Overconfidence
g) Casual Attitude

h) New product lines in which company does not have adequate experience and expertise
i) Heavy indebtedness of a firm

The most classic example is Kodak which diversified into pharmaceuticals and consumer health products and failed!

American car makers went on producing big and luxury cars because of very attractive high margin of profit. But ultimately they failed because they lost the market of small and affordable cars in the short run and lost the market of luxury cars too!

IBM the Giant was unable to recognize the importance of the vast scope of PC market in the mid 1980s.

Moral: It is more difficult to keep a business in running condition than to build it!

24. Duopaly Situation

It is in the interest of duopolistic firms to have a formal or a tacit compromise and cooperation.

If the rival wants to cooperate, continue to cooperate with hime, as long as the status quo continues. Mr. Axelrod found it advisable, if the rival betrays you, next time you must be prepared to betray him; that will bring him once again on a wiser track!

25. Economies of 'Scope'

Economies of scope may arise when a company produces wide variety of products (multi products) with common production facilities, overheads, infrastructure and inputs. E.g. Cars and Trucks, sugar and hard liquors, passenger and cargo services of Travel companies etc.

26. Cost Minimization during one Lone Run

In the long run, the firm can produce more than proportionately by the small additions on capital and labour inputs.

27. How do firms get new technology?

The most important method of acquiring product and process innovations is by independent R & D by the firm. (Observation of a survey of 650 executives in 130 industries of the U.S.)

The next dependable method is 'licensing' or 'Reverse Engineering' i.e. devising different method of producing a similar product.

Third advisable method is of hiring employees of innovative firms.

The last method is to have dialogues, informal discussions with experts of innovating firms.

Findings from Chapter 4 (Primary Data)

1) Tata's accepted a challenge of producing World's cheapest and Best car by a targeted cost of $2500! It made use of Robotics for designing and production in order to reduce cost and maintain the quality. It avoided heavy and costlier materials, used alternate materials such as aluminum for Engine instead of cast iron; 624 cc engine instead of 800/1000 cc engine in order to obtain fuel efficiency, instead of water cooling, air cooling; made smaller size but more comfortable leg space by making it taller, minimum selling costs and assured 'excellent' after sales service! At the same time, it took judicious care of making suspension and the chasis as sturdy as any other Tata car. It got a special reward of 'International' Car of the year 2008-9! (See Case no. 1-Chapter 4)

2) By introducing 'electronic security system' equipped with smart cards, sensors, electronic readers, magnetic locks, 'Turn style rotating iron doors', automatic openings and shutting of doors, lifts etc. and 'guard less ushering and exit, in 'Venus Jewelers', Surat, the company could save crores of rupees on its manual security; yet could prevent pilferages and stealing to the extent of more than 94 percent; which alone saved more than billion rupees of the company at the cost of meager fees of Rs. 10 lakhs paid to Tata Honeywell Group! Thus Cost Benefit ratio became exceptionally very high (1:10,000)!! The Security became tighter and automatic. (Read Case no. 2-Chapter 4)

3) H.R. Department of TCS used to spend very heavily on maintaining attendance record, Leave Account, subsidized medical facilities, lunch and refreshment coupons to be delivered by employees to the factory's canteen; yet it used to make delays by its reliance on the manual operations of its secretarial staff. The number of employees of TCS Hyderabad being more than 70,000, it became a great headache and a problem to H. R. Wing of Management.

   Tata Honeywell reorganized the entire system by introducing smart cards in which e-cash of Rs. 1200/- per employee per month was inserted. The electronic reader used to verify the authenticity of the user. As a result, accounts of canteen, vending machines, library etc. could be settled on day to day basis. The company could save huge amounts incurred far secretarial/manual work and further could raise the perks and satisfaction quotient of its employees. (Read Case no. 3 - Chapter 4).

4) The automatic Security System and guard less ushering and exit of visitors in Bombay House- Tata's Headquarters could reduce enormous costs on manual security, waste of time involved in the same and stress caused because of intolerable boredom experienced by the visitors. The company not only saved all these costs but earned Satisfaction Quotient, Goodwill and Pleasure of its visitors. (Read Case no. 4/Chapter 4).

5) H.R. Department of 'ONGC' similarly got rid of the huge costs, delays, unmanageable secretarial work etc. by introducing the 'Use of smart cards'. It could improve its communications, detailing of duties, transporting, providing prompt medical facilities to employees and their families, settling their salary and leave accounts by computerized operations. (Read Case no. 5/Chapter 4)

6) The main component of costs of IT companies is the huge salary bill of their software personnel. The minimum average salary with perks of one employee, happens to be around Rs. 50,000/-. Companies like Wipro,m TCS, Infosys employ more than 70,000 employees. Thus their annual average expenses exceed than Rs. 4200 crores per annum.

It is very difficult to keep a vigilant watch over the actual time of work per employee during a day, the surplus and idle labor without assignment of specific work on every bench; the rate of errors per every hundred units of a job and thereby the 'quality of the working hour', around fifteen to twenty days per year of 'Complete Worklessness' because of holidays in the countries of the clients, such as X'mas in U.S. and Europe, Two Golden Weeks of Thanks giving in Japan and New year celebrations in China.

As a result, Indian companies like Wipro which is supposed to make billing of $7.25 billion; receives only $3 billion and face huge losses of about $4 billions because clients make payment on the basis of actual working hours an material quality per hour. There used to be complete chaos or lack of coordination and planning to

make the fullest utilization of the employees by maintaining proper 'Time Sheets' and records of the quality of work.

A package named 'Whizible' designed ad issued by compulink company of Pune sorted out all the problems of Wipro and could save billions of dollars of company's billing which otherwise used to be lost because of inefficient H.R. Management. (Read Case no. 6/Chapter 4)

7) Installation of PLC and DCS for improving and maintain the production quality of HPCL.

Before 1991, Public Sector Refineries used to depend on manual operations for maintain the quality, purity and consistency of every petroleum product. There used to be hand operated knobs which used to be operated by several men at the worksite. The cost of their labor used to be very huge but because of lack in precision in adjustment of knobs petrol used to be mixed up with diesel; or diesel with oil or tar. Mixed petrol used to choke up the carburetors of the cars and break down of cars was a very common and funny phenomenon in pre-reform years.

After economic reforms began, all the new cars like Maruti, Suzuki, Honda City, Hyundai, BMW, Toyota etc. badly require pure petrol or pure diesel.

Tata Honeywell introduced 'Distributed Control System' equipped with a number of programmable logic controllers and analog controllers, plus the sensors to measure and judge

various parameters of the purity; by which HPCL could produce pure petro products and attracted the clientele of car/truck owners. The new system required only Rs. 35 crores so as to assure the purity of Rs. 10,000 crore worth petro products. Thus HPCL got the cost benefit ratio of an amazing figure of 3: 1000! Honeywell U.S. has given this package to Aramco, Exxon, Cherron, Shell and other companies all over the world and helped them to save their labor costs as well as improve the quality of the products. (Read in details Case no. 7, Chapter 4)

8) Huge Cost Reduction done by Diagnostic Software to read and report about the Boiler Health produced by Ecoaxis.

On an average, after a breakdown of the boiler, a sugar factory faces a loss of Rs. 1 ½ crore per day, a power plant of 500MW suffers a loss of Rs. 20/-crores and oil refineries lose Rs. 105 crores per day. Thermax company Pune, is India's principal Boiler Manufacturer and it assures 'after sales service' to its clients. Ecoaxis produced a 'diagnostic software' to judge and report the 'Boiler Health'; by subsequently prescribing the preventive solutions and has helped a large number of clients of Thermax; so as to avoid break downs and consequent losses. It has helped them to save huge amounts of losses, delays required for repairing etc. (See Case No. 8, Chapter 4)

9) Energy Cost saving by automation in huge buildings like Taj Hotel, Gateway of India.

By making essential alterations in the glass window panes of the heritage building, using colored glasses from the inside to prevent heat of outside and help air conditioning with limited input of energy and separate automatic control of 'Switch on and Switch off' operated by 'movement detectors and embedded sensors'; the use of lights and Air conditioners was rationalized and controlled; only when the user or occupier of the room or corridor needed lights or Ac. Instead of hundreds of electric geysers, common boiler started supplying hot water in all the rooms of the hotel. Taj Hotel, after installation of this system, started saving around Rs. 1.5 crores per annum on its energy bill. (Read in details Case no. 9, Chapter 4)

10) Reduction in costs of unwanted material supplied by the dealers of Tata Honeywell Building controls division, ordered by the field staff because of the communication barrier and consequent errors. Case of application of 'Six Sigma Method' for minimizing errors and reduce the wasteful costs.

Due to the communication gap between field staff, suppliers of building materials and Head office, many a time huge quantities of materials used to be ordered directly to the approved dealers of Tata Honeywell Builds Division.

When the instruction of 'Center of Excellence Team;' were not followed by the field staff and COE Team used to make amends in the design of the building and give specific quantities of materials required for new amends; the old ordered material which used to be around 20 to 30% of the total project cost; could not be returned to the Dealers. Company used to suffer heavy losses due to sheer 'communication gap'. By application of Six Sigma method by the COE Team, the company could reduce its huge costs and losses. PCs of field staff, dealers, COE Team and e-mailing enabled every one concerned, to get the correction information and changes were also promptly communicated to them. (See the details in Case. No. 10, Chapter 4)

11) The success story of Tata Honeywell Product XL 28 which became the cheapest and topmost popular system for maintaining the temperature and moisture at the shop floors of Tea Industries, Textiles, Food industry, IT parks, 5 start hotels, Hospitals etc.

American Honeywell Company used to supply HVAC system by brand name of XL 100 at a rice of Rs. 5.5 lakhs. It used to sell XL 50 to retailing shops, small public buildings, libraries, offices etc. at a price of Rs. 4.8 lakhs. Johnson Controls, its competitor got manufactured in China at a lower cost and started selling it at Rs. 4 lakhs; being a perfect substitute to U.S. Honeywell product XL 100.

Tata Honeywell with the initiative of the author of this Ph.D. thesis, eliminated the Heating part because it is redundant in India,

and only focused on AC arrangement. Therefore it could produce it only within about Rs. 1 lakh only.

Due to the least cost advantage, it offered a competitive price of Rs. 4 lakhs; when its competitors further lowered a price to Rs. 3.5 lakhs; it offered a retaliatory price of Rs. 3 lakh and made fabulous business all over in India. (Read in details Tata Honeywell's detailed programming of its cost-every component wise!)

Main Conclusion

The theoretical findings of the Part I, empirical findings of the actual case studies of World's Leading Corporations and case studies of companies in and around Pune; all together prove the vital role of 'Cost reduction' in not only for the survival of Modern Businesses but also for securing Top position in the market; in the present intense competitive conditions of businesses which are radically changed during the Economic Reforms Era Commenced from 1991 onwards. They have highlighted the role of innovation in cost minimization. They have also justified its Life-saving role during hard periods of economic slowdowns and recessions.

Thus findings have proved that Cost-Cutting also helps firms to raise their productivity, to enhance the quality of the products and promote its sales in the market. Cost Cutting therefore indirectly is an exercise to improve the Managerial Efficiency. Cost-Consciousness helps to stimulate creative intelligence for thinking of n number of solutions to the problems; and it is a must for Managerial Vision and Performance. Cost Cutting helps to raise 'Qualitative Profits' rather than Quantitative profits which make Business Managers too complacent and unaware of the serious crises, if there are sudden cyclical downturns.

The hypothesis which reads as follows:

"The role of Cost Reduction and Quality enhancement techniques, has proven their importance for maintaining the competitive edge in the present globalized Business Environment in general and is vitally indispensable in the conditions of cyclical slowdowns and recessions, in particular".

The hypothesis has been proved in 'toto', word by word in its letter and spirit by all the findings of the Secondary and Primary Data.

Thus proved perfectly by the findings, it has earned the 'Status of an undisputedly acceptable, true and Valid Thesis!!

To sum up, the Success of a Modern Business Unit largely depends on its capability of finding ways and means of Cost Cutting, raising the productivity per unit of input and improving the 'one-upmanship' of quality!!!

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System Engineering - SIPOC

8 SUPPLIERS Providers of the required resources	6 INPUTS Resources required by the process	7 PROCESS Top level description of the activity	2 OUTPUTS Deliverables from the process	4 CUSTOMERS Anyone who receives a deliverable from the proc	3
OH / BU Head.	Manpower	Optimistic use of Skilled, Trained, Experienced	1. Panel GA and Wiring Drawings	Factory	Clear with all details like ferrules.
OH / BU Head, IT Dept.	Resources like PC, Printer	In Oprating condition, Licenced, Dongles			
MFO	Indent	Clear and Complete.		MFO	Error free for fast delivery on time
MFO	Soft Copies of Layout Drawings	Should be in Auto Cad		BU Head	Error free for Less Mahours spent by factory and also to be made using less time by CE
MFO	BOM	Should specify the exact Part / Model No.	2. Data Sheets	CMG	Complete Spec, Without Ambiguity
MFO	I/O Summary	All I/O's listed with characteristics.		MFO	Error Free (most sutable product), on time.
MFO	Shematic Sketches	With Phylosophy.		BU Head	Optimal solution (Cheapest best solution)
MFO	Control Logic	Detailed, Implementable w.r.t. Hardware supplied and I/O summary.			
MFO	Third party interface details	Protocol details with I/O address.	3. Cable Schedules	MFO	Complete, Error Free, On time.
				BU Head	To be done by less utilisation of Mahours
IT Department, OH, BU Head	Base Softwares like CARE, CAE, SDU, MS Office, Auto Cad, Visio	Licenced, All Version, Dongles, Support from Honeywell and IT dept.	4. GA and Installation Drawings.	MFO	FAS - To fulfil customer submission requirement. BAS - Complete, Error Free, On time.
				BU Head	To be done by less utilisation of Mahours
Internal	Document Control Register	To be religiously filled up by all users.	5. Layout Drawings	MFO	Complete, Error Free, On time.
				BU Head	To be done by less utilisation of Mahours and folllowing specified standards.
Company.	Power, Turn Arround of Manpower	UPS, Good Motivation methods.	6. CARE	MFO	Complete, Error Free, On time. As per approved logic write up.
				BU Head	To do the CARE by using standard methods, and To be done by less utilisation of Mahours
			7. CAE	MFO	Complete, Error Free, On time. As per approved logic write up.
				BU Head	To be done by less utilisation of Mahours
			8. SDU	MFO	Complete, Error Free, On time. As per approved logic write up.
				BU Head	To be done by less utilisation of Mahours
			9. Graphics.	MFO	Complete, Error Free, On time. As per approved schematics.
				BU Head	To be done by less utilisation of Mahours
			10. Third Party Protocol S/W Developed	MFO	Complete, Error Free, On time. As per approved schematics.
				BU Head	To be done by less utilisation of Mahours

9 **Indent from MFO.**

1 **System Engineering**

5 **Quality Checks.**

Process:

Cause and Effect Matrix for ENGINEERING

Inputs		Output	Customer Requirements																Total Value
			Error Free Deleverables		Asthetics		Consistancy with same customer at diff		Consistancy with diff. Customers		On Time Delevery		Easy of Accesibility of DE.		Reduction in cost.				
		Weight	9		5		5		3		9		3		7				
Process Step	Process Input																		
Information Exchange			90 / 10		0		50 / 10		30 / 10		63 / 7		0 / 0		49 / 7		0		282
Generate New Document			63 / 7		5 / 1		20 / 4		3 / 1		63 / 7		0		28 / 4		0		182
Document Approval			63 / 7		20 / 4		35 / 7		3 / 1		63 / 7		0		7 / 1		0		191
Field Ter. Detail			90 / 10		35 / 7		20 / 4		12 / 4		63 / 7		12 / 4		28 / 4		0		260
Care Application Logics			63 / 7		20 / 4		35 / 7		12 / 4		63 / 7		21 / 7		28 / 4		0		242
Care Simulation			90 / 10		0		35 / 7		0		36 / 4		0		28 / 4		0		189
Project Documentation			36 / 4		35 / 7		20 / 4		12 / 4		63 / 7		0		28 / 4		0		194
GA and Installation			63 / 7		35 / 7		50 / 10		21 / 7		63 / 7		12 / 4		70 / 10		0		314
Data Sheets			63 / 7		35 / 7		50 / 10		21 / 7		63 / 7		12 / 4		70 / 10		0		314
Panel GA and Wiring			90 / 10		35 / 7		35 / 7		21 / 7		63 / 7		12 / 4		49 / 7		0		305
Cabinet Marshalling			90 / 10		50 / 10		35 / 7		12 / 4		63 / 7		3 / 1		49 / 7		0		302
Graphics			90 / 10		50 / 10		35 / 7		21 / 7		63 / 7		12 / 4		49 / 7		0		320
Application S / W'			90 / 10		5 / 1		35 / 7		21 / 7		63 / 7		12 / 4		49 / 7		0		275
Cable Schedule			63 / 7		35 / 7		35 / 7		21 / 7		90 / 10		12 / 4		49 / 7		0		305
Layout Drawings			90 / 10		20 / 4		35 / 7		12 / 4		63 / 7		3 / 1		49 / 7		0		272
Third Party Interface			63 / 7		0 / 0		20 / 4		3 / 1		9 / 1		3 / 1		7 / 1		0		105
Design Engineer			36 / 4		5 / 1		35 / 7		12 / 4		9 / 1		0		28 / 4		0		125
Factory Workmanship			9 / 1		5 / 1		5 / 1		3 / 1		36 / 4		12 / 4		49 / 7		0		119
Comunication Media			0 / 0		0 / 0		0		0 / 0		63 / 7		21 / 7		0		0		84
Infrastructure			36 / 4		0 / 0		0		0 / 0		63 / 7		0		28 / 4		0		127
System Architecture			36 / 4		5 / 1		5 / 1		3 / 1		9 / 1		3 / 1		7 / 1		0		68
BOM			63 / 7		0		0		0		0		0		0		0		63
Purchase Requisition			36 / 4		0		0		0		0		0		28 / 4		0		64
Indent			0		0		20 / 4		0		63 / 7		0		0		0		83
I/O summary			63 / 7		5 / 1		35 / 7		21 / 7		63 / 7		0		28 / 4		0		215
Control Strategy			36 / 4		0		35 / 7		0		0		0		28 / 4		0		99
Total			1512		400		680		264		1260		150		833		0		

Process/Product
Failure Modes and Effects Analysis

Process or Product Name:	**SYSTEM ENGINEERING**	Prepared by:	NVK / SS / LF	Page ____ of ____
Responsible:	NVK / SS / LF	FMEA Date (orig) _26/06/01_____		(Rev) _____

Process Step/Input	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN	Actions Recommended	Resp.	Actions Taken	pSVE	pOCC	pDTE	pRNP
What is the process step/ Input under investigation?	In what ways does the process step go wrong?	What is the impact on the Key Output Variables (Customer Requirements) or internal requirements?	How Severe is the effect to the cusotmer?	What causes the process step to go wrong?	How often does cause or FM occur?	What are the existing controls and procedures (inspection and test) that prevent either the cause or the Failure Mode? **Should include an SOP number.**	How well can you detect cause or FM?		What are the actions for reducing the occurrance of the Cause, or improving detection? **Should have actions only on high RPN's or easy fixes.**	Whose Responsible for the recommended action?	What are the completed actions taken with the recalculated RPN? **Be sure to include completion month/year**				
Information Exchange	Wrong or incomplete information collected.	All documents and engineering will not be as per customers requirement and a lot of re-engineering will have to be done. Cost will increase to complete the	10	1. Knowledge of PE's.	4	Nil.	7	280							-
			10	2. Lack of communication with customer.	7	Nil.	7	490							-
Care Application Logics	1. Wrong Basic logic requirement.	1. Approval Not taken.	4	Worked on Non Approved Logic Document.	4	Nil.	4	64							-
GA and Installation	1. Submission of faulty documents.	Wrong Installation at site. Heavy cost implication.	7	1. GA and INS prepared from earlier project which had errors.	4	Installation Manual Available.	4	112							-
			7	2. Wrong Information available.	4	Installation Manual Available.	7	196							
Data Sheets	1. Submission of faulty documents.	Wrong Installation at site. Heavy cost implication.	10	1.Data Sheets prepared from earlier project which had errors.	4	QC Checks.	4	160							-
			10	2. Wrong Information available.	4	Nil.	7	280							
Panel GA and Wiring	Wrong inputs given, Improper dimentions & ferruling	Deviation from requirement, late delivery of cabinet due to rework	10	1. No Checks when FAT is not involved.	7	Nil.	7	490							-
			10	1. No Checks when FAT is involved.	4	FAT.	4	160							

Process/Product Failure Modes and Effects Analysis (FMEA)

Continued

Graphics	Wrong Graphics Designing	Defetive screens, Wrong Addressing, Non Systematic	7	Wrong Input given	7	Nil.	7	343							-
			7	Wrong Preparing Procedures	7	QA	7	343							
Application S / W'	1. Wrong Basic logic requirement. 2. Knowledge of DE of software	1. Non functional logic, 2. Device functioning not as per req.	4	Wrong Input given	4	Nil.	7	112							-
			4	Wrong Preparing Procedures	4	QA	4	64							
Cable Schedule	1.Wrong Cable Schedule Prepareation	1. Wrong Cabling At Site	7	Wrong Input Given	4	Nil.	7	196.00							-
			4	Wrong Preparing Procedures	4	QA	4	64							
Layout Drawings	1.Wrong Detector Placement in drawing 2. Wrong Cable Rooting path 3.Wrong DXF Drawing Preparation for Graphics (Accumulation of problem)	1.Wrong Detector Placement	7	Wrong Input Given	4	Nil.	7	196							
			4	Wrong Preparing Procedures	4	QA by Design Engineer	4	64							-
								0							-
								0							-

ACTION PLANS

Process or Product Name:	**SYSTEM ENGINEERING**	Prepared by:	NVK / SS / LF		Page __1__ of __1__ Rev 0
Responsible:	NVK / SS / LF				Date - 27.06.01

Process Step/Input	Potential Failure Mode	Potential Failure Effects	S E V	Potential Causes	O C C	Current Controls	D E T	R P N	Priority	Actions Recommended	Resp.	Actions Taken	p S V E	p O C C	p D T E	p R N P
What is the process step/ Input under investigation?	In what ways does the process step go wrong?	What is the impact on the Key Output Variables (Customer Requirements) or internal requirements?	**How Severe is the effect to the cusotmer?**	What causes the process step to go wrong?	**How often does cause or FM occur?**	What are the existing controls and procedures (inspection and test) that prevent either the cause or the Failure Mode? **Should include an SOP number.**	**How well can you detect cause or FM?**			What are the actions for reducing the occurrance of the Cause, or improving detection? **Should have actions only on high RPN's or easy fixes.**	Whose Responsible for the recommended action?	What are the completed actions taken with the recalculated RPN? **Be sure to include completion month/year**				
Information Exchange	Wrong or incomplete information collected.	All documents and engineering will not be as per customers requirement and a lot of re-engineering will have to be done. Cost will increase to complete the prject.	10	1. Knowledge of PE's.	4	Nil.	7	280	7	1. Specific Training. 2. Visit Region and explain in detail the Information Exchange list made.	Naren	Nil				-
			10	2. Lack of communication with customer.	7	Nil.	7	490	1	1. Make standard system specificInformation Exchange list. 2. This list should also include some description of what / why this is required.	Naren	50 % Complete.				-
Care Application Logics	1. Wrong Basic logic requirement. 2. Knowledge of DE of CARE.	1. Non functional logic, 2. Device functioning not as per req.	4	1. No QA / Simulation Done.	4	Nil.	4	64	14	QA Procedure / Simulation method / Check list to be prepared.	Sunil Sethi.	Nil				-
GA and Installation	1. Submission of faulty documents.	Wrong Installation at site. Heavy cost implication.	7	1. GA and INS prepared from earlier project which had errors.	7	Installation Manual Available.	7	343	4	1. Prepare standards and all new documents should be prepared from standards only. 2. QA Checks shold verify if the document is prepared from standards only.	Sunil Sethi.	BAS devices 90 % Completed.				-
			7	2. Wrong Information available.	4	Installation Manual Available.	7	196	9	1. Througly go tender specs / Bid given by THL.	Sunil Sethi.					
Data Sheets	1. Submission of faulty documents.	Wrong Installation at site. Heavy cost implication.	10	1.Data Sheets prepared from earlier project which had errors.	7	QC Checks.	7	490	2	1. Prepare standards and all new documents should be prepared from standards only. 2. QA Checks shold verify if the document is prepared from standards only.	Sunil Sethi.	BAS data Sheets 90 % Completed.				-

ACTION PLANS

Start of Improve Phase. - Continued from Earlier Page

			10	2. Wrong Information available.	4	Nil.	7	280	8	1. Througly go tender specs / Bid given by THL.	Sunil Sethi.						
Panel GA and Wiring	Wrong inputs given, Improper dimentions & ferruling	Deviation from requirement, late delivery of cabinet due to rework	10	1. No Checks when FAT is not involved.	7	Nil.	7	490	3	1. Internal FAT should be done always. 2. Prepare FAT Check List. 3.FAT check list to be filled up before dispatch.	Naren	1. Wiring Diagrams - XL 100 Completed , XL 10 Completed.					-
			10	1. No Checks when FAT is involved.	4	FAT.	4	160	12	1. Internal Pre FAT should be done always. 2. FAT check list to be filled up before customer FAT.	Naren						
Graphics	Wrong Graphics Designing	Defetive screens, Wrong Addressing, Non Systematic	7	Wrong Input given	7	Nil.	7	343	5	1. Make standard philosophy document and submit during KOM and get the same approved.	Leroy.	Philosophy Document 60 % completed.					-
			7	Wrong Preparing Procedures	7	QA	7	343	6	1. Prepare standards (by using templates) and sub picture library. 2. QC to check if the standards are followed always. QC check list to be prepared. 3. Make DO and DON'T's template.	Leroy.	Completed 60 %.					
Application S / W'	1. Wrong Basic logic requirement. 2. Knowledge of DE of software	1. Non functional logic, 2. Device functioning not as per req.	4	Wrong Input given	4	Nil.	7	112	13	1. Make standard philosophy document and submit during KOM and get the same approved.	Leroy.	Nil.					-
			4	Wrong Preparing Procedures	4	QA	4	64	15	1. Prepare standards (by using templates). 2. QC to check if the standards are followed always. QC check list to be	Leroy.						
Cable Schedule	1.Wrong Cable Schedule Prepareation	1. Wrong Cabling At Site	7	Wrong Input Given	4	Nil.	7	196	10	1. Througly go tender specs / Bid given by THL. 2. Check layout drawings once more before preparing cable schedule.	Naren						-
			4	Wrong Preparing Procedures	4	QA	4	64	16	1. Prepare standard template.	Naren	Nil.					
Layout Drawings	1.Wrong Detector Placement in drawing 2. Wrong Cable Rooting path 3.Wrong DXF Drawing Preparation for Graphics (Accumulation of problem)	1.Wrong Detector Placement	7	Wrong Input Given	4	Nil.	7	196	11	1. Througly go tender specs / Bid given by THL.	Leroy.						
			4	Wrong Preparing Procedures	4	QA by Design Engineer	4	64	17	1. Prepare standards and sub picture library in Aoto Cad. 2. QC to check if the standards are followed always. QC check list to be prepared.	Leroy.	Nil.					-
								0									-
								0									-