SYSTEMS APPROACH TO DEVELOP HIGH MOBILITY ROAD NETWORK PLAN FOR SRI LANKA

W. A. S. S. Weththasinghe

(189293T)

Degree of Master of Science

Department of Civil Engineering

University of Moratuwa

Sri Lanka

December 2023

SYSTEMS APPROACH TO DEVELOP HIGH MOBILITY ROAD NETWORK PLAN FOR SRI LANKA

W. A. S. S. Weththasinghe

(189293T)

Thesis submitted in Partial fulfillment of the requirements for the Degree of Master of Science in Transportation

Department of Civil Engineering

University of Moratuwa

Sri Lanka

December 2023

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, 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).

UOM Verified Signature

…… Date: 22-Dec-2023

W. A. S. S. Weththasinghe

The undersigned hereby certified that I have read and recommended the thesis for the acceptance in partial fulfillment of the requirements for the Degree of Master of Science in Transportation

…… Date:……..

Prof. J. M. S. J. Bandara

ABSTRACT

A high mobility road network is crucial for Sri Lanka's economy, enabling efficient transportation of goods, services, and people. These roads facilitate domestic and international trade, support tourism, enhance regional connectivity, contribute to economic growth, promote rural development, industrial growth, and urban mobility, ensuring sustainable economic development and improving the quality of life for the people of Sri Lanka. However, the construction of the current road network was a result of natural and historical behavior. The construction of the expressways gave little thought to overall connection. Therefore, a methodical methodology of assigning priority for the network's future developments is urgently needed. The primary objective of this study is a systematic approach to a high-mobility road network at interdistrict level, including upgrades for current links.

To facilitate efficient connectivity, 25 District Capitals have been designated as primary nodes. It is assumed that other nodes within each district already possess adequate secondary-level road networks to connect to the primary nodes. These assumptions are the limitations of this study. In defining the original network, places with significant traffic attractions, intersections of the A-class roads and expressway interchanges were included as nodes. This approach aims to ensure seamless connectivity between essential locations and enable smooth traffic flow across the network. To address the particular difficulties and needs related to strategic choices, we limit our analysis to the inter-district level.

During analyzing stage, in order to find bottlenecks, critical nodes and links, minimum spanning trees and least distance paths were developed with respect to trip time and distance during the peak time. To find the optimum network, aspects like reducing the total network length, optimizing the average network speed, and achieving reasonable average speed levels were considered. In order to increase the country's overall mobility, a methodology was created to identify the links that require improvement and have a higher gravity level and slower average speed.

This study identified links with high demand and low service, particularly in Sri Lanka’s central and west regions, with population density as a key factor. A combined system approach using minimum spanning tree, gravity level, and mobility level, was used to rank the links for improvement, mainly requiring roadway infrastructure improvements to address geographical issues. These findings provide valuable insights into the specific areas that need attention to improve the transportation system's efficiency and effectiveness. The next step can be conducting a detailed evaluation and creating a targeted improvement plan considering their unique needs, road conditions, and surrounding land use.

Keywords: High Mobility Road Network, Minimum Distance Path, Minimum Spanning Tree, Systems Approach

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to research supervisor Prof. J. M. S. J. Bandara for providing an opportunity to undertake this research, giving guidance and helpful information to complete this research, for the constant support and supervision provided throughout this research, for coordinating the research project in a very organized manner and providing all the necessary guidelines to carry out the research and setting up milestones that encourage me to complete the research without any delay as the research coordinator.

I owe my deepest gratitude to Eng. D.S.D.D.C. Rajasinghe, General Manager, State Development and Construction Corporation, who always gives me opportunities to allocate time to continue my research work without trouble for my office works and encourages me to complete my research work.

I'm also grateful to all the other senior lecturers, instructors, and research assistants at the Transportation Engineering Division who helped me by providing necessary guidance and support.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES