AN ANALYTICAL STUDY OF COST-BENEFIT ANALYSIS OF DELHI METRO

Thesis submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy
In
“Management”

By Mona Goel
Registration No: BU/Ph.D/Mgmt./Reg. No./C-228

Under the Guidance of
Dr. R.K. Sharma

© Copyright [2016, Mona Goel]

BHAGWANT UNIVERSITY
AJMER, RAJASTHAN, INDIA
BHAGWANT UNIVERSITY

AJMER, RAJASTHAN, INDIA

Declaration by the Candidate

I, Mona Goel declare that the thesis entitled An Analytical Study Of Cost-Benefit Analysis Of Delhi Metro’’ Submitted by me for the Degree of Doctor of Philosophy in Management is the record of work carried out by me under the guidance of Dr. R.K. Sharma and has not formed the basis for the award of any degree, diploma, associate-ship, fellowship, titles in this or any other University or other similar institutions of higher learning.

Date: [Name & Signature of the Candidate]
I, Dr. R.K. Sharma certify that the thesis entitled “An Analytical Study Of Cost-Benefit Analysis Of Delhi Metro” submitted for the Degree of Doctor of Philosophy in “Management” by Mona Goel is the record of research work carried out by her under my guidance and supervision and that this work has not formed the basis for the award of any degree, diploma, associate-ship, fellowship or other titles in this University or any other University or Institution of higher learning.

Date: [Name & Signature of the Supervisor]

Date of Thesis Defended/Approved:

Internal Examiner
Signature: Adjunct Examiner
Name & Address: Signature:
Name & Address:
AN ANALYTICAL STUDY OF COST-BENEFIT ANALYSIS OF DELHI METRO

© Copyright [2016, Mona Goel]
ACKNOWLEDGMENTS

I would like to extend my gratitude to Dr. R.K. Sharma (Professor Finance and Dean), under whose supervision, I undertook the project. He guided me in this whole exercise and supported me at every step to ensure that the objectives of this project study are achieved to the best possible extent despite his immensely busy schedule. He provided me the right platform, motivation, enthusiasm, attitude and confidence.

I am also grateful for the guidance of the management and Ph.D. faculty at Bhagwant University for the whole period of my Ph. D. Last but not the least I would like to thank all the employees of DELHI METRO who took part in the project and helped in making it a success.

(MONA GOEL)
TABLE OF CONTENTS

I) DECLARATION
II) CERTIFICATE
III) ACKNOWLEDGEMENTS
IV) EXECUTIVE SUMMARY
V) LIST OF TABLES
VI) LIST OF FIGURES

1. INTRODUCTION 1
   1.1 TRANSPORT IN INDIA 3
   1.2 ENVIRONMENTAL ISSUES AND IMPACT 3
   1.3 TRANSPORTS IN DELHI 4
      1.3.1 HISTORY
      1.3.2 OVERVIEW
      1.3.3 INTRA-CITY TRANSPORTS
      1.3.4 INTER STATE TRANSPORTS
   1.4 DELHI METRO 13
      1.4.1 NEED FOR MRTS
      1.4.2 DELHI METRO RAIL- THE LIFE LINE
      1.4.3 DELHI METRO
      1.4.4 GENESIS
      1.4.5 HISTORY
      1.4.6 DESIGNING THE METRO
      1.4.7 NETWORK
      1.4.8 PLANNED EXTENSION
      1.4.9 ADVANCED TRACK TECHNOLOGY
      1.4.10 ROLLING STOCK: ENSURING PASSENGER COMFORT, SAFETY AND RELIABILITY
1.4.11 MODERN TELECOMMUNICATION FACILITIES

1.5 THE STUDY

1.5.1 NEED OF PROPOSED RESEARCH WORK
1.5.2 OBJECTIVES OF THE STUDY
1.5.3 LIMITATIONS OF THE STUDY
1.5.4 COST BENEFIT ANALYSIS
1.5.5 COST VOLUME PROFIT ANALYSIS
1.5.6 FACTOR ANALYSIS

2. RESEARCH METHOLOGY

3. REVIEW OF LITERATURE

4. SWOT ANALYSIS OF DELHI METRO

5. COST VOLUME PROFIT ANALYSIS OF DELHI METRO

6. DATA ANALYSIS AND INTERPRETATION (FACTOR ANALYSIS)

7. ECONOMIC AND SOCIAL COST AND BENEFIT ANALYSIS

8. SUMMARY, CONCLUSION AND RECOMMENDATIONS

ANNEXURES
REFERENCES
ABBREVIATIONS
LIST OF PUBLICATIONS
EXECUTIVE SUMMARY

Delhi Metro would one day be ranked as the 2\textsuperscript{nd} best in the world beating the likes of Paris RATP, Barcelona TMB, Hong Kong MTR and more. Metro is still going from strength to strength. It has definitely revolutionized the way the city commutes. Delhi Metro is not just beautiful but it is designed for maximum comfort and convenience. Also, the technological features like amazing frequency, regular announcements, automated fare collection system, automatic doors and the likes were a world apart when they started. It wouldn’t be wrong to say that Delhi Metro “truly” meets International Standards.

It’s so good to see Delhi Metro playing its part in saving the environment. It has won many awards because of it being environmental friendly, including one from United Nations and an ISO 14001 Certification for environment friendly construction.

Delhi Metro as a commercial organization operates with the objective of maximizing the profit. The financial benefits from the Metro are the traffic earnings and revenues from real estate, consultancy and external projects.

The study focuses on the calculation of analyzing various modes of earning revenue of Delhi Metro. The focus is on finding out the Break-Even Point. Break-Even point is where there is no profit or no loss. Effort has been made to project the revenues for future years.

Another section of study focuses on analyzing the factors which are important for commuters for shifting from traditional modes of transportation to Delhi Metro. For this, a questionnaire was framed and administered to 650 commuters of Delhi Metro to know the factors important for them. To analyze the data collected through questionnaire, factor analysis was done using SPSS software to find the most important factors contributing to commuters’ preference for Delhi Metro. Various factors were extracted like travelling convenience, automated services, and many more.

The third section of the study focuses on Cost-Benefit Analysis of Delhi Metro. Metro is an eco-friendly mode of transport. It has reduced air pollution and congestion on roads, resulting in time saving and savings of cost for commuters. The study focuses on analyzing the various cost and benefits incurred corresponding to Delhi Metro.
LIST OF TABLES

1.1 DELHI METRO LINES IN OPERATION
1.2 ROUTES OF DELHI METRO
1.3 CALCULATION OF NET PRESENT VALUE
1.4 CALCULATION OF PROFITABILITY INDEX
1.5 EXAMPLE OF SELLING PRICE CHANGES
1.6 EXAMPLE OF CHANGES IN VARIABLE COST
1.7 EXAMPLE OF CHANGES IN FIXED COST
1.8 EXAMPLE OF P/V RATIO
1.9 P/V RATIO WITH INCREASED SALES

5.1 FARE SENSITIVITY OF RIDERSHIP ON THE METRO
5.2 FARE CHARGED
5.3 ANNUAL RIDERSHIP
5.4 OPERATIONS & MAINTENANCE COST
5.5 TOTAL REVENUE EARNED
5.6 FIXED COST INCURRED
5.7 CALCULATION OF PROFIT

6.1 RELIABILITY STATISTICS
6.2 AGE OF THE RESPONDENT
6.3 GENDER OF RESPONDENT
6.4 KMO & BARTLETT’S TEST
6.5 TOTAL VARIANCE EXPLAINED
6.6 COMMUNALITIES
6.7 COMPONENT MATRIX
6.8 ROTATED COMPONENT MATRIX
6.9 ANOVA BETWEEN AGE AND VARIOUS VARIABLES OF FACTORS OF PREFERENCE TOWARDS METRO
6.10 DESCRIPTIVE OF TRAVELLING CONVENIENCE FOR AGE
6.11 POST HOC TEST ON TRAVELLING CONVENIENCE FOR AGE
6.12 DESCRIPTIVE OF AUTOMATED SERVICES FOR AGE
6.13 POST HOC TEST ON AUTOMATED SERVICES FOR AGE TOWARDS PREFERENCE OF DELHI METRO

6.14 GROUP STATISTICS OF GENDER TOWARDS PREFERENCE OF METRO

6.15 T-TABLE OF GENDER AND VARIOUS FACTORS OF PREFERENCE TOWARDS METRO

7.1 REDUCTION IN VEHICLES DUE TO METRO (PHASE I & II)

7.2 VALUES OF PARAMETERS D, Sd, Sc AND T

7.3 TIME SAVINGS AND VALUE OF TIME FOR PASSENGERS

7.4 ANNUAL RUN AND FUEL CONSUMPTION NORMS

7.5 FUEL SAVINGS DUE TO DECONGESTION

7.6 EMISSION FACTORS OF VEHICLES AS PER EURO II NORMS (Kg/Km)

7.7 REDUCTION IN POLLUTION LOAD DUE TO DIVERTED TRAFFIC

7.8 COMPENSATION VALUES

7.9 CALCULATIONS OF NPV AND IRR
LIST OF FIGURES

1.1 TRANSPORTATION INPUTS AND OUTPUTS
1.2 NEED FOR MRTS: CHOKED DELHI ROADS
1.3 DELHI METRO
1.4 DELHI METRO RAIL NETWORK
1.5 AIRPORT EXPRESS
1.6 INSIDE VIEW OF DELHI METRO COACH
1.7 AUTOMATIC DOORS OF DELHI METRO COACH
1.8 EFFECTS OF CHANGES IN SELLING PRICES ON PROFITS
1.9 BREAK-EVEN CHART

5.1 PROJECTED ANNUAL RIDERSHIP OF DELHI METRO
5.2 SOURCE WISE BREAK UP OF REVENUE OF DELHI METRO
5.3 BREAK UP OF FIXED COST
5.4 BREAK EVEN POINT OF DELHI METRO

6.1 ESCALATORS AT DELHI METRO STATION
6.2 FEEDER BUS SERVICE PROVIDES LAST MILE CONNECTIVITY
6.3 ADEQUATE PARKING FACILITY AVAILABLE AT ALL METRO STATIONS
6.4 RESERVED SEATS FOR LADIES
6.5 SEPARATE COACHES FOR WOMEN
6.6 AUTOMATIC FARE COLLECTION SYSTEMS
6.7 DELHI METRO RUNS WITH INCREASED FREQUENCY DURING PEAK HOURS
6.8 NINE FACTORS EXTRACTED FROM FACTOR ANALYSIS

7.1 VEHICLE-WISE REDUCTION DUE TO DELHI METRO IN 2010-2011
7.2 SOCIAL BENEFITS DUE TO DELHI METRO