FORMULATION OF DATABASE & PERFORMANCE INDICATORS FOR LAND PASSENGER TRANSPORT IN SRI LANKA

C.T. Danthanarayana

(8870)

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

Department of Civil Engineering

University of Moratuwa
Sri Lanka

February 2013
Declaration of the Candidate & Supervisor

“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 the 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)

……………………………      …………………
C.T. Dathathrayana                 Date

The above candidate has carried out research for the Masters under my supervision.

……………………………      …………………
Prof. Amal S. Kumarage                        Date
Department of Transport & Logistics
University of Moratuwa
Sri Lanka
Acknowledgements

I wish to express my hearty gratitude to my supervisor, Prof. Amal S. Kumarage, Professor in the Department of Transport & Logistics Management, for his dedication and commitment right through the research work.

I am also grateful to Dr. W.K. Mampearachchi, course coordinator of M.Eng and M.Sc in Transportation for his continuous support to complete the study.

Secondly, my heartfelt gratitude must be extended to Mr. W.A.C. Weerasekara, Director-Quality Assurance of the National Transport Commission, who did all encouragement and administrative support to continue the study.

Then my appreciation go to Mr. B.A. Livinis, Deputy General Manager and Mr. C.M.D.J Thudugala, Manager-Development & Planning of the Sri Lanka Transport Board, Mr. Wijaya Samarasinghe, Director Planning of the Sri Lanka Railways, Mr. Anura de Silva, Statistician of the Department of Motor Traffic and Ms. R. Sanjeeewani de Silva, Research and Development Officer of the National Transport Medical Institute for their kind support and help extended me to fulfill my study.

Finally my special thank go to my dearest husband for his constant encouragement and support extended throughout the study and making a suitable environment to devote time to this study.

C.T. Danthanarayana
Abstract

Statistical information on transport activities serve an important role for transport related decision making. As such many developed countries maintain common transport databases to store transport data in different transport related organization. These data are important to understand the changes of transport variables and to evaluate transport benefits and impacts.

However responsible bodies for collection of data, storage and analysis have not been established in Sri Lanka and this is a common issue for all transport authorities and other transport related institutions, organizations for planning transport related projects and policy decision making. Due to lack of transport databases, performance indicators are not used for proper evaluation and planning. Formulations of transport databases and Performance Indicators minimize the deficiencies in transport sector directing transport regulators and planners to get remedies for the existing issues.

The main objective of this study is to identify different types of Key Performance Indicators (KPI) which are applicable to measure key aspects of performance in Land Passenger Transport Sector such as quality, efficiency, safety etc. Outcome of this study is to provide an initiative to formulate common transport data base and KPIs in order to evaluate the Land Passenger Transport in Sri Lanka. This study reflects a brief analysis of performance in Land Passenger Transport Sector. This performance evaluation is carried out by means of KPIs derived on available transport variables in different transport organizations.

Key observations of this study reveal that formulation of KPIs with a special emphasis on sectoral performance and user perspectives are essential to address the existing Land Transport issues. Improving a proper mechanism is needed to collect necessary data from relevant institutions in order to formulate above KPIs. In addition establishment of a responsible body for transport data collection is essential to formulate a common transport database.

Key Words: Transport Database, Key Performance Indicators, Transport variables
# Table of Contents

Declaration of the Candidate & Supervisor .................................................. i  
Acknowledgements .................................................................................... ii  
Abstract ...................................................................................................... iii  
Table of Contents ......................................................................................... iv  
List of Tables ............................................................................................... viii  

CHAPTER 1 1  
INTRODUCTION  
1.1 Transport Data Base ................................................................. 1  
1.2 Key Performance Indicator (KPI) ............................................... 1  
1.3 Importance of Transport Databases ........................................... 2  
1.4 Objectives of the Study ............................................................ 3  

CHAPTER 2 4  
BACKGROUND & PROBLEM IDENTIFICATION ......................... 4  
2.1 Review of Transport in Sri Lanka ............................................. 4  
2.2 Necessity of Transport Database & Key Performance Indicators for Sri Lanka ........... 7  

CHAPTER 3 8  
LITERATURE REVIEW  
3.1 International Transport Databases ............................................ 8  
3.1.1 North American Transport Statistics On-Line Database .... 8  
3.1.2 RAP International Transport Statistics Database .......... 9  
3.1.3 The Earth Trends database ............................................... 10  
3.1.4 OECD (Organization for Economic Cooperation and Development) Transport Statistics database .................................................. 10  
3.2 Europe ....................................................................................... 11  
3.3 United Sates of America .......................................................... 13  
3.4 Canada ...................................................................................... 15  
3.5 Britain ....................................................................................... 16  
3.6 India ......................................................................................... 16  

CHAPTER 4 18  
METHODOLOGY .................................................................................. 18  

CHAPTER 5 21  
DEVELOPMENT OF KEY PERFORMANCE INDICATORS FOR LAND PASSENGER TRANSPORT .............................................. 21  
5.1 Classification of Key Performance Indicators .............................. 21  

CHAPTER 6 27  
PERFORMANCE EVALUATION OF LAND PASSENGER TRANSPORT IN SRI LANKA ......................................................... 27  
6.1 General Economic Background .................................................. 27  
6.2 General Key Performance Indicators In Transport Sector ........... 29
6.2.1 Transport share of GDP (%) ____________________ 29
6.2.2 Private Consumption Expenditure on Transport Sector_________________ 31
6.2.3 Transport Modal Share__________________________________________ 31
6.2.4 Vehicle Growth Rate ________________________________________________________________________ 33
6.2.5 New Registration of Vehicles ___________________________________________ 35
5.2.6 Motor Vehicle Share (Operated) ___________________________________________ 37
6.2.7 Driving License issued ________________________________________________________________________ 38
6.2.8 Vehicle Ownership per 100 households ___________________________________________ 39
6.3 Key Performance Indicators Of Bus Transport Sector _____________________ 40
6.3.1 Average Daily Vehicle Kilometers Traveled ___________________________ 40
6.3.2 Average Bus Fleet Operated ___________________________ 42
6.3.3 Bus Routes in operation ________________________________________________________________________ 45
6.3.4 Passenger km traveled ________________________________________________________________________ 45
6.3.5 Passenger Volume ________________________________________________________________________ 47
6.3.6 Total Cost per Km ________________________________________________________________________ 48
6.3.7 Operating Expenses per vehicle kilometers ___________________________________________ 50
6.3.8 Operating expense per passenger ___________________________________________ 52
6.3.9 Fuel Cost per km ________________________________________________________________________ 53
6.3.10 Total Fuel Consumption ___________________________________________ 55
6.3.11 Average Fuel Consumption ___________________________________________ 57
6.3.12 Fuel Efficiency ________________________________________________________________________ 58
6.3.13 Revenue per km ___________________________________________ 59
6.3.14 Profit & Loss per kilometer ___________________________________________ 61
6.4 Key Performance Indicators of Rail Transport Sector _____________________ 62
6.4.1 Route kilometers per year ___________________________________________ 63
6.4.2 No. of Trains Operated per Year ___________________________________________ 64
6.4.3 Total Passenger Kilometers ___________________________________________ 64
6.4.4 Vehicle Kilometers per day ___________________________________________ 66
6.4.5 Passenger Volume ___________________________________________ 67
6.4.6 Total Fuel Consumption ___________________________________________ 68
6.4.7 Average Fuel Consumption ___________________________________________ 69
6.4.8 Fuel Efficiency ___________________________________________ 70
6.4.9 Total Cost per Km ___________________________________________ 70
6.4.10 Fuel Cost per Km ___________________________________________ 71
6.4.11 Revenue per km ___________________________________________ 72
6.4.12 Profit & Loss per km ___________________________________________ 72
6.5 Key Performance Indicators in Road Safety _____________________________ 73
6.5.1 Road Accidents per thousand population ___________________________________________ 73
6.5.2 Fatalities per 10,000 inhabitants ___________________________________________ 75
6.5.3 Road traffic pedestrian fatalities ___________________________________________ 75
6.5.4 Road accidents per ten thousands vehicles ___________________________________________ 76
6.5.5 Fatalities per 10,000 Operated Motor Vehicles ___________________________________________ 77
6.5.6 People killed in road accidents ___________________________________________ 77
6.5.7 People seriously injured in road accidents ___________________________________________ 79
7. CONCLUSION AND RECOMMENDATION ______________________________ 86
REFERENCE LIST ______________________________________________________ 89
List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 2.1</td>
<td>Public Transport Issues in Sri Lanka</td>
<td>7</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>Selected KPIs in General Transportation</td>
<td>18</td>
</tr>
<tr>
<td>Figure 4.2</td>
<td>Selected KPIs in Land Passenger Transport</td>
<td>19</td>
</tr>
<tr>
<td>Figure 4.3</td>
<td>Selected Safety and Quality KPIs in Land Passenger Transport</td>
<td>20</td>
</tr>
<tr>
<td>Figure 5.1</td>
<td>Basic Performance Concepts</td>
<td>21</td>
</tr>
<tr>
<td>Figure 5.2</td>
<td>Classification of KPIs on Fielding Modal</td>
<td>23</td>
</tr>
<tr>
<td>Figure 5.3</td>
<td>Classification Method- 2</td>
<td>24</td>
</tr>
<tr>
<td>Figure 6.1</td>
<td>Economic Growth Rate</td>
<td>28</td>
</tr>
<tr>
<td>Figure 6.2</td>
<td>Transport Sector Change in GDP</td>
<td>30</td>
</tr>
<tr>
<td>Figure 6.3</td>
<td>Passenger Transport Modal Share -2010</td>
<td>32</td>
</tr>
<tr>
<td>Figure 6.4</td>
<td>Total Vehicle Growth Rate (2010 on 2002 base)</td>
<td>34</td>
</tr>
<tr>
<td>Figure 6.5</td>
<td>Growth Rate by Class of Vehicle-2006</td>
<td>34</td>
</tr>
<tr>
<td>Figure 6.6</td>
<td>Vehicle Growth by Category (2010 on 2005 Base)</td>
<td>35</td>
</tr>
<tr>
<td>Figure 6.7</td>
<td>New Vehicle Registration Growth Rate-2010</td>
<td>36</td>
</tr>
<tr>
<td>Figure 6.8</td>
<td>Relationship between GDP Growth Rate &amp; New Vehicle Registration</td>
<td>37</td>
</tr>
<tr>
<td>Figure 6.9</td>
<td>Average Scheduled Km Vs Operated Km-SLTB</td>
<td>41</td>
</tr>
<tr>
<td>Figure 6.10</td>
<td>Average Bus Fleet &amp; Average Buses Operated-SLTB</td>
<td>43</td>
</tr>
<tr>
<td>Figure 6.11</td>
<td>Average Required Buses &amp; Average Buses Operated-SLTB</td>
<td>43</td>
</tr>
<tr>
<td>Figure 6.12</td>
<td>Passenger Km Per Day-SLTB</td>
<td>46</td>
</tr>
<tr>
<td>Figure 6.13</td>
<td>Passenger Kilometers Per Day-Private Buses</td>
<td>47</td>
</tr>
<tr>
<td>Figure 6.14</td>
<td>Total Cost vs. Operated Km, Rate of Change</td>
<td>49</td>
</tr>
<tr>
<td>Figure 6.15</td>
<td>Total Cost Per Km-SLTB</td>
<td>49</td>
</tr>
<tr>
<td>Figure 6.16</td>
<td>Operating Cost Change in Private Bus Transportation</td>
<td>52</td>
</tr>
<tr>
<td>Figure 6.17</td>
<td>Bus Fare Revision in Private Bus Transportation</td>
<td>55</td>
</tr>
<tr>
<td>Figure 6.18</td>
<td>Total Fuel Consumption in Private Bus Service</td>
<td>57</td>
</tr>
<tr>
<td>Figure 6.19</td>
<td>Average Fuel Consumption in SLTB</td>
<td>58</td>
</tr>
<tr>
<td>Figure 6.20</td>
<td>Fuel Efficiency in State Buses</td>
<td>59</td>
</tr>
<tr>
<td>Figure 6.21</td>
<td>Profit &amp; Loss (WO) Per Km-SLTB</td>
<td>61</td>
</tr>
<tr>
<td>Figure 6.22</td>
<td>Profit &amp; Loss (W) Per Km-SLTB</td>
<td>62</td>
</tr>
<tr>
<td>Figure 6.23</td>
<td>No of Scheduled and Operated Trains</td>
<td>64</td>
</tr>
</tbody>
</table>
Figure 6.25: Passenger Km Per Day-SLR ______________________________ 65
Figure 6.26: Train Km Operated-SLR ______________________________ 67
Figure 6.27: Passenger Volume in SLR ______________________________ 68
Figure 6.28: Average Fuel Consumption in SLR _________________________ 69
Figure 6.29: Fuel Efficiency in SLR ______________________________ 70
Figure 6.30: Fuel Cost Per Km in SLR ______________________________ 71
Figure 6.31: Profit & Loss Per Km-SLR ______________________________ 73
Figure 6.32: Road Accidents Per 10,000 Population _____________________ 74
Figure 6.33: Fatalities Per 100,000 Inhabitants _________________________ 75
Figure 6.34: Road Accidents Per 10,000 Vehicles _________________________ 76
Figure 6.35: Fatalities Per 100,000 Operated Motor Vehicles ______________ 77
Figure 6.36: Fatalities of Divers by Age Groups- 2008 _________________ 78
Figure 6.37: Fatalities of Drivers by Age Groups-2009 _________________ 78
List of Tables

Table 3.1: Fuel Price, Consumption, Travel and Risk (OECD 2006; Metschies 2005) 11
Table 3.2: Passenger Mobility in Europe 12
Table 3.3: Indian Cities Modal Split, 2007 17
Table 2.2: Examples of Performance Indicators for Various Modes 25
Table 6.1: Key Socio Economic Indicators in Sri Lanka 27
Table 6.2: Transport Sector Composition 29
Table 6.3: GDP in Transport Sector 31
Table 6.4: Composition of Private Consumption Expenditure 31
Table 6.5: Transport Modal Share 32
Table 6.6: Total Vehicle Population 33
Table 6.7: New Registration of Vehicles 36
Table 6.8: Operated Motor Vehicle Share 38
Table 5.9: Total No. of Driving License Issued 38
Table 6.10: Vehicle Ownership Per 100 Households 40
Table 6.11: Vehicle Kilometers Per Day-SLTB 41
Table 6.12: Vehicle Km Per Day-Private Buses 42
Table 6.13: Average Bus Fleet-SLTB 42
Table 6.14: Average Private Buses Operated 44
Table 6.15: Inter Provincial Private Buses 45
Table 6.16: Passenger Km-SLTB 45
Table 6.17: Passenger Km in Private Bus Transportation 46
Table 6.18: Passenger Volume-SLTB 47
Table 6.19: Passenger Volume in Private Bus Service 48
Table 6.20: Total Expenditure in SLTB 48
Table 6.21: Operating Cost-SLTB 50
Table 6.22: Bus Operating Cost Index 51
Table 6.23: Operating Cost Per Passenger-SLTB 52
Table 6.24: Operating Cost Per Passenger-Private Buses 53
Table 6.25: Fuel Cost -State Bus Service 53
Table 6.26: Diesel Price Per Liter 54
Table 6.27: Fuel Cost Per Km in Private Bus Service 54
Table 6.28: Total Fuel Consumption-SLTB ............................................. 56
Table 6.29: Total Fuel Consumption in Private Bus Service ......................... 56
Table 6.30: Fuel Efficiency in State Buses .............................................. 58
Table 6.31: Revenue of SLTB ................................................................. 60
Table 6.32: Ticket Revenue-SLTB ......................................................... 60
Table 6.33: Profit & Loss of SLTB ......................................................... 61
Table 6.34: Length of Rail Tracks Open for Traffic ..................................... 63
Table 6.35: Annual Train Operations ....................................................... 64
Table 6.36: Total Annual Passenger Km ................................................ 65
Table 6.37: Vehicle Km Per Day-SLR ..................................................... 66
Table 6.38: Total Vehicle Km & Scheduled Km-SLR .................................. 66
Table 6.39: Passenger Volume in SLR .................................................... 67
Table 6.40: Total Fuel Consumption-SLR ............................................. 68
Table 6.41: Average Fuel Consumption-SLR .......................................... 69
Table 6.42: Fuel Efficiency in SLR ......................................................... 70
Table 6.43: Total Cost Per Km-SLR ....................................................... 71
Table 6.44: Fuel Cost Per Km-SLR ......................................................... 71
Table 6.45: Revenue Per Km-SLR ......................................................... 72
Table 6.46: Financial Performance in SLR ............................................. 72
Table 6.47: Total Road Accidents .......................................................... 74
Table 6.48: Road Traffic Pedestrian Fatalities .......................................... 76
Table 6.49: People Killed in Road Accidents ........................................... 77
Table 6.50: People Seriously Injured in Road Accidents ............................ 79
Table 6.51: Passenger Satisfaction of Long Bus Service ............................. 80
Table 6.52: Passenger Satisfaction on Level of Service .............................. 81
Table 6.53: Comparison of KPIs in Bus & Rail Transport-2010 .................... 82