# Methodology to Assess the Reliability of Transport Networks under Disaster Conditions

By

Varuna Viraj Adikariwattage



This thesis was submitted to the Department of Transport and Logistics Management of the University of Moratuwa in partial fulfillment of the requirements for the Degree of Master of Science

Supervised by

Professor J.M.S.J Bandara

**Department of Transport and Logistics Management**

**University of Moratuwa**

**Sri Lanka**



**September 2008**

***Dedication:***

*To my dear*

*Father, Mother and Brothers*

# Declaration

I, Varuna Viraj Adikariwattage hereby declare that the content of this thesis is the output of original research work carried out over a period of 15 months at the Department of Transport and Logistics Management, University of Moratuwa, Sri Lanka. Whenever others' work is included in this thesis, it is appropriately acknowledged as a reference.

*UOM Verified Signature*

---

**Varuna Viraj Adikariwattage**
Department of Transport and Logistics Management,
University of Moratuwa,
Sri Lanka.



*UOM Verified Signature*

---

**Prof. J.M.S.J Bandara,**
Department of Transport and Logistics Management,
University of Moratuwa,
Sri Lanka.

# Abstract

Transportation research and development covers a multitude of topics regarding all areas in transportation. Transportation reliability and vulnerability studies are a new area that has started to draw a lot of attention particularly about its possible applications to help disaster management practices. But unfortunately transportation network risk and vulnerability assessment has not received due recognition so far when formulating preparedness policies in disaster management operations. There are various types of studies such as environmental impact assessment, cost benefit studies for transportation infrastructure where a wide variety of features are looked at, but risk and vulnerability analysis of the transportation network has not yet been considered with much importance. One major reason for this can be highlighted as the lack of established terminology and associated means of analysis that can be specifically adopted for the purpose. And further more it is difficult to draw a firm consensus on available methods due to various disparities among the concepts proposed.



The aim of this research is to develop a methodology to evaluate the state of transportation networks in terms of accessibility and connectivity under disaster situations. A new methodology is proposed based on concepts of both vulnerability and reliability assessment of transportation networks. The proposed method expresses the state of the network using an index defined as the Preparedness Index that is used as a measurement of the state of the network against possible threats and degradation due to damage.

The proposed preparedness index has two components, one to assess the quality or the effectiveness of the connection in terms of distance covered, travel time or LOS provided, and the other component to assess the probability of maintaining the connection that takes in to account the prevailing uncertainty in the network. With the proposed concept it was possible to achieve a good balance in the measurement regarding the state of the network without any one component, either network structural aspects or predictability and probability aspects dominating the analysis. Therefore this proposed index has the potential to over come some of the draw backs identified with conventional methods.

# Acknowledgement

First and foremost I wish to express my deep and sincere gratitude to my supervisor, Professor J.M.S.J Bandara, University of Moratuwa for giving me the opportunity to undertake this research study. I am deeply indebted to my supervisor whose guidance, constructive comments and all the other support that helped me to successfully complete the research and writing of this thesis.

I would also like to gratefully acknowledge the important comments given by Professor Amal S. Kumarage, University of Moratuwa, coordinator of my research and Dr. I.M.S Sathyaprasad, University of Peradeniya, Sri Lanka. Their ideas and constructive comments enormously helped me in achieving the objectives of my research.

I have furthermore to thank the staff of the Department of Transport and Logistics Management, University of Moratuwa for their support in the course of my study.



I owe a very special gratitude to Dr. M.A.W Kumara and the fellow research students at the Transportation Engineering Division of the Department of Civil Engineering University of Moratuwa. I want to thank them for all their support, interest and valuable comments.

Finally I would like to take this opportunity to extend my heartfelt gratitude to all the academic and non academic staff of the University of Moratuwa, who has contributed to my work in numerous ways.

*V:V Adikariwattage*

# Table of contents

# List of figures

# List of tables