THE DEVELOPMENT OF ONLINE CHECKLIST SYSTEM FOR TRAFFIC IMPACT ASSESSMENT (e.C-TIA) REPORT SUBMISSION IN MALAYSIA

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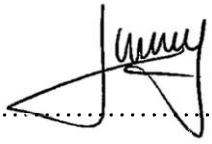
I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

Student : 

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ABSTRACT

Rapid urbanisation and development lead to expansion of roads and accelerated land use demand causing congestion, accidents, pollution and other transportation-related problems. Traffic Impact Assessment is introduced and conducted to assess and mitigate traffic impacts generated from the proposed development and improve road safety. The reports provide the authorities, developers and consultants the framework in making critical land use and site planning decisions regarding traffic and transportation issues. However, the different reporting standard due to different level of knowledge and experience of stakeholders, institutionalisation of the practice as well as lack of cooperation cause fragmentation in the standard TIA report submission. Besides, there is no online system in Malaysia to assist the stakeholders. Hence, this research aims to develop an online checklist system as a standard platform to manage and monitor the TIA reports more effectively and efficiently. This developed system is verified by test case using information systems success model and validated using Delphi method for users' satisfaction. This system enables consistency in fulfilling the requirements for TIA report based on guidelines by developers or consultants with standardised checklist and workflow and allows the authority who check multiple reports from different projects within 14 days. This research found that the system is useful as a managing tool for the coordination, collaboration and communication among stakeholders in reviewing, submitting, monitoring and updating the TIA report submission. Finally, the invited expert panel that evaluated the system was satisfied with the functionality of the design and flow of the system and 80% of them agreed that the system could be implemented in practice.

ABSTRAK

Perkembangan perbandaran dan pembangunan yang pesat memerlukan perluasan jalan serta peningkatan penggunaan tanah mengakibatkan isu kesesakan jalan raya, kemalangan, pencemaran dan masalah pengangkutan yang lain. Untuk mengatasi masalah ini, Penilaian Kesan Lalu Lintas diperkenalkan dan dilaksanakan untuk menilai serta mengurangkan penjanaan kesan trafik daripada sesebuah pembangunan untuk meningkatkan keselamatan jalan raya. Laporan penilaian ini membolehkan pihak berkuasa, pemaju dan perunding membuat keputusan kritikal tentang penggunaan tanah serta memberi cadangan untuk mengatasi isu-isu mengenai lalulintas dan pengangkutan. Namun, perbezaan prosedur laporan disebabkan oleh perbezaan tahap pengetahuan dan pengalaman pihak yang terlibat, penginstitusian amalan serta kekurangan kerjasama pihak terlibat menyebabkan fragmentasi dalam penghantaran laporan yang seragam. Selain it, Malaysia tidak mempunyai sistem untuk membantu penghantaran laporan tersebut. Oleh itu, kajian ini bertujuan untuk membangunkan sistem semakan atas talian sebagai platform standard untuk menyemak dan memantau laporan penilaian dengan lebih berkesan dan cekap. Sistem yang dibangunkan ini diverifikasikan dengan model kerjaya sistem maklumat dan divalidasikan menggunakan kaedah Delphi untuk mendapatkan tahap kepuasan pengguna terhadap sistem. Dengan menggunakan sistem ini, pemaju atau perunding dapat mematuhi piawaian Penilaian Kesan Lalu Lintas dengan konsisten melalui senarai semak dan aliran kerja yang ditetapkan serta membolehkan pihak berkuasa menyemak beberapa laporan daripada pelbagai projek dalam tempoh 14 hari daripada tarikh penyerahan laporan. Kajian ini mendapati pembangunan sistem ini berguna untuk alat yang menggalakkan koordinasi, kolaborasi dan komunikasi dalam kalangan pihak yang terlibat dalam mengurus, memantau, mengemaskini dan menghantar laporan penilaian. Selain itu, pakar panel yang dijemput berpuas hati dengan fungsi dan aliran reka bentuk sistem dan 80% panel berpendapat bahawa sistem ini harus dilaksanakan secara praktikal.

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LIST OF ABBREVIATIONS

TIA	-	Traffic Impact Assessment
UAV	-	Unmanned Aerial Vehicle
IS	-	Information System
LOS	-	Level of Service
RAD	-	Rapid Application Development
PHP	-	Hypertext Preprocessor
API	-	Application Programming Interface
ATJ	-	Arahan Teknik Jalan
JKR	-	Jabatan Kerja Raya
e.C-TIA	-	Electronic Checking of Traffic Impact Assessment
KUiTTHO	-	Kolej Universiti Teknologi Tun Hussein Onn
PuMAS	-	Pusat Minda Emas
UTHM	-	Universiti Tun Hussein Onn Malaysia
WIMS	-	Web-Based Information Management System
SIDRA	-	Signalised Intersection Design and Research Aid

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CHAPTER 1

INTRODUCTION

1.1 Background

The world is at a rapid pace of urbanisation, cities expanding changing countries social structure and travel patterns (Withanaarachchi, Setunge, & Bajwa, 2012). Urban cities are experiencing high degree of heavy congestion because traffic demand surpasses the capacity of existing transportation system. This phenomenon gets worse as traffic continues to grow uncontrollably and soon suffocate the already congested condition (Mathew, 2014). Many metropolitan areas both in developed and developing countries had reached intolerable level of traffic congestion (Hokao & Mohamed, 1999). In this environment with increasing traffic problems and private vehicles usages cause longer travel times, frustrations on road, road rages and environmental degradation (Ardekani, Hanuer, & Jamei., 1992) consequently leading to accidents and fatalities on the road.

In Malaysia, the growth of urban population is on a rise. Malaysian population raised 1.1% from 2017 to 32.6% in 2019 (Department of Statistics Malaysia, 2019) with unprecedented road infrastructure expansion (Alamgir *et al.*, 2018). Car owners made up 84 percent of the population in Malaysia (Valley, 2013) and the fatality rate in the country is among the highest in the world. Land use development and transportation system should be managed and supervised in development proposal application, assessment and mitigation as the countermeasures for traffic problems (Wang *et al.*, 2013). In addressing these problems of accommodation, land acquisition and traffic congestion, comprehensive policies are as significant as enforcement. (Yaakob, Masron, & Masami, 2010). Therefore, Traffic Impact Assessment (TIA) is adopted and applied in Malaysia.

TIA reports are used by the authority to consider the feasibility and rationality for the approval of proposed development. Submission of technical report holds the records of the engineering work done. Thus, as important as the application of mathematical knowledge, in the engineering practice, the reports are necessary to communicate the engineering works, in conveying the information of the performed engineering studies among the practitioners. These reports should be stored in a comprehensive manner so that all the vital information is well recorded. With checklist, the significant elements of a report can be fulfilled. However, based on previous case studies and publications, there are number of issues in the implementation of TIA such as lack of knowledgeable staffs, lack of detailed information and lack of monitoring process result in the institutionalisation of the practice in major cities where the staffs had more experience compared to local area where the practice is neglected.

Following this, online system is proposed as one of the approaches to overcome those issues in the practice of TIA. The consolidation of information technology as a sustainable approach in the industry is encouraged to improve the productivity. Also, there is an emphasis on the internet of things in Industrial Revolution 4.0. Thus, this research studies, the online checklist system is developed, a web-based system act as a standard centralised platform, integrating information technology in the submission of TIA reports.

1.2 Problem Statement

Malaysia has a growing population of 28.3 million in 2010 to 31.7 million in 2016 and is estimated to reach 41.5 million by 2040. Urbanisation growing rapidly from 51% in 1985 to 71% in 2010 and projected to reach 80% in 2030. Coupled with increasing affluence and mobility trends, it is estimated that Malaysians will make an estimated 131 million daily trips in 2030, a significant increase from the 40 million trips in 2010 (Ministry of Transport Malaysia, 2019). The transport network is facing unacceptably high accident and fatality rates, and congestion as shown in Figure 1.1. Since TIA has become notable in the international interest especially in developing countries to create sustainable land use development and transport network. Full establishment of TIA practice in Malaysia takes time and are facing challenges in implementation.

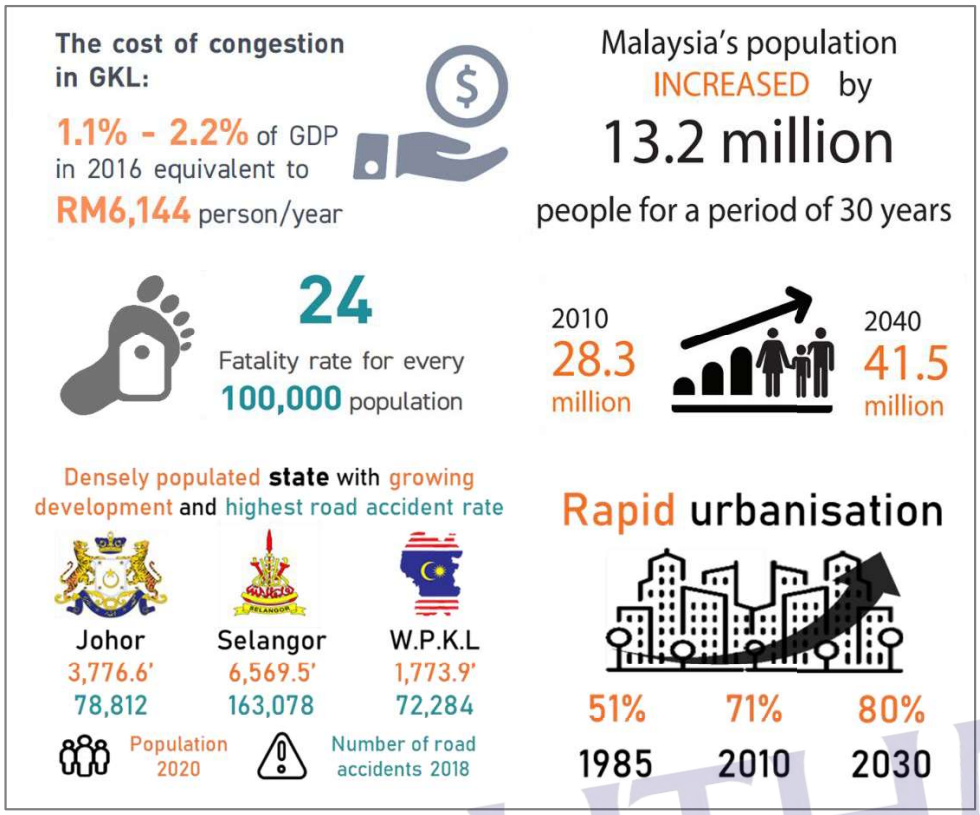

Figure 1.1: Malaysian Demography and Traffic Statistics

National Transport Policy 2019 – 2030 stated the following challenges: outdated standards, acts and regulations; poor readiness to embrace changes especially new technology; inadequate transport data to help in planning and developing transport sector; absence of centralised transport database to support evidence based and strategic planning by government agencies; coordination issues among transport related agencies; inadequate skilled workers or technical expertise in transport industry; inadequate research, development and innovation; and insufficient enforcement.

Despite efforts undertaken to reform the transport sector, policies and plans formulated at federal level didn't cascade effectively for implementation to the state and local authorities. Besides, there is insufficient expertise in the agencies involved in transport planning and development to enable them to carry their roles and functions effectively. There is absence of regularly updated data and centralised database that is accessible by all transport-related agencies. A common database that can be used as a reference point by respective agencies for evidence-based planning. There is a need for a centralised, commonly accessible database to allow more and better analytics, monitoring and evaluation.

Similarly, Dar es Salaam City in Tanzania a developing nation as a case study to depict the effects of TIA practice on land use change to the surrounding road network. The results of TIA implementation in Tanzania are illustrated in Figure 1.2. Submission of TIA report in Tanzania is not mandatory for land use and development application. Hitherto, the government yet to gazette standard guidelines in implementation of TIA practice (Kazaura & Burra, 2017).

	Planned on 1992 (Before land use change)	Observed on 2016 (change after land use)	Difference percentages
Population	36,633	124,278	258%
Vehicle trips	69,050	236,134	242%

	Planned and implemented on 1992		Change from 1993 -2016	
	Implemented without TIA	Implemented with TIA	Changed without TIA	Changed with TIA
Total TIA performance	167	3	446	0

		Before land use change (planned)	After land use change (observed) in 2016
		LOS	LOS
BAMAGA	Peak hours	C	F
	None peak hours	C	D
AFRICA SANA	Peak hours	D	F
	None peak hours	D	E
MWIKA	Peak hours	D	F
	None peak hours	D	E
KIJIWENI	Peak hours	D	F
	None peak hours	D	E
SHEKILANGO	Peak hours	C	E
	None peak hours	D	D

Figure 1.2: TIA Implementation in Tanzania

Since 1992 only 3 developments or larger projects in the city implemented TIA because medium and small scale developments do not qualify TIA standard and requirements and therefore TIA study is often exempted, disregarded or completely neglected. The population and vehicle trips in the city continue to grow and increased by about 250%, LOS of intersections deteriorated below baseline condition compared to as planned or at worst of LOS F. Whereby, additional trips generated on existing transport infrastructure exceed the planned and forecasted trips; the transport demand beyond the supply of transport infrastructures; losing its capacity to accommodate traffic that resulted into traffic congestion, jam and severe accidents. Urbanisation is a good sight for a developing nation, but uncontrolled rapid extension of spatial developments and cumulative adverse traffic impacts exert great pressure on existing

transport systems. This international case study justifies the importance and effects of TIA practice in land use change. The necessity of TIA reports submission as statutory attachment for the approval of development planning application. Besides, the report submission is important and should be well-documented for evaluation to help authorities in decision making and for monitoring to ensure mitigation measures has been implemented in the developments.

In the interview with practitioners of TIA as detailed in Appendix A, conducted with members from road department headquarters of Public Work Department as well as developers from JM Concord and traffic consultants from STEP Consultant and Hiway Matra Consult found that there is no online system in the current practice to assist the stakeholders in managing the submitted TIA reports. Reports are submitted to the respective Authority manually both hardcopy and softcopy. The disadvantages of this submission method are documents may be lost overtime and the sheer amount of reports cumulated will take time for sorting and back-tracking. Besides, the inconvenient to consistently carry hardcopies around and on site inspired the idea to have those documents well-sorted online. Without a system to distribute the document for effective information process flow resulted in a need to shift from static, stand-alone applications to dynamic and shared environment. This study researches the application of internet technology to access TIA reports online for faster and no longer need to wait for a printed report and contact whenever the TIA reports are needed. Lastly, those traffic data are stored online will be useful future spatial development planning and traffic monitoring studies.

1.3 Objectives

The aim of this study is to develop an online checklist system known as e.C-TIA to assist the stakeholders in TIA reports submission in Malaysia with the following objectives:

(i) To identify the management elements for TIA report submission;
(ii) To determine and design the online checklist system; and
(iii) To validate and verify the developed e.C-TIA system.

1.4 Scope of Research

In order to achieve the objectives of this study, the scope of the research must be clearly defined and the research is scoped in the following manner:

The stakeholders are defined as practitioners in TIA in this study consist of the authority, developer and TIA consultants. The authority here is the road authority and local authority in Malaysia who are the decision makers in the approval of TIA reports. Meanwhile, online checklist system is a web-based information management system to manage TIA reports online. The main purpose of the system is for developers to submit the softcopy of TIA reports based on the checklist, consultants to fulfil the requirement for TIA report based on the gazette guidelines with the pre-requisite list of items and for the authority to check, review and monitor the submission online.

Every country has individual standard guidelines, there is no universal standard due to demography and local behaviour and the practice of TIA varies based on the standard of their respective countries. This system is developed based on Malaysian standard. The benefit of the online checklist system is there are room for adaptation to their countries, with modifications, the practitioners can use the system to improve the way for checking the TIA report submissions in their respective countries.

The study location involved Johor, Selangor and Kuala Lumpur for the demography characteristics of rapid growing development and population, congestion and traffic accidents issues which TIA is widely implemented. Whereby, the stakeholders at federal government departments and TIA consultancies had more experience and knowledge due to their exposure and direct involvement in TIA implementation. This study also work closely with the road department headquarters of Malaysia Public Work Department Kuala Lumpur, agency that establishes TIA practice and guidelines in Malaysia. While, for traffic monitoring study was taken at Pusat Minda Emas, UTHM where TIA conducted with availability of submitted report.

1.5 Contributions

This research contributes to the knowledge, visibility and significance of TIA practice in Malaysia, publications produced for this research are listed in Appendix E. The main contribution of this research is the development of online checklist system will assist stakeholders in TIA report submission in Malaysia. e.C-TIA system computerises

submission of softcopy via network technology, increasing the transparency of standard requirements among stakeholders. Complementing with the manual submission of hardcopy, e.C-TIA system will benefits stakeholders with:

(i) A standard web-based platform for stakeholders to submit TIA reports in fulfilling the requirements based on Malaysian Guidelines.
(ii) Ability to store, retrieve, and view the submitted TIA reports online making them to be easily accessible, making it portable.
(iii) Ability to monitor traffic impacts of a development after a period of time with the historical record from the reports.
(iv) Ability to communicate in a platform and view status of submission online.

1.6 Thesis Layout

The brief introduction of each chapter is provided in this section. There are 7 chapters starting with research background, problems that lead to aim and objectives of study, scope, and contributions in Chapter 1. Followed by the intensive reviews in Chapter 2 which consists of comparative studies on TIA practice, document analysis on web-based information management system, and descriptions on research methods. Chapter 3 provides the methodology used with Rapid Application Development as main approach. Findings for each method conducted are interconnected in three chapters.

Chapter 4 presents findings from traffic study, comparing traffic conditions of the before and after. The significant outcomes of the study are incorporated as elements in designing monitoring checklist during the development of e.C-TIA system.

Chapter 5 discusses results of developed e.C-TIA system. This system is created using web-builder with 4 management elements for TIA report submission, drawn from findings in previous chapters. Besides, detail explanations on each design element and functionality of each interface are presented. Then, the system is tested.

Chapter 6 presents findings for e.C-TIA system testing. The system is validated using interview and questionnaire, and verified with test case, in two rounds using Delphi method with a panel of 10 experts.

Finally, this research is concluded in Chapter 7. This chapter discusses the research achievements, limitations, advantages of developed e.C-TIA system, and recommendations for future works.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the practice of TIA in developed and developing countries as well as the practice of TIA in Malaysia in comparative studies to understand the issues in the practice that supports the idea of the development of online checklist system as implementation improvements to overcome those issues. Following that is the knowledge acquisition on the web-based information management system for the development of the online checklist system for the TIA report submission.

2.2 Traffic Impact Assessment

Traffic Impact Assessment is a technical appraisal of the traffic impact and safety implications relating to a development, which is a process of compiling, analysing and documenting the effect a development possible will have on the adjacent roads operation and transport networks (Weerasekera, 2011). Traffic impacts and environment impacts, land-use policy and resource consent and development planning and management together are significant in the decision making for development applications (Atchia, 2017).

The TIA report contains the information on the projected traffic expected from a proposed development and evaluation of the impacts of proposed development on the surrounding and immediate proximity roadways. Besides, the report contains the identifications of potential traffic operational problems or concerns and the

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