

IMPROVING THE EVALUATION OF TRANSPORT INFRASTRUCTURE PROJECTS

Isuru Madhushan Gamalath

(138027F)



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
Degree of Master of Science
www.lib.mrt.ac.lk

Department of Civil Engineering

University of Moratuwa

Moratuwa

Sri Lanka

December, 2014

IMPROVING THE EVALUATION OF TRANSPORT INFRASTRUCTURE PROJECTS

Isuru Madhushan Gamalath

(138027F)



University of Moratuwa, Sri Lanka.

Thesis submitted in partial fulfilment of the requirements for the degree

Electronic Theses & Dissertations

www.lib.mrt.ac.lk

Master of Science

Department of Civil Engineering

University of Moratuwa

Moratuwa

Sri Lanka

December, 2014

DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature:

Date:



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations

The above candidate has carried out research for the Master's thesis under my supervision.

Signature of the supervisor:

Date:

ABSTRACT

Investment on transport infrastructure is a significant component in a country's budget as it is identified as a key factor to facilitate the country's development. At the same time demand for transportation is positively correlated with the development. With this increasing demand for transport infrastructure and funding available, proper evaluation is necessary to identify the most desirable alternative. Current appraisal practices at the early stages of projects fail to identify some important criteria and therefore, may ultimately end up not selecting the most appropriate project(s) which addresses contemporary concerns. Further it is necessary to assess whether the intended impacts were achieved through these projects, to continue with same kind of projects or to take necessary remedial actions. Therefore the objectives of this research were to identify cost effective methods and factors that should be considered in evaluating transport infrastructure projects both at pre-construction and post construction stages.

Both academic and grey literature were reviewed to identify current practices; evaluation methodologies and impacts concerned. In depth interviews were held with experts in academia and industry to identify current practices and improvements needed. Study revealed that current practices focus only on direct and short term impacts and neglect wider impacts such as climate change impact, disaster resilience of communities and travel time reliability. Criteria that are needed to be considered to assess all the major impacts of transport infrastructure developments were selected based on literature and were broadly categorised into engineering, environmental, socioeconomic and transport based on the field of expertise of the evaluators of each impact. Linear additive model based on multi criteria analysis was selected for prefeasibility analysis as it helps to combine both quantitative and qualitative impacts for the assessment and time, data and financial resources are limited to evaluate number of alternatives at this stage.

Propensity score matching technique was selected for post construction evaluations, for the indicators which have suitable comparison groups. This was selected considering the fact that it takes considerable time to mobilise the impacts and transport interventions are not assigned randomly, but by considering social and geographic issues. However where no suitable comparison groups are available basic techniques such as pre post evaluation has to be used for post construction studies. The methodology of these two analysis techniques and ways to overcome the limitation are discussed in this thesis together with the indicators that should be selected to assess the impacts of transport projects.

DEDICATION

To

My Loving Parents and Brother

Who Always Encouraged Me Towards Success.



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

ACKNOWLEDGEMENT

I would like to acknowledge many people who supported me to complete the master's research successfully. First of all I would like to thank the research supervisor Prof. Saman Bandara for suggesting this research topic, which gave me the opportunity to explore interdisciplinary areas and giving guidance and helpful information to complete the research. Further for providing opportunity to attend conferences workshop for knowledge enhancement and reviewing the papers admits his busy schedule. This gratitude extends to Mr. Loshaka Perera for his guidance and support in this study.

Further thank go to the progress review committee member, Prof. (Mrs.) Nilanthi Bandara for her comments to improve the research output and providing the opportunity to attend workshops in this research area. Thank goes to Prof. Saman Thilakasiri for his comments as a progress review committee member and facilitating the official process of the master's degree program as the research co-ordinator of the Department of Civil Engineering.

Thank goes to Prof. (Mrs.) G. Jayasinghe, Director Post Graduate Studies and Prof. S.M.A. Nanayakkara, Head Department of Civil Engineering for facilitating the official process and conducting seminars and workshops at faculty and department levels to enhance the research skills. Further I would like to thank Dr. W.K. Mapearchchi and Dr. H.R. Pasindu of the Transportation Engineering Division for their support in this study.

This research outputs would not have been possible if it wasn't for the comments and suggestion from academic and professional experts in respective fields. Therefore I would like to thank the following personnel for giving their time and expertise to the successful output of this research.

Mr. H. M. K. G. G. Bandara	Road Development Authority
Prof. S. Barnhardt	Indian Institute of Management Ahmedabad
Mrs. K. de Silva	Central environmental Authority
Dr. L. I. N. de Silva	University of Moratuwa
Ms. D. Dhar	CLEAR/J-PAL South Asia at IFMR

Mr. D. Gunawardena	University of California, Los Angeles
Dr. (Ms.) W. B. Gunawardana	University of Moratuwa
Prof. SK. Hennayake	University of Peradeniya
Dr. M.W. Jayaweera	University of Moratuwa
Dr. E Lokupitiya	University of Colombo
Dr. J. M. A. Manatunge	University of Moratuwa
Mrs. D. A. P. Padmani	Road Development Authority
Prof. M. Pavan	Indian Institute of Management Ahmedabad
Dr. R. L. H. L. Rajapakse	University of Moratuwa
Prof. (Mrs) N. Ratnayake	University of Moratuwa
Ms. K. Rupinder	CLEAR/J-PAL South Asia at IFMR
Prof. A. Sarin	Indian Institute of Management Ahmedabad
Dr. A.J. Satharasinghe	Department of Census and Statistics
Prof. B.M.P. Singhakumara	University of Sri Jayewardenepura
Mrs. D. N. Siyambalapitiya	Road Development Authority
Mr. G. Tunkrans	Swedish National Road Consulting AB
Mr. N. Wilmink	CLEAR/J-PAL South Asia at IFMR
Ms. S.E. Yasaratne	The Secretariat - Business & Biodiversity

Further I like to thank Miss. Gayani Galapaththi and others colleagues in transport and highway engineering labs for their continuous support and comments given to successful completion of the research. Thank goes to Ms. Melani Jayakodi for her support in all official matters throughout this study.

Last but not least I would like to thank my parents and my brother for their unending support throughout my journey. Without them I wouldn't be able to accomplish any of the achievements that I have attained so far.

Isuru Madhushan Gamalath

TABLE OF CONTENTS

DECLARATION	i
ABSTRACT.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS	vi
LIST OF FIGURES	viii
LIST OF TABLES	ix
LIST OF ABBREVIATIONS	x
1. INTRODUCTION.....	1
1.1 Problem Statement and Background	1
1.2 Objective of the Research	2
1.3 Scope of Work.....	2
2. LITERATURE REVIEW.....	3
2.1 Transport Infrastructure Investment in Sri Lanka	3
2.2 Transport Impacts.....	6
2.3 Transport Project Appraisal	11
2.4 Evaluation	12
2.4.1 Evaluation and its purpose	12
2.4.2 Designing an evaluation.....	13
2.4.3 Mechanism of transport impacts.....	14
2.4.4 Selecting indicators.....	16
2.4.5 Measuring impact	17
2.4.6 Evaluation of transport infrastructure projects	20
2.5 Sri Lankan Practice.....	24
3. METHODOLOGY.....	30
4. PROPOSED STRATEGY	32
4.1 Pre-feasibility Evaluation.....	32
4.1.1 Pre-feasibility evaluation matrix.....	32

4.1.2 Pre-feasibility evaluation analysis	39
4.2 Beyond Pre-feasibility Analysis	42
4.2.1 Evaluation Matrix	42
4.2.2 Post-construction Evaluation Analysis	51
4.2.3 Post-construction Evaluation Timing.....	56
5. PREFEASIBILITY CASE STUDY FOR THE KANDY EXPRESSWAY	57
6. POST CONSTRUCTION EVALUATION CASE STUDY FOR THE PUTTALAM – TRINCOMALEE ROAD (A 12)	65
7. CONCLUSION AND RECOMMENDATIONS	71
REFERENCES	72
APPENDIX A.....	81
APPENDIX B.....	85
APPENDIX C.....	101
APPENDIX D.....	113



University of Moratuwa, Sri Lanka.
 Electronic Theses & Dissertations
www.lib.mrt.ac.lk

LIST OF FIGURES

Figure 1: Composition of Government Expenditure 2012	4
Figure 2: Theory of Change.....	14
Figure 3: Impact.....	17
Figure 4: Cost Overrun for Road Projects	20
Figure 5: Cost Overrun for Rail Projects.....	21
Figure 6: Inaccuracies in Traffic Forecasts of Road Projects	21
Figure 7: Inaccuracies in Travel Time Savings Forecasts of Rail Projects	22
Figure 8: Road Traces Considered in the Evaluation.....	58
Figure 9: Sensitivity Analysis on Topography	64
Figure 10: A 12 Road Section from Puttalam to Pullayara Junction	65
Figure 11: Accident Data for the Selected Road.....	67



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

LIST OF TABLES

Table 1: Road inventory of Sri Lanka (length in km)	3
Table 2: Government Expenditure (Rs. ‘000)	4
Table 3: Expected Expenditure for Highway Sector in Billion Rupees (Road Development Authority, 2007).....	5
Table 4: Objectives of Transport Infrastructure Projects	7
Table 5: Mechanism of Transport Impacts	15
Table 6: Factors Considered in Sri Lankan Transport Project Appraisal	24
Table 7: Factors Considered In EIA of Sri Lankan Transport Projects.....	26
Table 8: Prefeasibility Evaluation Matrix	34
Table 9: Extended Evaluation Matrix	43
Table 10: Possible Evaluation Technique for each Criterion	52
Table 11: Alternatives Considered in the Evaluation.....	57
Table 12: Weights Assigned by Each Member of the Study Group	59
Table 13: Marks Given for Each Alternative.....	60
Table 14: Kandy Expressway-Alternative Analysis.....	61
Table 15: Ranking of Alternatives under Various Considerations.....	64
Table 16: Sorted Data.....	68
Table 17: Methodologies adopted in several EIA/IEEs in Sri Lanka	92
Table 18: Problems identified from the interviews	95

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
ADT	Average Daily Traffic
AHP	Analytical Hierarchy Process
BCR	Benefit Cost Ratio
CBA	Cost Benefit Analysis
EIA	Environmental Impact Assessment
IEE	Initial Environmental Examination
IPCC	Intergovernmental Panel on Climate Change
LCA	Least Cost Approach
MCA	Multi Criteria Analysis
PAA	Project Approving Agency
PP	Project Proponent
RDA	Road Development Authority
REA	Rapid Environmental Assessment
VOC	Vehicle Operating Cost



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk