

DEVELOPMENT OF FRAMEWORK FOR GREEN HIGHWAY
IMPLEMENTATION IN MALAYSIA

YAZLIN SALFIZA BINTI MOHD YAZID

A thesis submitted in fulfillment of the
requirements for the award of the degree of
Master of Engineering (Construction)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

FEBRUARY 2015

Dedicated to my beloved; Azam, Ariff & Ameer..

ACKNOWLEDGEMENT

In the name of Allah s.w.t. the Most Beneficent, the Most Merciful

Firstly, my appreciation goes to the Malaysian Highway Authority and Universiti Teknologi Malaysia for giving me the opportunity to embark on this study.

My appreciation goes to my supervisor, Prof. Madya Ir. Dr. Rosli Mohamad Zin for the continuous support, supervision and guidance that has led to the completion of this project. Special thanks go to Dr. Rozana Zakaria for the encouragement and guidance in preparing this thesis.

My gratitude also goes to JKR, CIDB and the concessionaires that have provided invaluable information to complete this thesis. To my beloved parents, husband, my boys and everybody in my family as well as friends, nothing compares to your patience and perseverance in providing continuous moral support.

Last but not least, thank you everyone who has been involved directly and indirectly in this research.

ABSTRACT

Sustainability and green concepts are closely linked to environmental protection. Over the years, various green initiatives have been taken to support global efforts in maintaining the world's ecological balance. Looking at the local context, most green initiatives that have been implemented in this country are mainly related to buildings and roads. In the highway project development, efforts to implement green initiatives are relatively low even though full support has been provided by the government. Reviews of literature revealed that Malaysia is still lacking of a framework or model that can be used to successfully implement green highway project development. In view of the issue, this study is carried out with the aim to develop a Green Highway Framework for Malaysia that serves as a guide for the implementing agency, i.e. Malaysian Highway Authority (MHA), in order to realize the green highway development. The green highway implementation can be monitored and assessed with the established framework coupled with availability of a rating tool known as the Malaysia Green Highway Index (MyGHI). In this study, the existing green initiatives and barriers to green highway implementation have also been investigated. The methodologies employed in the study consisted of qualitative and quantitative data collections mainly through questionnaire survey and expert interviews. The survey and interview respondents were mainly officers from government agencies including the MHA and highway concessionaires. Analysis of the data collected indicates that the implementation of green initiatives in the existing highways is marginal and needs to be improved. The findings lead to the establishment of a Green Highway Framework, made up of three main processes which are Strategic Process, Tactical Process and Operational Process. The development of the Green Highway Framework enables implementation of green initiatives in highway project developments in Malaysia to be more structured and organised.

ABSTRAK

Konsep mampan dan hijau sering berkait rapat dalam pemeliharaan alam sekitar. Sejak sekian lama, pelbagai aspek pendekatan hijau dilaksanakan bagi menyokong usaha sejagat dalam mengekalkan keseimbangan ekologi dunia. Melihat konteks tempatan, kebanyakan inisiatif hijau yang diaplikasi adalah berkait rapat dengan bangunan dan jalan. Dalam pembangunan lebuh raya, usaha melaksanakan inisiatif hijau masih dianggap rendah walaupun sokongan penuh Kerajaan diberikan. Kajian literature menunjukkan Malaysia masih tidak mempunyai kerangka mahupun model yang boleh digunapakai bagi menjayakan pembangunan lebuh raya hijau. Berdasarkan isu yang dinyatakan, kajian ini dilaksanakan dengan tujuan untuk membangunkan Kerangka Lebuh raya Hijau di Malaysia sebagai panduan kepada agensi pelaksana iaitu Lembaga Lebuh raya Malaysia (LLM) bagi merealisasikan pembangunan lebuh raya hijau di Malaysia. Pelaksanaan lebuh raya hijau dapat dipantau dan dinilai dengan terbentuknya kerangka ini ditambah pula adanya alat penarafan yang dikenali sebagai Malaysia Green Highway Index (MyGHI). Di dalam kajian ini kewujudan inisiatif hijau dan halangan kepada pelaksanaan lebuh raya hijau juga telah diselidiki. Metodologi yang digunapakai merangkumi kaedah pengumpulan data secara kualitatif dan kuantitatif melalui kajian soalselidik dan temubual pakar. Responden kajian terdiri daripada kalangan pegawai agensi kerajaan serta syarikat konsesi lebuh raya. Analisis data menunjukkan pelaksanaan inisiatif hijau di lebuh raya sedia ada masih di tahap marginal dan perlu dipertingkatkan. Penemuan ini membawa kepada pembentukan Kerangka Lebuh raya Hijau, gabungan tiga proses utama iaitu Proses Strategik, Proses Taktikal dan Proses Operasi. Pembangunan Kerangka Lebuh raya Hijau ini membolehkan inisiatif hijau dalam pembangunan projek lebuh raya dapat dilaksanakan dengan jelas dan tersusun.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENTS	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	xii
	LIST OF FIGURES	xiv
	LIST OF ABBREVIATIONS	xvi
	LIST OF APPENDICES	xvii
1	INTRODUCTION	
	1.1 Background	1
	1.2 Problem Statement	2
	1.3 Aim of Research	4
	1.4 Objective of the Research	4
	1.5 Scope of the Research	5
	1.6 Limitation of Study	5
	1.7 Significance of the Research	6
	1.8 Brief Research Methodology	7
	1.9 Summary	9

LITERATURE REVIEW

2.1	Introduction	10
2.2	Sustainable Development	11
	2.2.1 Concept of Sustainable Development	11
2.3	Green Initiatives in Malaysia	14
2.4	Green Highway Concept	20
2.5	Highway Development In Malaysia	22
2.6	Green Policies and Initiatives	29
	2.6.1 Green Policy in United States	29
	2.6.2 Green Policy in Australia	31
	2.6.3 Green Policy in Singapore	32
	2.6.4 Initiative in ISO 14000: Environmental Management	33
2.7	Green Highway Framework	34
	2.7.1 Terms of Framework	35
	2.7.2 Types of Framework	37
	2.7.3 Overview of Existing Green Framework	38
	2.7.3.1 The Organization for Economic Co-Operation and Development (OECD) Framework	38
	2.7.3.2 Greening of Government Operations (GoGo) Framework	40
	2.7.3.3 New York State Department Of Transportation (NYSDOT)	41
	2.7.3.4 United Nations Environment Programme (UNEP)	42
	2.7.3.5 Texas Department of Transportation (TxDOT) Framework	43
	2.7.4 Green Rating System	44
	2.7.4.1 Green Roads	44
	2.7.4.2 LEED USA	45
	2.7.4.3 I-LAST	45

2.7.4.4	GreenLITES	45
2.8	Barriers or Problems / Challenges In Green Initiatives Implementation	46
2.9	Summary	50

3**RESEARCH METHODOLOGY**

3.1	Introduction	51
3.2	Research Design and Procedure	52
3.3	Research Framework	53
3.4	Population and Respondent	57
3.4.1	Selection of Respondent for Questionnaire Survey	61
3.4.2	Selection of Respondent for Semi-Structured Interview	62
3.4.3	Selection of Respondent for Focus Group Method	63
3.5	Qualitative and Quantitative Data Collection	63
3.5.1	Qualitative Data Collection	65
3.5.1.1	Semi-Structured Interview	65
3.5.1.2	Focus Group Interview	66
3.5.2	Quantitative Data Collection	67
3.5.2.1	Questionnaire Survey	67
3.5.2.2	Questionnaire Design	69
3.5.2.3	Scaling and Level of Measurement	70
3.5.3	Validity and Reliability Test	71
3.6	Methods of Analysis	73
3.6.1	Qualitative Data Analysis	73
3.6.2	Quantitative Data Analysis	76
3.6.2.1	Croanbach's Alpha Reliability Test	78
3.6.2.2	Multiple Linear Regressions (MLR)	78
3.6.2.3	Koenker Bassett Test	80
3.6.3	Critical Elements of Green Highway Framework	81
3.7	Summary	87

4	DATA ANALYSIS	
4.1	Introduction	88
4.2	Section A: Demographic of Respondent	89
4.3	Frequency of Respondents	89
4.4	Academic Qualification	92
4.5	Working Experience	93
4.6	Green Highway Experience	94
4.7	Objective 1	95
	4.7.1 Adoption of Green Highway Concept	95
4.8	Objective 2	99
	4.8.1 Frequency of Barriers	100
	4.8.2 Relationship Between Barriers and Impact	101
	4.8.3 Croanbach’s Alpha Reliability Test	103
	4.8.3.1 Interpretation of Reliability	103
	4.8.4 Multiple Linear Regressions (MLR)	104
	4.8.4.1 Interpretation of MLR Analysis	105
	4.8.5 Koenker Bassett Test	106
	4.8.6 Model Evaluation Checking	107
	4.8.6.1 Analysis on Assumption A	109
	4.8.6.2 Analysis on Assumption B and C	110
	4.8.6.3 Analysis on Assumption D	112
	4.8.6.4 Analysis on Assumption E	113
	4.8.7 Inferences From Semi Structured Interview	114
	4.8.7.1 Suggestion from Respondents	115
4.9	Summary	117
5	MALAYSIA GREEN HIGHWAY FRAMEWORK	
5.1	Introduction	119
5.2	Identifying the Critical Element of the Framework	120
5.3	Analysis of Semi-Structured Interview	121
5.4	Critical Elements Model	125
	5.4.1 Principles	125
	5.4.2 Assessment Management	127
	5.4.3 Delivery Mechanism	132

5.4.4	Monitoring	134
5.5	Proposed Malaysia Green Highway Framework	135
5.5.1	Level 1 - Strategic Process	136
5.5.2	Level 2 – Tactical Process	137
5.5.3	Level 3 – Operational Process	138
5.6	Validation of the Malaysia Green Highway Framework	142
5.7	Validated Malaysia Green Highway Framework	149
5.8	Summary	152
6	CONCLUSION AND RECOMMENDATION	
6.1	Introduction	153
6.2	Conclusions	154
6.3	Recommendations	158
	REFERENCES	159
Appendices	A – C	165 - 183

LIST OF TABLES

TABLE NO.	TITLE	PAGE
1.1	Research Outcome	6
2.1	Highway Category in Malaysia	24
2.2	List of Highways Under Supervision of Malaysian Highway Authority	25
2.3	Summary on Barriers or Problems to Implement Green Initiatives	48
3.1	Research Framework Chart	55
3.2	List of Highways and Concession Companies	59
3.3	Statistical Analysis in SPSS	76
3.4	Details on Critical Elements in Agencies / Organizations	83
3.5	Summarization of Critical Elements in Agencies / Organizations	86
4.1	Number of Respondents by Highway Location	90
4.2	Respondents Based on Academic Qualification	92
4.3	Respondents Based on Working Experience in Highway Sector	93
4.4	Green Highway Experience	94
4.5	Adoption of Green Highway Concept in Concession Company	95
4.6	Percentage of Coded Text in Green Initiative Approach	97

4.7	Company Certification in Environmental Management System	98
4.8	Factors in Barriers and Impacts	102
4.9	Summary of Reliability Test	104
4.10	Summary of Multiple Linear Regressions Results	106
4.11	Test Statistic Anova	111
4.12	Residual Statistics	112
4.13	Summary Results of Collinearity Statistics	113
4.14	Percentage References of Coded Text in Challenges Factor	114
5.1	Implementation of Green Highway Assessment in Company	120
5.2	Details of Respondents of Semi-Structured Interview	122
5.3	Awards in Green Rating Tools	131
5.4	Details of Panels for Validation Data Process	142
5.5a	Validation Data by Malaysian Highway Authority – Level 1	144
5.5b	Validation Data by Malaysian Highway Authority – Level 2	145
5.5c	Validation Data by Malaysian Highway Authority – Level 3	146
5.5d	Validation Data by Malaysian Highway Authority – Level 3 (cont'd)	147

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	Research Methodology Chart	8
2.1	Highway Alignment in Malaysia	28
2.2	OECD Framework	39
2.3	South Australian's GoGo Framework	41
2.4	Texas Department of Transportation (TXDOT) Framework	43
3.1	Sample Size Formula	61
3.2	Data Collection Process	64
3.3	Process of NVivo 10	75
4.1	Respondents Based on Academic Qualification	92
4.2	Percentage of Respondents Based on Working Experience in Highway Sector	93
4.3	Percentage of Green Highway Experience	94
4.4	Adoption of Green Highway Concept in Company	96
4.5	Company Certification in Environmental Management System	98
4.6	Frequency of the Barriers	100
4.7	Graph of Normal P-P Plot	109
4.8	Scatter Plot	110
5.1	Critical Elements Model	124
5.2	Critical Elements in Principle Theme	126

5.3	Critical Elements in Assessment Management Criteria	128
5.4	Critical Elements in Delivery Mechanism	134
5.5	Critical Elements on Monitoring	135
5.6	Relationship of Critical Elements in Level 1	137
5.7	Relationship of Critical Elements in Level 2	138
5.8	Relationship of Critical Elements in Level 3	139
5.9	Proposed of Malaysia Green Highway Framework	141
5.10	Comparison Between Two Frameworks (Proposed And After Validation)	148
5.11	Validated of Malaysia Green Highway Framework	151

LIST OF ABBREVIATIONS

CIDB	Construction Industry Development Board
EIA	Environmental Impact Assessment
EPA	Environmental Protection Act
EQA	Environmental Quality Act 1974
GBI	Green Building Index
ISO	International Organization for Standardization
LLM	<i>Lembaga Lebuhraya Malaysia</i>
MHA	Malaysian Highway Authority
MOW	Ministry of Works
OECD	The Organization for Economic Co-Operation and Development
pH JKR	<i>Penarafan Hijau JKR</i>
PWD /JKR	Public Works Department / Jabatan Kerja Raya
TBL	Triple Bottom Line
UNEP	United Nations Environment Programme

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Research Questionnaire Survey	165
B	Interview Survey Form	174
C	Process of Data Analysis Using NVivo 10	179

CHAPTER 1

INTRODUCTION

1.1 Background

It is undeniable that highway is among the major infrastructures contributing towards the enhancement of national economy. With the increasing number of highway developments over the last few years, it shows that the number of vehicles has also been increasing.

Concurrently, environmental crisis such as global warming, climate change, deforestation and other environmental problems are issues that have arisen from the lack of environmental awareness especially in the context of highway development. These environmental issues have become a subject of discussion across the world over the years. It needs to be solved at the global level in order to ensure environmental balance. Various execution methods have been taken to alleviate environmental impact such as establishing policies, enforcing laws, establishing index and rating tools, raising awareness among the public, among many others.

In Malaysia, the term “Green Technology” has only become popular in the last few years although it was introduced in the western countries in the early 1990’s. In order to support the efforts towards green approach, the National Policy on the Environment has been introduced in 2002 as a guide for all Malaysian stakeholders to preserve a clean, safe, healthy and protective environment. Then, the Green Policy of National Green Technology was launched in July 2009 to strengthen the green implementation in Malaysia. The Policy states, “Green Technology shall be a driver to accelerate the national economy and promote sustainable development”. The policy covers all agencies of infrastructure including highways.

1.2 Problem Statement

Highway projects are closely linked with people’s everyday lives. They play an essential role in a nation’s social and economic development (Huang, 2008). Based on data from the Malaysian Highway Authority, up to the December 2011, the total length of 26 tolled highways operating in Malaysia is 1,732.44 km, while the number of vehicles using the highway has been increasing from time to time.

The highway construction which involves major construction activity is a common source of environmental problem in the country. The development involves massive earthwork in construction. These earthworks such as cut and fill may bring negative impact to the surrounding environment. In the operation and maintenance perspective, traffic congestion on the highways is one of the issues that are causing environmental problems. Thus, the highway industry contributes to a major impact on the environment.

Data recorded by Fong (2008) shows that the total carbon emission (CO₂) in Malaysia is the third highest compared to the other developing Southeast Asian countries after Indonesia and Thailand. The breakdown of CO₂ emissions by sector shows that it is led by transportation (31%), followed by the energy industries (28%) and manufacturing industries (22%). Despite the importance of the national

transportation network, there is a growing recognition that highway construction and maintenance have major environmental impacts (Hassan, 2008).

With a range of environmental issues that exist, the concept of green highways is introduced to overcome the various issues related to the environment. Green Highway is one element of sustainable transport. It is a new concept even though the implementation of a large number of technologies involved in green highway design has been encouraged for many years (Bryce, 2008). The implementation of green highway requires proper planning in every aspect of highway development. With the current level of public acceptance on the importance of preserving the environment, the need to create a sustainable highway development has become mandatory. One of the approaches in green highway concept is the implementation of rating tools. It is an important instrument to measure the effectiveness of green implementation in an objective approach. The existence of multiple rating tools both in and outside the country show the level of awareness towards green development is generally good.

Recognizing the importance of green development, several initiatives have been taken to support the government mandate. For building projects, the Green Building Index (GBI) has been introduced by Persatuan Arkitek Malaysia (PAM) as reference to measure the green building; Penarafan Hijau JKR (pH JKR) was developed by Public Works Department (PWD) to measure the green level of federal buildings and roads, and also GreenPASS, developed by CIDB to calculate the percentage of carbon emissions. All the rating tools were implemented by various government and private agencies as an effort to sustain green development.

However, most rating tools that exist in Malaysia only focus on buildings and roads. Initiatives that focus on green highway are still lacking especially in the context of development of rating tools, monitoring standards, guidelines and green framework. Therefore, the need to develop standard for the development of green highway has become a major challenge. As a regulatory agency for toll highways, Malaysian Highway Authority (MHA) is the entity that is responsible for developing

and implementing the framework for green highway development in order to ensure the balance between the development of roads and highways construction industry in country.

According to the Malaysian Highway Authority (2010), the green highway concept and characteristics shall be applied throughout the highway development stages; comprising planning, designing, construction, operation and maintenance. With very limited research in highways, the implementation of green highway development is seen as having huge impact on sustainable highway development. Hence, in order to ensure that all highway developments and operations do not cause negative impact to the environment, tools or methods with standard criteria has to be developed in order to measure the standard of green implementation in all phases of highway construction.

1.3 Aim of Research

The aim of the research is to develop a framework of Green Highway to be implemented in Malaysia.

1.4 Objective of the Research

The objectives of this research are:

- i. To investigate the existing implementation of green highway in Malaysia.
- ii. To identify and evaluate barriers in developing green highway.
- iii. To establish critical elements for developing a conceptual framework for green highway.
- iv. To validate the green highway framework from the viewpoint of highway stakeholders.

1.5 Scope of the Research

The research focuses on tolled highways in Malaysia that are being monitored by the Malaysian Highway Authority. The perimeter of the study is limited to the Malaysia Peninsular which comprises the Northern, Southern, Eastern and Central Regions (Klang Valley). In this research, the case studies were selected based on different phases of projects starting from planning, design, construction to operation and maintenance. It also covers main features of the highway such as mainline, interchanges, toll plaza, road furniture, landscape, and services provided such as lay-by, rest and service area and response team.

This research also involved the communities within highway development such as concession companies, consultants, contractors, any related Government agencies including the point of view of UTM academicians who have green highway related expertise.

1.6 Limitation of Study

There are several limitations encountered during the course of the study. They are:

- i) The participants involved in this study are limited to highway concessionaires; there is lack of involvement among the experts such as consultants and contractors who are knowledgeable in highway industry.
- ii) Deeper explanation had to be done to provide details on some other new terms in sustainable and green development due to the lack of exposure and the fact that its implementation is still at an early stage.

1.7 Significance of the Research

In order to implement green highway in Malaysia, a proper system needs to be developed so that the implementation covered all aspects. As highlighted in Section 1.3, this research aims to develop green highway framework. Since this is the first green highway framework in Malaysia, it may serve as a master plan for the Malaysian Highway Authority (MHA) to implement green highway. At the same time, the framework will be used by highway stakeholders as medium to enhance the understanding of green highway concept. The outcome of the research may contribute directly to the highway industry especially to the related government agencies and concession companies. The involvement of concession companies in this green initiative sends the message that the company is well-run, responsible and committed to the future. Besides, the outcome of this research can be viewed in various related standpoints: economic, environmental and social aspects as indicated in Table 1.1.

Table 1.1: Research Outcomes

Aspect	Outcome
Economic aspects	<ul style="list-style-type: none"> - improve Malaysia's ranking in world environment ratings - reduce resources consumption while sustaining national economic growth - reduce in project cost due to good project management - enhancement to the national economy with the development in green technology
Social aspects	<ul style="list-style-type: none"> - improve quality of life and public awareness especially to the highway user
Environmental aspect	<ul style="list-style-type: none"> - conserve and minimize impact to the environment - improve sustainable development and conserve the environment for future generation.

1.8 Brief Research Methodology

This research methodology covers detail processes involved in developing green framework so that the implementation will become more relevant to the highway industry. It began with the literature review on various areas related to sustainable and green development. The research employed triangulation method involving both qualitative and quantitative approaches. Details of the research methodology can be found in Chapter 3.

In general, the process of data collection consisted of qualitative method which involved interviews and focus group discussions and quantitative method which are indicated in survey questionnaire. The survey respondents were from government agencies and highway concessionaires. Several methods were used to analyze the data. Qualitative data was processed using NVivo 10 application, while quantitative data was analyzed using SPSS v.17.0. Critical elements were derived from the analysis to develop the Malaysia Green Highway Framework. In order to ensure that the framework is relevant to the industry, the proposed framework was validated by the relevant agency before it can be fully implemented. The complete flow of this research investigation is visualized in Figure 1.1.

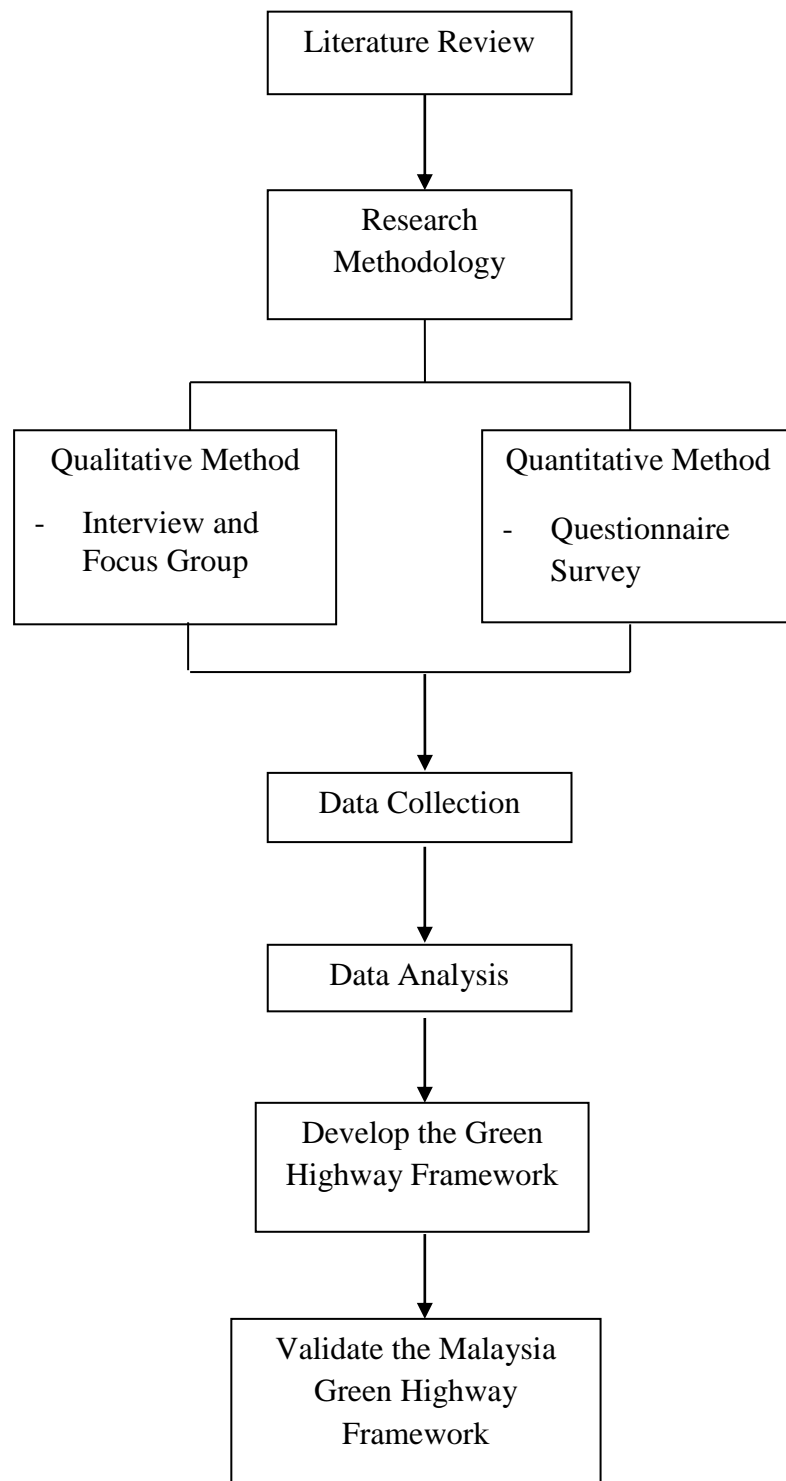


Figure 1.1: Research Methodology Chart

1.9 Summary

This chapter has provided the overall introduction to the research. The background of the study has led to the problem statements to be overcome in this study. Several initiatives have been taken to support the government mandate as a step to recognize the importance of green development. However, most of the rating tools in Malaysia only focus on buildings and roads. Initiatives on green highway are still lacking in the aspect of the development of rating tools, monitoring standards, guidelines and green framework. Thus, a proper system needs to be developed so that the implementation of green initiatives can cover all aspects of green development. This research aims to develop a green highway framework in Malaysia. It may serve as a master plan for the Malaysian Highway Authority (MHA) to implement green highway since this is the first green highway framework in Malaysia. The research focuses on tolled highways in Malaysia. The significance of research has impact on various aspects including economic, social and environmental impacts with some limitations. The research methodology processes have been outlined for an overall picture of the research. This study employs both qualitative and quantitative approaches for triangulation. In the next chapter, a review of literature related to this research will be explored in detail.

REFERENCES

- Abu Bakar Hashim (2011). Improving Malaysian Tolled Highways Operations Using Intelligent Transport Systems (ITS), Slide Presentation, http://www.piarc.org/ressources/documents/actes-seminaires06/c14malaisie06/8611_TS11-Hashim-ppt.pdf. Accessed on 26/10/2011
- Ahmad Zairin Ismail (2010). Development of National Green Technology. Malaysian Green Technology Corporation, Slide Presentation, Kementerian Tenaga, Teknologi Hijau dan Air, Putrajaya.
- Alfan, E., & Zakaria, Z. (2012). Accountability in Public-Private Partnership Projects: A Financial Analysis of Malaysian Highway Authority. *World Applied Scienced Journal*, 20(2), 221-227.
- Amekudzi, A., and C.M. Jeon (2007). Evaluating Transport Systems Sustainability: Atlanta Metropolitan Region. Presented at 86th Annual Meeting of the Transportation Research Board, Washington, D.C.
- Anderson, J.E. (1994). *Public policymaking: An Introduction: Second edition*. Houghton Mifflin Company, Boston.
- Barbara, C. Richardson (2005). Sustainable transport: analysis frameworks. *Journal of Transport Geography*. 13(2005), 29-39. Elsevier Ltd.
- Barry Ness, Evelyn Urbel Piirsalu, Stefan Anderberg, Lennart Olsson (2006). Categorizing Tools for sustainability assessment. *Ecological Economics*. 60(2007), 498-508. Elsevier Ltd.
- Bexter and Jack (2008). The Qualitative Report. Volume 13 Number 4 December 2008 544-559. Accessed on 15/4/2012. <http://www.nova.edu/ssss/QR/QR13-4/baxter.pdf>
- Briggs, S.R. & Cheek, J.M. (1986). The Role of Factor Analysis in the Development and Evaluation of Personality Scales. *Journal of Personality*, Vol(54), pp.106-48.
- Bowen, P.A and Hill, R. C. (1997). Sustainable construction: principles and a framework for attainment. *Construction Management & Economics*, 15(3), 223-239.
- Brundtland, G.H (1987). Report of the World Commission on Environment and Development: Our Common Future. UN General Assembly.
- Bryce, J.M (2008). Developing Sustainable Transportation Infrastructure. Washington Internship for Student of Engineering (WISE). ASTM International Standards Worldwide.
- Bryman, A. (2004). *Triangulation and Measurement*. Loughborough University, Department of Social Sciences, United Kingdom.
- Bushra Waheed, Faisal Khan and Brian Veitch (2009). Linkage-Based Frameworks for Sustainability Assessment: Making a Case for Driving Force-Pressure-State-

- Exposure-Effect-Action (DPSEEA) Frameworks.
www.mdpi.com/journal/sustainability. Accessed on 16/1/13
- Calista, Y. Tsai, Andrew S.Chang (2011). Framework for developing construction sustainability items: the example of highway design. *Journal of Cleaner Production*. 20(2012), 127-136. Elsevier Ltd.
- Chiu Y.H., Chen, C.H., Lin, C.F. and Liaw, S.L. (2002), “Development of a System Dynamics Model for Sustainable Land Use Management,” *Journal of the Chinese Institute of Engineers*, Vol. 26, No. 5, pp. 607-618.
http://www.astm.org/SNEWS/SO_2008/bryce_so08.html
- Chua, L.H (2002). The Singapore Green Plan 2012. Ministry of Environment. Internet Accessed on 13/5/13 <http://www.env.gov.sg/sgp2012>
- CIDB (2013). Guidebook on Planning and Implementing Green Practices for Building Construction Works. Malaysia Construction Industry Development Board, Kuala Lumpur.
- USEPA (2011). Committee of Incorporating Sustainability in the U.S. Environmental Protection Agency 2011; National Research Council Sustainable and U.S. EPA; National Academic Press
- Damodar N. Gujarati, & Dawn C. Porter (2010). *Basic Econometrics* (5th Edition). New York: McGraw-Hill Publications.
- Daniel, W.W. (1990). *Applied Nonparametric Statistics* (2nd Edition), USA: Duxbury Classic Series, Thomson Learning Publications.
- Debra, A.N; Paul K.; Michael R., (2011). Sustainable Decision Making Paper: Incorporating Sustainability into NYSDOTS’S Decision. International Conference on Ecology & Transportation ICEOT 2011 Department of Transportation, New York State.
- DEH (2004). Greening of Government Operations (GoGo) Frameworks 2004: A Green Framework for South Australian Government. Department of Environment and Heritage.
- DSM (2011). Department of Standards Malaysia. MS ISO 14000 Series: Environmental Management. Internet Accessed on 13/5/13
<http://www.standardsmalaysia.gov.my/> doi: 10.1061/41148(389)14
- Dora, C. (2007) Health Burden of Urban Transport: The Technical Challenge. *Sadhana: Academy Proceedings in Engineering Science*, 32(4) 285-292
- Douglas Knuth, P. E., & Fortmann, J. (2010). *The Development of I-LAST Illinois—Livable and Sustainable Transportation*.
- Elkington, J. (2004). Enter the Triple Bottom Line. In A. Henriques & J. Richardson (Eds.), *The Triple Bottom Line: Does it All Add Up? Assessing the Sustainability of Business and CSR* (pp. 1-16). London: Earthscan Publication.
- EPA (2005). Environmental Protection Agency: The Green Highways Partnership [Online] Available from:
http://www.greenhighwayspartnership.org/index.php?option=com_content&view=article&id=2&Itemid=29#GHPPRINCIPLES [Accessed on 28th October 2011]
- EQA (1974). Environmental Quality Act 1974. The Commissioner of Law Revision, Malaysia. Published in 2006.
- Ervina, Alfian (2007). Public-Private Partnership (PPP) Projects in Malaysian Tolled Highways – An Insight Using a Politically Economy Approach. *Proceeding of The Salford Postgraduate Annual Research Conference*. Pp 18-32. Internet

- Accessed on 13/3/13
http://usir.salford.ac.uk/15914/1/SPARC_2007.pdf#page=22
- European Network for Rural Development (ENRD); [Online]
http://enrd.ec.europa.eu/policy-in-action/improving-implementation/delivery-mechanisms/en/delivery-mechanisms_en.cfm; Accessed on 20 November 2013
- Exploring Green Highways (Sept/Oct. 2008) [Online] Available from:
http://www.astm.org/SNEWS/SO_2008/bryce_so08.html [Accessed on 28th December 2011]
- Fakhruf Arif and Mehmet Emre Bayraktar (2012). Theoretical framework for transportation infrastructure asset management based on review of best practice.
- Fong, W.K (2008). CO2 Emission by Source: 2005; [Online] Available from:
http://earthtrends.wri.org/searchable_db/results.php?years=2005-2005&variable_ID=463&theme=3&cID=114&ccID=1
- GBI (2011). GBI tools. GBI Residential New Construction (RNC) Tool V2.0.
<http://www.greenbuildingindex.org/Resources/GBI%20Documents/20090423%20-%20The%20Development%20of%20GBI%20Malaysia.pdf> Accessed on 26/10/2011
- GHP (2011). Green Highway Partnership.
<http://www.greenhighwayspartnership.org/index.php>. Accessed on 5/3/2012.
- Goh, C.W. and Zailani, Suhaiza (2010). Green Supply Chain Initiatives: Investigation on the Barriers in the Context of SMEs in Malaysia. *International Business Management* 4(1):20-27, 2010. Medwell Journals.
- Governance for Sustainable Development: A Framework
 Green Performance Assessment System In Construction (GREEN PASS), Slide Presentaion-A Quantitative Carbon Based Performance Assessment System for Buildings. Lembaga Pembangunan Industri Pembinaan Malaysia (CIDB).
- Grbich, C. Kitto, S. C. & Chesters, J., (2007). Quality in qualitative research. *Medical Journal of Australia*, 188(4), 243.
- Guidebook on Planning, Implementing Green Practices for Building Construction Works; Construction Industry Development Board; 2013.
- H. Meyar-Naimi, S. Vaez-Zadeh (2012). Sustainable development based energy policy making frameworks, a critical review. *Journal of Energy Policy*. 43(2012), 351-361. Elsevier Ltd.
- Hassan, M.M., (2008). Developing a LEED specification for design and construction of flexible pavement. Louisiana State University.
- Halilah Haron (2010). Research Methodology [Power Point Slides]. Unpublished Manuscript, STA650, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia.
- Highfield, C (2011). Sustainable Pavement Construction; Developing a methodology for integrating environmental impact into the decision making process. Master Thesis, Blacksburg, Virginia.
- Hui, Tay Sze, Shapiee Abdul Rahman and Jane Labadin (2012); Statistical Modelling of CO2 Emissions in Malaysia and Thailand. *International Journal on Advance Science Engineering Information Technology*, Vol. 2 (2012) No.5
- Huang, R. Y., & Yeh, C. H. (2008). Development of an assessment framework for green highway construction. *Journal of the Chinese Institute of Engineers*, 31(4), 573-585.

- I-LAST (2009), Illinois Livable and Sustainable Transportation Rating System and Guide. Illinois Department of Transportation.
- IRDA (2011). Environmental Planning Blueprint for Iskandar Malaysia. Iskandar Regional Development Authority (IRDA), Johor Bahru.
- Ismail, Mohd Affendi et al (2013); Fundamental Elements of Malaysia Green Highway, Applied Mechanics and Material, 284-287, 1194
- Jaafar, Noraini (1992) Sustainable Development in Perspective, Definition, Concepts and Policy Issues. In: Conference On Development On Malaysian Natural Resources, 29-30 September, 1992, Bilik Jumaah, Universiti Teknologi Malaysia, Kuala Lumpur. (Unpublished)
- Jeon C.M and Amekudzi A. (2005). Addressing Sustainability in Transportation Systems: Definitions, Indicators, and Metrics. Journal of Infrastructure System, ASCE.
- JKR (2012). Pelancaran Polisi Pembangunan Lestari JKR. 2013. <https://www.jkr.gov.my/news/read/1389>. Accessed on 16/11/2013
- Josephine K.Musango, Alan C. Brent (2010). A Conceptual Framework for Energy Technology Sustainability Assessment. Energy for Sustainable Development. 15(2011), 84-91. Elsevier Ltd.
- Julie Pallant (2010). SPSS Survival Manual (4th Edition). New York: McGraw-Hill Publications.
- Kurtner, Nachtsheim, & Neter (2008). Applied Linear Regression Models (4th Edition). New York: McGraw-Hill Publications.
- LLM and UTM (2014). Malaysia Green Highway Index (MyGHI) Manual Version 1.0. Lembaga Lebuhraya Malaysia and Universiti Teknologi Malaysia.
- Martens, P. (2006). Sustainability: science or Fiction? Sustainability: Science Practice and Policy
- Meryman, H., & Silman, R. (2004). Sustainable Engineering-Using Specifications to make it Happen. Structural Engineering International, 14(3), 216-219.
- MHA (2008). Guidelines for Malaysia Toll Expressway System – Design Standards; Lembaga Lebuhraya Malaysia, Kajang; 2008.
- MHA (2010). Preliminary Guide to Nurture Green Highway in Malaysia; Lembaga Lebuhraya Malaysia.
- MHA (2013). Laporan Tahunan LLM 2013. Lembaga Lebuhraya Malaysia, Kajang.
- MRCB (2011). Thinking Green, Doing Green. MRCB Sustainability Report 2011, Malaysian Resources Corporation Berhad (MRCB).
- Mukherjee, A. and Cass, D. (2012); A Project Based Framework for Assessing and Monitoring Highway Construction Greenhouse Gas Emissions. Construction Research Congress 2012:pp. 1941-1950.
- Mun, T.L. (2009). Green Building Index Malaysia. PAM Sustainability Committee. Internet Accessed on 13/5/13
- Mun, T.L. (2009a). The Development of GBI Malaysia (GBI). PAM Sustainability Committee. Malaysia.
- Munasinghe, M. (1992). Environmental Economics and Sustainable Development, Paper presented at the UN Earth Summit, Rio de Janeiro, Environment Paper No.3, World Bank, Washington DC, USA.

- NYSDOT (2001). GreenLITES Recognizing Leadership in Transportation Environmental Sustainability. Internet Accessed on 18/5/13 <https://www.dot.ny.gov/programs/greenlites>
- OECD (2008). Sustainable Development. Internet Accessed on 13/5/13 http://www.legrand.com/EN/sustainable-development-description_12847.html -
- OECD (2012). What is Sustainable Development? International Institute for Sustainable Development. Internet Accessed on 13/5/13 <http://www.iisd.org/sd/>
- Pallant, J. (2010). SPSS Survival Manual (4th edition), New York: McGraw –Hill Publications.
- Patrick et al. (2009). On the contribution of labelled Certified Emission Reductions to sustainable development: A multi-criteria evaluation of CDM projects. *Energy Policy*, 37(1), 91-101.
- Paul, B.D. (2008). A History of the Concept of Sustainable Development: Literature Review. *The Annals of the University of Oradea, Economic Sciences Series 17.2* (2008): 576-580.
- PLUS (2011). Enhancing Quality of Life, PLUS Sustainability Report 2011, PLUS Malaysia Berhad.
- Public-Private Partnership Policy and Practice – A Reference Guide; Edited by HK Yong; Commonwealth Secretariat; 2010.
- Radin Diana R.Ahmad (2003). Estimation of Carbon Dioxide Emissions from the Transport and Residential Sectors in Malaysia Using Asia-Pacific Integrated Model. Master Thesis. Universiti Putra Malaysia, Selangor.
- Rajesh Kumar Singh, H.R. Murthy, S.K Gupta, A.K. Dikshit (2011). An Overview of Sustainability assessment methodologies. *Journal of Ecological Indicators*. 15(2012), 281-299. Elsevier Ltd.
- Ramani, T. et al. (2008); Developing Sustainable Transportation Performance Measures for TxDOTs Strategic Plan: Technical Report; Texas Transportation Institute, Texas
- Richardson, B. C. (2005). Sustainable transport: analysis frameworks. *Journal of Transport Geography*, 13(1), 29-39.
- Ross Curz, Leed AP, Jin-Lee Kim, M.Asce, Hee Sung Cha (2012). Using A Thematic Framework To Compare Sustainability Rating System Applicable To Transportation Projects. *Construction Research Congress 2012@ASCE*.
- Schroer, A. (2011) The Road to Sustainability – The Focus Turns to Our Nation’s Transportation System. <http://www.gbutler.com/news-road-to-sustainability.html>. Accessed on 26/10/2011.
- Shen, T.H. (2001), Green Construction Engineering Projects – A Study of Establishing the Design Regulations and Standards of Green Highway Construction Engineering, Research report of the Public Construction Commission, Executive Yuan, R.O.C.
- Sheridan, J. Coakes, Lyndall Steed, & Clara Ong (2010). SPSS Version 17.0 for Windows: Analysis without Anguish. Australia: John Wiley and Sons Publications.
- Shu Yi Chu and Heike Schroeder (2010), Private Governance of Climate Change in Hong Kong: An Analysis of Drivers and Barriers to Corporate Action, *Asian Study Review*, 34:3, 287-308.

- Slaper, T.F., & Hall, T.J (2011). The Triple Bottom Line: What is it and how it work? *Indiana Business Review*, 86(1), 4-8.
- Snelling, S. (2010) Towards Green Bridges. *Green Streets and Highways 2010*: pp. 163-179.
- Soderlund, M., Muench, S. T., Willoughby, K., Uhlmeier, J., & Weston, J. (2008, January). Green Roads: A Sustainability Rating System for Roadways. In *Proceedings of the 87 TRB Annual Meeting*, Washington DC.
- Spohn, O.M (2004). Sustainable Development Indicators within the German Water Industry – A Case Study Carried out at Chalmers University of Technology, Sweden.
- Stake, R. (1995). The art of case study research (pp49-68). Thousand Oaks, CA: Sage.
- Litman, T. (2003). Sustainable Transportation Indicators. A Recommended Research Program for Developing Sustainable transportation Indicators and Data. Victoria Transport Policy Institute 100.
- Tara L. Ramani, Josias Zietsman, William E. Knowles and Luca Quadrifoglio (2011). Sustainability Enhancement Tool for State Departments of Transportation Using Performance Measurement. *Journal of Transportation Engineering*.137 (2011), 404-415
- Tim Weilkiens, Christian Weiss, Andrea Grass (2010) Chapter 7-Frameworks, OCEB Certification Guide, Morgan Kaufmann, Boston, 2011, Pages 123-140, ISBN.
- UNEP (2009). Integrated Policymaking for Sustainable Development: A reference manual (August 2009); United Nations Environment Programme.
- United Nations New York (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition: New York: United Nations Publication. Retrieved on January 18, 2013, from <http://www.un.org>
- United Nations New York (2008). Measuring Sustainable Development; Report of the Joint UNECE/OECD/Eurostat Working Group on Statistics for Sustainable Development. United Nations, New York and Geneva 2008.
- Wayne W. Daniel (1990). Applied Nonparametric Statistics (2nd Edition). USA: Duxbury Classic Series, Thomson Learning Publications.
- WCED (1987). <http://www.un-documents.net/our-common-future.pdf>. Accessed on 26/10/2011Wikipedia, 2013
- Wee, Kean Fong and Matsumoto, Hiroshi and Ho, Chin Siong and Yu, Fat Lun. Energy Consumption and Carbon Dioxide Emission Consideration in the Urban Planning Process in Malaysia. In: Unspecified
- Weinstein, N. et al (2008); Green Highways; Low Impact Development for Urban Ecosystem and Habitant Protection: pp. 1-7; American Society of Civil Engineers
- Whatls.com (2012). The ISO 14000 Standards. <http://www.iso.org/iso/home/standards/management-standards/iso14000.htm>. Accessed in 22/6/2012.
- Yin, R. K. (2003). Case studies research: design and methods. Thousand Oaks, Sage.Yin, 2003.
- Zietsman, J. and Rilett L.R. (2002). Sustainable Transportation: Conceptualization and Performance Measures. Texas Transportation Institute, Texas
- Zikmund, W., Babin, B., Carr, J., & Griffin, M. (2012). Business Research Methods. Cengage Learning.