

# **IMPACT OF LOGISTICS MANAGEMENT ON THE COMPETITIVENESS OF INDIAN ORGANIZATIONS**

**Ph.D. Thesis**

Submitted in fulfilment of the requirements for the degree of

**DOCTOR OF PHILOSOPHY**

By

**AMRITA JHAWAR**

2K10/PHD/DSM/08



**DELHI SCHOOL OF MANAGEMENT  
DELHI TECHNOLOGICAL UNIVERSITY**

**MAY 2017**

## DECLARATION

I hereby declare that the work reported in the Ph.D. thesis entitled “**Impact of Logistics Management on the Competitiveness of Indian Organizations**” submitted to Delhi School of Management, Delhi Technological University is an authentic record of my work carried out under the supervision of **Prof. S.K.Garg and Dr. Shikha. N. Khera**. I have not submitted this work elsewhere for any other degree or diploma. I am fully responsible for the contents of my Ph.D. Thesis.

**Amrita Jhavar**

2K10/PHD/DSM/08

Research Scholar

Delhi School of Management

Delhi Technological University

## **CERTIFICATE**

This is to certify the thesis entitled “**Impact of Logistics Management on the Competitiveness of Indian Organizations**” being submitted by **Amrita Jhavar** to the Delhi School of Management, Delhi Technological University for the award of the degree of **Doctor of Philosophy** is a bonafide record of original research work carried out by her. She has worked under our guidance and supervision and has fulfilled the requirement for submission of this thesis, which has reached requisite standard.

The results contained in this thesis have not been submitted, in part or full, to any other University or Institute for the award of any degree or diploma.

Prof. S. K. Garg  
Pro Vice Chancellor &  
Professor  
Delhi Technological University

Dr. Shikha.N. Khera  
Assistant Professor  
Delhi School of Management  
Delhi Technological University

*Dedicated to.....*

*my childhood dream*

## **ACKNOWLEDGEMENT**

Completion of this doctoral dissertation was possible with the support of several people. I would like to express my sincere gratitude to all of them.

First of all, I am extremely grateful to my research guide, Prof. S. K. Garg, Pro Vice Chancellor and Professor, Department of Mechanical Engineering, for his valuable guidance, scholarly inputs and consistent encouragement I received throughout the research work. This feat was possible only because of the unconditional support provided by Sir. A person with an amicable and positive disposition, Sir has always made himself available to clarify my doubts despite his busy schedule and I consider myself blessed to do my doctoral programme under his guidance and to learn from his research expertise. Thank you Sir, for all your help and support. No words can define my gratitude for you.

I am also very thankful to my co-guide, Dr. Shikha. N. Khara, Assistant Professor, Delhi School of Management, who has been very encouraging and supportive, and I express my gratitude to her.

I am thankful to Prof. P.K.Suri, DRC Chairman, Dr. Rajan Yadav, Head, Delhi School of Management and the whole staff of Delhi School of Management for their support extended during my research work.

I owe a lot to my parents, who encouraged and helped me at every stage of my personal and academic life, and longed to see this achievement come true. Despite being from a traditional Marwari family, I was always encouraged to study and follow my dreams.

My husband Ankur, words fail me to express my appreciation for your support, love, care, motivation and sleepless nights in completing and contributing to my work. It was your unconditional support, enthusiasm and encouragement, that made me complete my work.

I am thankful to my in-laws, my family and friends who have motivated me to complete my research work. I am also thankful to all my research scholar friends for their motivation and support.

Last but not the least, I am thankful to God for being by my side always and blessing me with Atharva, my son, who was so understanding even at such a young age; his smile was my strength.

Amrita Jhawar

## **ABSTRACT**

Wars have been won or lost on the strength of logistics capability or lack of it. Triggering intense competition, globalization coupled with liberalization, forced both private and public firms to commit themselves to making available their product or service at the right cost, at the right time, in the right condition and in the right place to give maximum satisfaction to their customers.

This research investigates the current logistics scenario in India and compares it with other developed economies. The objective of this research is to identify the investment amount and strategies for improving the logistics performance of Indian organizations. For achieving this objective extensive literature review was carried out and improvement in human resources, IT enabled logistics system, improvement in government regulation and development of infrastructure has been chosen as the four areas which require investment.

Cost, time, reliability, flexibility and safety are chosen as the five competitiveness factors, which influence the logistics performance. These have been considered as the five components of the logistics performance index, which is considered as the main component of this study. Effect of investment on logistics performance index is the basis of the study.

System dynamics modelling has been applied to generate various scenarios in simulated environment to formulate and test various investment plans and policies. The system dynamics methodology has been explained in detail and the models developed are validated and sensitivity analysis has been performed on them. The models are found to be stable. Scenario generation was carried out to formulate policies and to understand the model behaviour under different conditions. Interpretive Structural Modelling is applied to sixteen critical success factors chosen for logistics improvement. These factors are categorised into different categories using MICMAC analysis. This will help to understand the interdependencies among all the variables and also to identify the key performance variables.

The study has major contribution to the research area as the models developed are very generic in nature and can be used by any government and organization for identifying the effects of investment on logistics performance. Also, the time frame required for the effects of improvement can also be simulated under various scenarios. Contributions of the study, limitations and scope for future work are also discussed.

## TABLE OF CONTENTS

Declaration	I	
Certificate	Ii	
Acknowledgement	Iv	
Abstract	Vi	
List of Figures	Xii	
List of Tables	Xv	
List of Abbreviations	Xviii	
<b>Chapter 1: Introduction</b>		
1.1	Logistics Management	1
1.2	Logistics and Competitiveness	3
1.3	Indian Logistics Industry	4
1.4	Need for Research	7
1.5	Research Objectives	7
1.6	Scope of Study	8
1.7	Research Plan	8
1.8	Organization of Thesis	8
1.9	Conclusion	11
<b>Chapter 2: Literature Review</b>		
2.1	Introduction	13
2.2	Logistics Management	14
2.2.1	Logistics Issues in India	14
2.2.2	Global Logistics Industry	15
2.2.3	Interrelationship of Logistics and Economy	16
2.2.4	Impact of Logistics on Competitiveness	18
2.2.5	Logistics Performance Measurement	19
2.3	Research technique	20
2.3.1	Empirical Studies	20
2.3.2	Simulation Studies	22
2.3.3	Modelling Studies	22
2.3.4	System Dynamics	24
2.3.5	Interpretive Structural Modelling	26

2.4	Gaps in Literature Review	27
2.5	Conclusion	28
	<b>Chapter 3: Research Methodology</b>	
3.1	Introduction	29
3.2	Research Strategy	29
3.3	System Dynamics	31
	3.3.1 Causal Loop Diagram	32
	3.3.2 Stock and Flow Diagram	33
	3.3.3 Equations	34
3.4	Logistics Performance Index	34
	3.4.1 Reduction in Cost	36
	3.4.2 Reduction in Time	36
	3.4.3 Improvement in Reliability	36
	3.4.4 Improvement in Flexibility	36
	3.4.5 Improvement in Safety	36
3.5	Case Study	37
3.6	Data Collection for System Dynamics	37
3.7	Data Required for Simulation	38
	3.7.1 Existing and Target Values of Performance Measures	38
	3.7.2 Improvement in Performance Measures in the Next Interval	38
	3.7.3 Improvement in LPI	39
3.8	Interpretive Structural Modelling	40
	3.8.1 Steps in ISM Modelling	40
	3.8.2 MICMAC Analysis	42
3.9	Conclusion	43
	<b>Chapter 4: Logistics Improvement by Investment in Human Resources</b>	
4.1	Introduction	44
4.2	Role of Human Resources in Logistics	46
4.3	Identification of Areas of Investment	46
4.4	Research Methodology	49

4.4.1	Chapter Aims	49
4.4.2	Model Assumptions	49
4.4.3	Investment Plans	50
4.4.4	Research Framework	51
4.5	Causal Loop Diagram	52
4.6	Stock and Flow Diagram	54
4.6.1	Data Required for Simulation	55
4.6.2	Improvement in Performance Measure for Every One Lakh Investment	55
4.7	Model Validation	56
4.8	Result and Discussion	58
4.8.1	Quarter Wise Investment in Semi Focus Plan	58
4.8.2	Quarter Wise Investment in Indirect Focus Plan	60
4.8.3	Year Wise Improvement in PA4-QAP4	62
4.9	Sensitivity Analysis	64
4.10	Scenario Generation	65
4.11	Conclusion	69
4.12	Managerial Implications	71
	<b>Chapter 5: Logistics Improvement by Investment in Information Technology</b>	
5.1	Introduction	72
5.2	Identification of Technologies for Investment	73
5.3	Research Methodology	77
5.3.1	Chapter Aims	77
5.3.2	Model Assumptions	78
5.3.3	Investment Plans	78
5.3.4	Research Framework	79
5.4	Causal Loop Diagram	80
5.4.1	RFID	80
5.4.2	EDI	81
5.4.3	GPS/GIS	81
5.4.4	ERP	82

5.5	Stock and Flow Diagram	83
5.5.1	Data Required for Simulation	83
5.5.2	Existing and Target Values of Logistics Processes	84
5.5.3	Improvement in Performance Measure for Every One Lakh Investment	84
5.5.4	Improvement in Performance Measures	84
5.6	Model Validation	86
5.7	Result and Discussion	87
5.7.1	Quarter Wise Investment in Semi Focus Plan	88
5.7.2	Quarter Wise Investment in Indirect Focus Plan	90
5.7.3	Year Wise Improvement in PA4-QAP4	92
5.8	Sensitivity Analysis	93
5.9	Scenario Generation	95
5.10	Conclusion	99
5.11	Managerial Implications	100
<b>Chapter 6: Logistics Improvement By Simplifying Government Regulations And Investment In Infrastructure</b>		
6.1	Introduction	101
6.2	Causal Loop Diagram	104
6.2.1	Development of Infrastructure	105
6.2.2	Improvement in Government Regulations	107
6.3	Stock and Flow Diagram	108
6.4	Conclusion	110
<b>Chapter 7: ISM of Critical Factors For Improvement In Logistics Performance</b>		
7.1	Introduction	111
7.2	Identification of Critical Success factors	112
7.3	Data Collection for ISM	114
7.4	Application of Proposed Methodology	114
7.4.1	SSIM	114
7.4.2	Reachability Matrix	116
7.4.3	Level Partitions	117

7.5	Formation of Digraph	121
7.6	MICMAC Analysis	121
7.7	Result and Discussion	122
7.8	Conclusion	124
	<b>Chapter 8: Summary and Conclusions</b>	
8.1	Introduction	126
8.2	Contribution of Study	126
8.3	Limitation of Study and Scope for Future Work	127
8.4	Concluding Remarks	127
	<b>References</b>	130
	<b>Appendix A</b>	155
	<b>Appendix B</b>	159
	<b>Publications from Research Work</b>	163

## LIST OF FIGURES

<b>Figure No.</b>	<b>Title</b>	<b>Page No.</b>
Figure 1.1	India's GDP Growth Rate	2
Figure 1.2	Logistics and Competitiveness	3
Figure 1.3	Total Freight Transport Modal Mix	5
Figure 1.4	Break-up of Logistics Cost in India	6
Figure 1.5	Status of Indian Logistics Industry	6
Figure 1.6	Chapter Framework	10
Figure 2.1	Literature Review	13
Figure 3.1	Research Strategy	30
Figure 3.2	Causal Loop Diagram for Population Model	32
Figure 3.3	Stock and Flow Diagram for Population Model	34
Figure 3.4	Flow Chart for Developing ISM	42
Figure 4.1	Research Framework	52
Figure 4.2	Causal Loop Diagram for Investment in HR and its Effect on LPI	53
Figure 4.3	Stock and Flow Diagram for Investment in HR	57
Figure 4.4	Results for LPI for Alternative Investment Plans in Activities	58
Figure 4.5	Results for LPI for Quarter Wise Investment in PA3	59
Figure 4.6	Results for Performance Measures for Quarter Wise Investment in PA3-QAP4	60
Figure 4.7	Results for LPI and Profit Improvement for Quarter Wise Investment in PA3-QAP4	60
Figure 4.8	Results for LPI for Quarter Wise Investment in PA4	61
Figure 4.9	Results for Performance Measures for Quarter Wise Investment in PA4-QAP4	62
Figure 4.10	Results for LPI and Profit Improvement for Quarter Wise Investment in PA4-QAP4	62
Figure 4.11	Results for Performance Measures for Year Wise Investment in PA4-QAP4	63
Figure 4.12	Results for LPI and Profit Improvement for Year Wise Investment in PA4-QAP4	63
Figure 4.13	Input Window for Sensitivity Analysis in Stella Software	64

Figure 4.14	Results for Performance Measures for Sensitivity Analysis	64
Figure 4.15	Results for LPI and Profit Improvement for Sensitivity Analysis	65
Figure 4.16	Improvement in Profit in PA3-QAP4	69
Figure 4.17	Improvement in Profit in PA4-QAP4	69
Figure 5.1	Investment in IT by Indian Logistics Players in 2009	73
Figure 5.2	Research Framework	80
Figure 5.3	Causal Loop Diagram for Investment in IT and its Effect on LPI	82
Figure 5.4	Stock and Flow Diagram for Investment in IT	85
Figure 5.5	Results for LPI for Alternative Investment Plans in Activities	87
Figure 5.6	Results for LPI for Quarter Wise Investment in PA3	88
Figure 5.7	Results for Performance Measures for Quarter Wise Investment in PA3-QAP4	89
Figure 5.8	Results for LPI and Profit Improvement for Quarter Wise Investment in PA3-QAP4	89
Figure 5.9	Results for LPI for Quarter Wise Investment in PA4	90
Figure 5.10	Results for Performance Measures for Quarter Wise Investment in PA4-QAP4	91
Figure 5.11	Results for LPI and Profit Improvement for Quarter Wise Investment in PA4-QAP4	91
Figure 5.12	Results for Performance Measures for Year Wise Investment in PA4-QAP4	92
Figure 5.13	Results for LPI and Profit Improvement for Year Wise Investment in PA4-QAP4	93
Figure 5.14	Input Window for Sensitivity Analysis in Stella Software	93
Figure 5.15	Results for Performance Measures for Sensitivity Analysis	94
Figure 5.16	Results for LPI and Profit Improvement for Sensitivity Analysis	94
Figure 5.17	Improvement in Profit in PA3-QAP4	98
Figure 5.18	Improvement in Profit in PA4-QAP4	98
Figure 6.1	Causal Loop Diagram for Investment by Government and its Effect on LPI	106
Figure 6.2	Stock and Flow Diagram for Investment by Government for	109

Development of Infrastructure and Simplifying Government Regulations

Figure 7.1	Driving Power and Dependence Diagram	121
Figure 7.2	ISM Framework for Improvement in Logistics Performance	123
Figure 8.1	Integrated Causal Loop Diagram for Investment by Government and LSP	129

## LIST OF TABLES

<b>Table No.</b>	<b>Title</b>	<b>Page No.</b>
Table 1.1	Challenges in the Indian Logistics Industry	4
Table 2.1	Logistics Issues in India	14
Table 2.2	Global Logistics Industry	16
Table 2.3	Interrelationship of Logistics and Economy	17
Table 2.4	Studies Conducted on Logistics and Competitiveness	18
Table 2.5	Studies Conducted on Logistics Performance Measurement	20
Table 2.6	Empirical Studies Conducted in Logistics Context	21
Table 2.7	Simulation Studies Conducted on Logistics Management	23
Table 2.8	Modelling Studies	24
Table 2.9	Studies Conducted on System Dynamics	25
Table 2.10	Studies Conducted on ISM	26
Table 3.1	Description of Important System Dynamics Components	33
Table 3.2	India's LPI Score	35
Table 3.3	Existing and Target Values of Performance Measures	38
Table 3.4	Improvement and Contribution in LPI by Each Performance Measure	40
Table 3.5	Development of SSIM	40
Table 3.6	Development of Initial Reachability Matrix	41
Table 3.7	Categorization of Variables	43
Table 4.1	Benefits of HRM Practices in Logistics	47
Table 4.2	Investment in Training, Welfare, Wages and Working Conditions	48
Table 4.3	Investment Plans for Different Activities	50
Table 4.4	QAP as Percentage of Activity	51
Table 4.5	Distribution of Human Resources by Education Level	52
Table 4.6	Level-Wise Distribution of Human Resources in the Road Transportation and Warehousing Segment	53
Table 4.7	Percentage Change in Performance Measure by Per Lakh Investment in Activity	56
Table 4.8	Model Validation Results	56

Table 4.9	Results for Performance Measures with Quarter Wise Investment in PA3	59
Table 4.10	Results for Performance Measures with Quarter Wise Investment in PA4	61
Table 4.11	Year wise Improvement in Performance Measures	63
Table 4.12	Scenario Generation	66
Table 4.13	Highly Pessimistic Scenario Result	67
Table 4.14	Pessimistic Scenario Result	67
Table 4.15	Optimistic Scenario Result	68
Table 4.16	Highly Optimistic Scenario Result	68
Table 5.1	Role of IT in Logistics Management	72
Table 5.2	Various Technologies Used in Logistics Management	74
Table 5.3	Technologies Identified	74
Table 5.4	Investment Plans for Different Activities	78
Table 5.5	QAP as Percentage of Activity	79
Table 5.6	Existing and Target Levels of Processes Achieved from IT Adoption	84
Table 5.7	Percentage Improvement in Processes by Investing (Rs in Lakh) in Technologies	86
Table 5.8	Percentage Change in Performance Measure by Percentage Improvement in Processes	86
Table 5.9	Validation Results	87
Table 5.10	Results for Performance Measures with Quarter Wise Investment in PA3	88
Table 5.11	Results for Performance Measures with Quarter Wise Investment in PA4	90
Table 5.12	Year Wise Improvement in Performance Measures	92
Table 5.13	Scenario Generation	95
Table 5.14	Highly Pessimistic Scenario Result	96
Table 5.15	Pessimistic Scenario Result	97
Table 5.16	Optimistic Scenario Result	97
Table 5.17	Highly Optimistic Scenario Result	97
Table 6.1	Initiatives Taken by Different Countries for Logistics Improvement	102

Table 6.2	Growth in GDP/ Freight/Vehicle/Road during 1950-51 to 2011-12	104
Table 7.1	Critical Success Factors	112
Table 7.2	Structural Self- Interaction Matrix	115
Table 7.3	Initial Reachability Matrix	116
Table 7.4	Final Reachability Matrix	117
Table 7.5	Iteration I	118
Table 7.6	Iteration II	118
Table 7.7	Iteration III	119
Table 7.8	Iteration IV	119
Table 7.9	Iteration V	120
Table 7.10	Iteration VI	120
Table 7.11	Level Partitions	120

## LIST OF ABBREVIATIONS

3PL	Third Party Logistics
4PL	Fourth Party Logistics
AHP	Analytical Hierarchy Process
ANP	Analytical Network Process
BTKM	Billion Tonne Kilometres
CAGR	Compound Annual Growth Rate
CILT	Chartered Institute of Logistics And Transport
CPFR	Collaborative Planning Forecasting And Replenishment
CRM	Customer Relationship Management
CS	Customer Satisfaction
DEA	Data Envelopment Analysis
DPI	Distributor Performance Index
DSS	Decision Support Systems
DT	Delta Time
EDI	Electronic Data Interchange
ELR	Empty Load Ratio
ERP	Enterprise Resource Planning
FAHP	Fuzzy Analytic Hierarchy Process
FDMATEL	Fuzzy Decision Making Trial, Evaluation Laboratory
FMS	Fleet Management System
FSC	Flexible Supply Chain
FTOPSIS	Fuzzy Techniques To Order Preferences By Similarity To Ideal Solution
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System

GSCM	Green Supply Chain Management
HR	Human Resources
HRM	Human Resource Management
ICT	Information And Communications Technology
ILS	Integrated Logistics Services
IM	Intermodal
IMS	Inventory Management Software
ISM	Interpretive Structural Modelling
IT	Information Technology
KM	Kilometres
LLP	Lead Logistics Provider
LPI	Logistics Performance Index
LSC	Logistics And Supply Chain
LSCM	Logistics And Supply Chain Management
LSP	Logistics Service Provider
MCDM	Multi Criteria Decision-Making
MICMAC	Cross-Impact Matrix Multiplication Applied To Classification
MRP	Material Resource Planning
PCT	Pairwise Comparison Technique
PMS	Performance Measurement System
PPP	Public Private Partnership
PV	Present Value
QAP	Quarter Wise Fund Allocation Plan
QFD	Quality Function Deployment
RBV	Resource Based View
RCA	Root Cause Analysis

RFID	Radio Frequency Identification
ROI	Return on Investment
SAARC	South Asian Association for Regional Cooperation
SAP-LAP	Situation Actor Process – Learning Action Performance
SC	Supply Chain
SCEM	Supply Chain Event Management
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference
SCP	Supply Chain Performance
SCRM	Supply Chain Risk Management
SD	System Dynamics
SEM	Structural Equation Modelling
SME	Small And Medium-Sized Enterprises
SS	Scheduling System
SSIM	Structural Self- Interaction Matrix
TMS	Transport Management System
TOPSIS	Technique For Order Preference By Similarity To Ideal Solution
TRANSIT	Transport Network Strategic Investment Tool
TV	Target Value
UK	United Kingdom
USA	United States of America
USD	U.S Dollars
WMS	Warehouse Management System