



The Development of Online Checklist System in the Practice of Traffic Impact Assessment Report Submission in Malaysia

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ABSTRACT

Traffic Impact Assessment is a process to assess the traffic impacts generated from a proposed development so that proper mitigation measures can be proposed to reduce those impacts in order to maintain the road safety. TIA reports are used by the authorities, consultant and developers to make critical land use and planning decision on the feasibility of the development planning application with regard to the traffic and transportation issues. In practice, the lack of standardized procedure causes TIA reporting varies with the level of knowledge of the practitioners and the lack of cooperation resulted in the institutionalisation in major cities. This study developed an online checklist system to overcome those issues by reducing the fragmentation in the management of TIA report submissions. This system enables consultants and developers to fulfil the requirements of TIA report based on the gazetted guidelines with prerequisite checklist in the system and allows the authority to assess multiple report from different projects within the 14 days period. The system is verified with information success model and validated by expert panel using Delphi's method. The expert panel is satisfied with the system functionality in meeting their requirements to effectively manage the report submissions.

Key words: standardized report, Traffic Impact Assessment, web-based information management system.

1. INTRODUCTION

Malaysia like other developing countries are facing issues in the implementation of TIA [1], [2]. One of the issues is political priority, TIA in developed countries are established with proper guidelines, plans and handbooks. While in developing countries, the discrepancy is the practice is under weak urban land use plan and lacking of legal framework [3]. Besides, some guidelines do not clarify the responsibility of the parties involved in TIA practice and without the establishment of this responsibility leads to the lack of

cooperation between roles [4]. In additional, the experts and technicians in the government and consultants do not have the sufficient experience and technical understanding on TIA together with no incentives for improvement will results to the inefficient and unsuccessful implementation of TIA [5]–[7]. Lack of knowledge among the stakeholders in developing countries had been discussed in many previous studies and Malaysia too facing with this issue as studied in [8]. This is because the practice is concentrated in major cities due to the abundant development projects that required the conduct of TIA. As the country continues to develop, local area also requires TIA in the proposed development planning application. The institutionalisation of the practice in major cities enables the stakeholders to acquire the necessary experiences and skills. While, the staffs in the local region lack of knowledge on the conduct of TIA coupled with the lack of cooperation between stakeholders, the lack of standardised procedure and less emphasis on the review and monitoring process resulted in the fragmentation of the practice [9]–[11]. When the conduct of TIA is neglected in the long term with rapid development growth, the accumulation of traffic impacts will result in the build-up of traffic volume in minor region. The occurrence of congestion and traffic accidents will become more pronounce and severe.

The mitigating of traffic impacts will be more time consuming and costly if the existing developments already in the surrounding environment. Uncontrolled developments results in the increasing trend in traffic accident and fatality [12]. The mixture of commercial, industrial and residential developments varies the speed limit across regions, road users are having difficulties complying with the traffic safety on the road [13], [14]. Congestion is happening frequently especially during peak hour because of the overcrowded development and land use [15], [16]. These traffic impacts can be mitigated in the early planning stage of proposed development with the traffic study in TIA practice. The TIA reports record the mitigation measures that address those traffic impacts for the stakeholder to make critical land use decisions and feasibility of the development planning proposal. This keep the development under controlled and the parties are still

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responsible involve in the changes. Thus, an online checklist system is developed in this study to assist the stakeholders in fulfilling the requirements for TIA report as in the gazetted Malaysian guidelines so that the management of the submissions is computerised in a standard singular platform.

1.1 Web-based Information Management System

Information technology (IT) is the use of computer systems, software and networks to process and distribute data. Information management system embedded all aspects of IT for capturing, storing, organising and retrieving data [17], [18]. Internet is among the IT application that facilitates the management of information in the collaborative working environment. Internet of Things is the advancement of life and in engineering is used to improve the productivity of work with technology [19]. Web-based information management system (WIMS) is the merging technology served as the tool in the engineering industry to enhance documentation and control. The use of WIMS revolutionised the way in projects administration and monitor by improving the communication, coordination and collaboration that connects boundary and offer opportunity for teamwork and workflow automation [20]–[23]. The multiple stakeholders and their hectic schedules limited in-person meetings, many organisation resort to the use of IT for time optimisation and to bridge communication. WIMS is the common method applied in the industry that allow the real time interaction and collaboration between multiple parties and phases of projects. A well-defined system streamline workflow with customised features and automated tasks increase the speed and dissemination of information with instant feedbacks. This technology is the engineering industry, education and business to improve productivity and quality of work [24].

Information in web-based is stored on servers with standard web browser as a getaway for the exchange of this information, geographic and boundaries limitation can be eliminated in a closed network. WIMS able to incorporate project hierarchy that restrict document to individuals at certain levels of responsibility and seniority. Consequently, mistakes by poor communication and delays due to time taken to manage document and people around for approvals and meetings can be minimised [25]–[27]. Construction industry apply WIMS in project management, evaluation system, risk management system and monitoring system. While in traffic and transportation, web-based system mainly on the topic regarding modelling and simulating traffic impacts [28] and traffic conditions [29]. Little study concerning the provision of interactive system for the management of reports. Hence, this study utilise the same application for the stakeholders consist of authority, developers and TIA consultants to manage the TIA report submission as illustrated in Figure 1.

One of the advantages of WIMS is ability to reduce data redundancy and promote consistency, presenting information in an integrated database [30]. Changes appear consistently and reflected immediately across the database preventing duplication of data among users in a singular database. Sharing real time data allows multiple users to access the data based on their role with the right protocols, authorised users can access

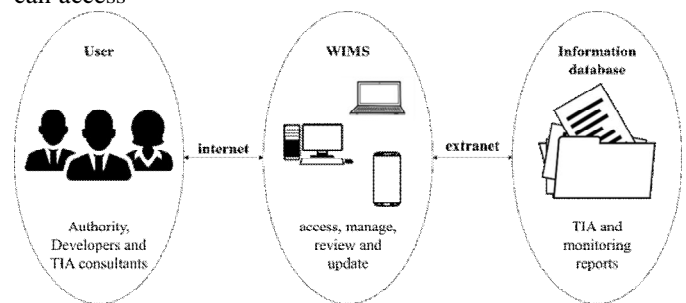


Figure 1: The proposed concept for the web-based information management system

to the database simultaneously with the jointed data. With this, the system able to promote data integrity with accurate data for all users in the database. The authentication where users access to their database using their identification of username and password enhance the security and privacy setting of the system. Time constraints in data management can be eased with the use of WIMS. The storing of large amount of data provides the historical data and records of trends which is useful and valuable over time especially in traffic conditions to show the logical links and changes over time. This is because in the engineering disciplines required the gather, enter and process of data to help the organisation to run in a regulated and managed manner and this is made possible with proper management system.

1.2 Online Database Website Builder

The two common methods used by software engineer to develop WIMS are by manual coding or by website builder. Now, many application was built with website builder and this method able to create the same system with less hustle. Website builder is an all in one tool with easy drag and drop editor for the quick construction of websites of basic create, read, update and delete (CRUD) functionality without coding. Unlike offline website builder, the benefits of online website builder such as Tadabase.io eliminates the need to download software on the computer and installation that required technicians. An application can be developed with web browser and internet connection. Builders can then save time and cost as the website builders' vendor provides the latest version updates and the vendor also provides web hosting services. Builders do not need to take the effort to update the software themselves neither to purchase or set up hosting

services separately [31]. Hence, in this study to develop the online checklist system, online database website builder is suitable due to the low-cost, quick development of professional application system. Besides, the system development life cycle of rapid application development approach requires the constant interactions with the stakeholders or users feedbacks in iteration process to develop a system that meets their requirements in managing the TIA report submission.

1.3 TIA Workflow in Malaysia

Public Work Department Malaysia gazetted the latest Malaysia TIA guidelines in 2018 [32] in replace of the first guidelines in 2010 [33] as a framework to the conduct of TIA. In the guidelines, the stakeholders in the practice of TIA are the developers, TIA consultants and authority. Developers are the owner of the development project; TIA consultant are those accredited as TIA assessor; Authority is the local authority who are the local municipals, town councils and public work department.

In the initial stage of proposed development planning, the developer is to liaise with the authority to demonstrate the traffic planning for the development. Then, they are responsibility to engage and appoint the TIA consultant to conduct the TIA for the professional inputs of the traffic issues. The report will be used by planners or architects to develop the preliminary site or layout plans which is important to avoid undesirable situation as the project progress where the traffic requirements will incur more cost and time to be corrected.

The TIA report is submitted to the authority for evaluation in the permission for planning application. Currently, there is no web-based system for the submission of TIA report. The authority is using the manual management for the application and traditional hand submission to the respective authority in charge of the area. Record of the changes are kept at the local department with their respective record keeping management. As there is no standard management method, there is difficulties in track record of the changes in progress and interaction of the multiple submissions. Meanwhile, the load of TIA submission for proposed development planning application at the one time can increase the burden of checking the TIA reports. Besides, the authority is given a 14 days period for evaluation and approval from the date of submission of the finalised TIA report by the developer [34]. Hence, this study proposed web-based system as an alternative to manage the TIA report acting as a singular platform for all submissions and for the stakeholders to engage in the system.

2. METHODOLOGY

The two main phases in this study is the first phase of the development of online checklist system and the second phase of system testing for verification and validation.

2.1 Development of online checklist system

The first phase of development consists of system requirements process and the process for design and build of the system. In the system requirements process, the items for the system are identified such as the purpose and objectives, entities, interactions and flow of the system. Upon meeting discussions with the experts and practitioners in TIA and the staffs from the road department of Malaysian Public Work Department who gazetted the Malaysian TIA guidelines, the list of item for the TIA reports are obtained which is standardised in ATJ 38/2018.

By hardcopies, the submission to the authority includes 3 set of plans in A1 size and the TIA report with cover letter all endorsed by TIA consultant who are the professional engineers with engineering practice statement. By softcopies, TIA report with cover letter, presentation slides of the report and the proposed improvement for the traffic and road infrastructure of development and its surrounding in AutoCAD drawings format. Other required plans and flow of TIA application are attached in the Appendix A and Appendix B respectively. This proposed online checklist system is to create an online platform the softcopies submission together with the hardcopies so that the reports are intact in a cloud system when in need for future references. When there is no centralised management system, this valuable reports will lose over time due to changes of the staff in charge, disposal of documents or movement in organisation office place. With the list of items, flow of submission, stakeholders are identified, the next process is the design and build of the system.

In this process of design and build of the system, the items and flow are according to the order and priority of the requirements as shown in Figure 2. Based on this, the interfaces are designed based on the stakeholders or users role either as developer, TIA consultant or authority with their respective designated tasks. Besides, the features are determined to allow the interaction between the stakeholders and information such as email notification, comments and remarks option, historical tracking of submission, and other buttons of easy navigation in the system. The four parameters in the system management are in terms of information, document, centralisation and time. This parameters will ensure that the developed system will meets works as the intended functionalities in assisting the users to manage the TIA report submissions.

In the build process, the website builder, Tadabase.io is used to create the professional web-based information management system. The first step of the build is the registration interface, based on the users' role and responsibility either as consultant, developer or authority are created as individual group of entities. Then, second step of build is management interface where each user's entities are connected to their dashboard or account to manage the submission with their designated tasks.

In the management interface, the developer is to create the TIA application and assign the TIA consultant. Then, they are to fulfil the list of items programmed into the system in an orderly manner. The list of items are arranged in a way that allow the consultant to present their TIA report information that meets the requirements outlined in the gazetted Malaysian guidelines and application cannot be submitted unless the required items are fulfilled.

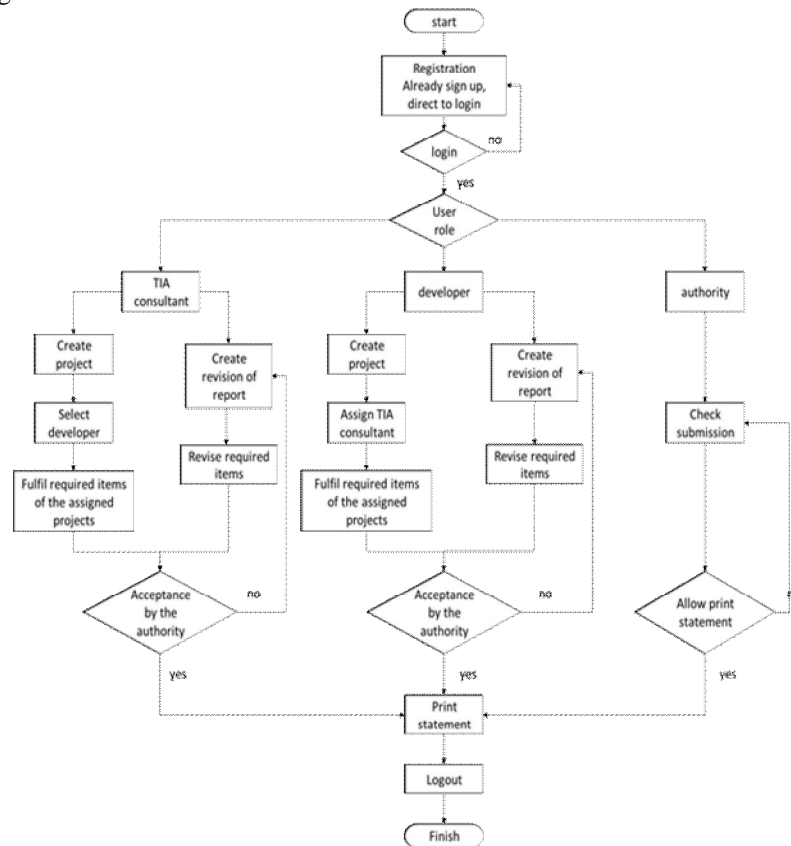


Figure. 2: Proposed online checklist system flow

The third step in the build is the submission interface, email notification will be automatically send to alert the relevant involving users on the submission. From the date of the submission within 14 days, the authority is to check and evaluate the report and to give their approval to accept or reject the application. The developer and consultant will be notified via email on the status of application and they also can read the remarks in the online system on their submission.

2.2 Verification of System

After intensive review on information success model for the verification of web-based system, [22] suggested the DeLone and McLean improved information success model as shown in Figure 3. If a web-based information management system

able to meet all the attributing factors deduced in the model, then the system is working successfully as expected in meeting the system requirements. Those affecting factors are system (processing of information), information (production of system outputs) and service (quality of service) to determine the success or failure of a WIMS. A system is consider successful is the system able to work seamlessly with the intended function and the system able to meet the users' satisfaction to give a net benefit to all individuals using the system in managing the project, increasing the performance and productivity of work. Hence, in the system verification, test case is used to determine the use of the developed system, where 10 users are invited to use the system for submission and test each features in the system whether those features function as expected. While, users' satisfaction is tested in the validation of system discussed in the next sub-topic.

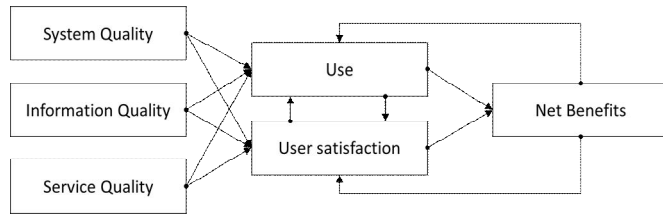


Figure 3: Delone and Mclean IS success model [35]

2.3 Validation of System

User’s satisfaction is after the users experience with the system, the measure of their degree of agreement with the quality of the system in meeting their needs. This study used Delphi’s method of validation with two rounds of questionnaire with 10 invited experts as shown in Table 1. The first round is done in meeting with the expert panel, where they are introduced with the system, each interfaces and features of the system. Then, they go through the system by carrying the submission from the registration interface to the completion of submission interface. After the experience, they are to give their expert recommendations for improvement so that modifications can be done to refine the system. The second round of questionnaire is done via email with the refined system and the responses are collected in a 5 point Likert scale feedback form. Their level of satisfaction is rate from 1 strongly disagree to 5 strongly agree.

Table 1: Characteristics of invited participants

Participants	Characteristics
(5) Authority	They are the road authority from the Malaysian road department of Public Work Department who are the committee member in the preparation of Malaysian TIA guidelines
(3) Developers	They are in the civil construction industry for at least 3 years who submitted TIA reports for their development planning application
(2) Consultants	They are civil engineers or traffic engineers who completed at least 3 TIA reports and registered with Board of Engineers, Malaysia as Professional Engineer

3. RESULTS

The purpose of the online checklist system to create a centralised online platform for the submission of the final TIA report for evaluation. The developed system is named as e.C-TIA stands for electronic checking of TIA report submission. The interfaces are designed to assist the stakeholders in the management of TIA report submission accessible online anytime and anywhere.

3.1 Interfaces in E.C-TIA and Functionalities

In the registration interface, there is option to sign up as users as shown in Figure 4 and if already a user, then can proceed to sign in button to log into their account. The users are asked for the name, password, email address, contact number, representing organisation and their role during sign up. After signing in to the system, the users are brought to their respective dashboard with the designated task in the system.

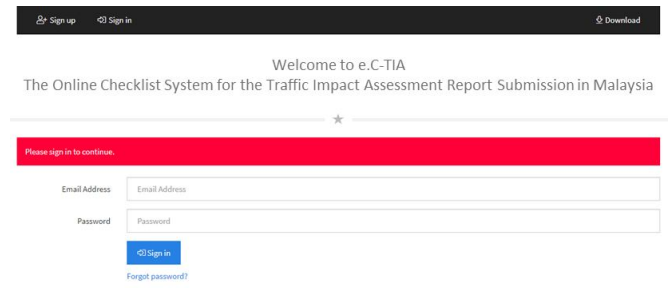


Figure 4: Registration interface for users

Their role is either as developer (create application and assign TIA consultant), TIA consultant (fulfil the required information for TIA report in the system) or authority (to evaluate and give approval of the submission). In the management interface, the main display is the table of submission on their dashboard where the users can view, and delete their application as shown in Figure 5 (a). For the authority as shown in Figure 5 (b) where they can review and evaluate the submission with colour status for easy viewing and tracking.

The screenshot shows the 'Developer Project List' dashboard. It features a search bar, 'Add Filter', and 'Create Project' buttons. The table below has the following data:

Submission	Date/Time	Project Name	Status	Statement of Approval	View	Edit	Submit	Delete
In Review	07/19/2019 04:03 AM	Project F			View			Delete
Overdue	07/04/2019 04:02 AM	Project E			View			Delete
Completed	07/19/2019 04:01 AM	Project D	Reject		View			
Completed	07/19/2019 03:58 AM	Project C	Approve	Download	View			
In Progress		Project B			View	Edit	Submit	Delete
Submitted	07/19/2019 03:56 AM	Project A			View			Delete

(a)

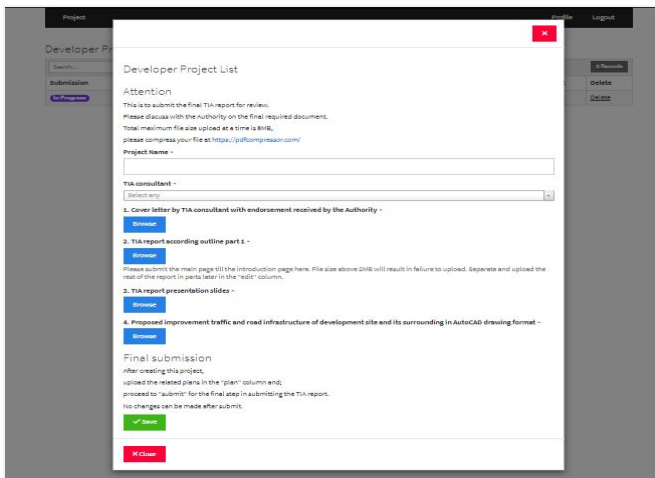
The screenshot shows the 'Project Data Table' dashboard. It features a search bar, 'Add Filter', and '5 Records' indicator. The table below has the following data:

Submission	Date/Time	Project Name	Developer	TIA consultant	Status	View	Review	Delete
In Review	18.07.2019 12:26 AM	Project E	developer	consultant		View	Review	Delete
Completed	18.07.2019 12:26 AM	Project D	developer	consultant	Approve	View	Review	Delete
Completed	18.07.2019 12:25 AM	Project C	developer	consultant	Reject	View	Review	Delete
Submitted	18.07.2019 12:24 AM	Project B	developer	consultant		View	Review	Delete
Overdue	01.07.2019 12:00 AM	Project A	developer	consultant		View	Review	Delete

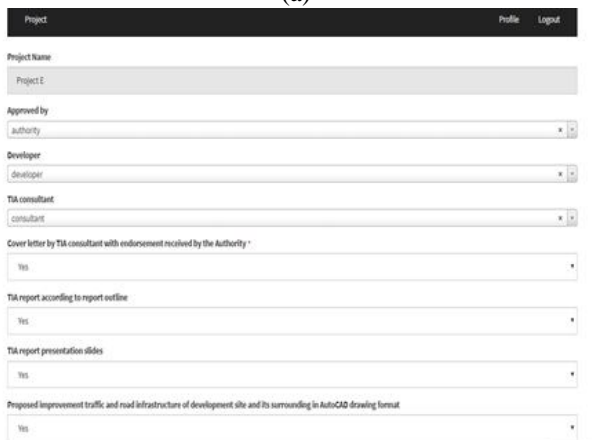
(b)

Figure 5: Main display for (a) developer or TIA consultant (b) authority

The information of the TIA report to be uploaded into the system is organised in the checklist system for easy tracking and only can proceed is the required items are fulfilled. This is shown in figure 6 (a) where the TIA consultant is compulsory to include the TIA report with cover letter and presentation slides to create a new application. Then, they can edit the submission to fill up the rest of the items in the checklist. While in figure 6 (b) is for the authority to accept by yes button or reject by no button in the individual uploaded information in the checklist. The accepted submission is attached with a statement of acceptance to mark the success application and authority is to give remarks if the application is rejected. This management interface included the four parameters where e.C-TIA acted as a centralised platform for the users to communicate and all engagements is recorded in the system. Besides, the information is arranged where it is prerequisite to fulfil all the required item in the checklist before proceeding to submission and status of submission to be given within 14 days with automated email to alert the authority on submission with not status given. Finally, the document can be managed more easily with users' friendly buttons for navigation and promote transparency among the stakeholders coming from different organisation with a standard submission order.



(a)



(b)

Figure 6: (a) Create new TIA application (b) Check application

3.2 System Verification

System verification shows that e.C-TIA able to meet the system requirements as a successful web-based information management system. E.C-TIA able to perform as an integrated system for the users to manage the TIA report submission. Tabulated in Table 2 are some of the test case carried out to show that the system indeed able to function as expected based on the factors of Delone and Mclean IS success model. The system able to meet all the assessment as attached in Appendix C. During the conduct of test case with the expert panel, it is noted that the traditional manual submission presented the issue of where some of the required items are not fulfilled in the submitted TIA report to the authority which is necessary in the TIA study. Now, with e.C-TIA this issue will not happen as the system will ensure the required items are achieved before submission can be done.

Besides, the issue of the lack of monitoring in the practice of TIA can be overcome as the report is accessible online in time of need to compare the traffic condition during the time of study and the changes after 5 or even 10 years of development. This is because the reports are stored in online system where authority can track whether the approved development application has implemented the measures for optimal traffic condition. The purpose of monitoring is to ensure the recommended mitigation measures are adopted in the development [36] and this process also will enforce the significant of TIA in practice of development planning [37].

Table 2: Sample of test cases

	Test case	Result output
System Quality	System compatibility with Microsoft office and AutoCAD	Successfully uploaded and downloaded file and opened as stored in the said format
Information Quality	Able to offer information on real time	System displayed the real time status of submission whether in progress, submitted, in review and approved or rejected
Service Quality	Service provider possess the knowledge of traffic engineering	System is developed by researcher with the knowledge of traffic engineering and tested by expert panel are the stakeholders in TIA

3.2 System Validation

In the first round of validation, the expert panel recommended email notification for the users on the submission status to ensure timely updates. This have been added into the system

along with other modifications. In the second round of validation, the expert panel gave their feedbacks on e.C-TIA with questionnaire form asking them regarding their level of agreement with the developed system. Closer to 5 on the Likert scale shows that they agreed and satisfied with the designated interface of the developed system as shown in Table 3. They agreed that e.C-TIA able to assist the stakeholders in fulfilling the requirements of TIA report parallel with the Malaysian TIA guidelines. The time restraint in the system for submission status of 14 days from the data of submission with email notification is a good feature as the quick and accurate response of the application is essential to prevent delay in the development progress. The expert panel agreed that e.C-TIA to be implemented in the practice of TIA for better management of TIA report submissions.

Table 3: Second round questionnaire-mean

No	Question	Mean
1.	The interfaces of the developed system are organised and easy to follow.	4.8
2.	The TIA online checklist system is in line with the Malaysian TIA guideline.	4.6
3.	This system able to assist the developer, TIA consultant and Authority in fulfilling the requirements for TIA report submission.	4.7
4.	Evaluation can be done within 14 days.	4.8
5.	The system will benefits the stakeholders and can be implement in the TIA practice.	4.5

4. DISCUSSION AND CONCLUSION

The developed online checklist system, e.C-TIA able to achieve the purpose as an integrated centralised platform assisting the stakeholders in the managing of TIA report submissions. The contributions of e.C-TIA is the system able to assist the developer and TIA consultant to complete the TIA report submission accurately with the checklist programmed into the system. When the required items are systematically organised, authority able to check the information of the TIA report more effectively as all information are standardised, reducing duplication with consistent reporting. This system provides the colour filtration of the submission status, even with multiple applications received by the authority with simple buttons they able to arrange each submission based on the status. If results are not given within 14 days, email notification will be send automatically to alert them. With the TIA reports stored in an online system, regardless of time and locations, the information of the TIA reports are accessible on their portable devices via internet. The system also promotes collaboration between stakeholders where all the engagements are recorded

and documented in real time. With these benefits, the expert panel recommended e.C-TIA as an alternative for the TIA report submission to enhance the workflow in the management of the reports.

APPENDIX

Appendix A is other plans in the checklist of the system. Appendix B is the flow of TIA application and Appendix c is the assessments for Delone and Mclean Information Success model. All appendixes are attached below.

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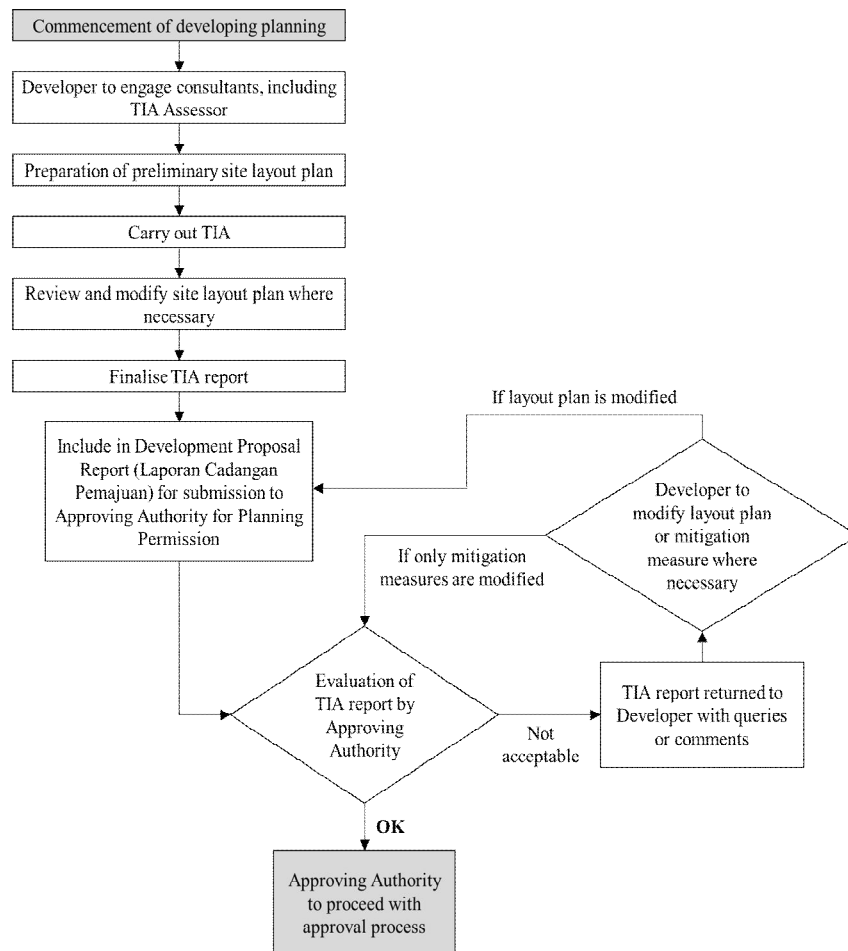
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Appendix A: List of Plans for TIA report

Plan	Content
Plan 1	a) Table showing components of development, plot ratio, density, total gross floor area, model split and annual growth
	b) Traffic study coverage area and survey location of junction and mid-block
Plan 2	a) Ingress and egress traffic distribution and assignment pattern plan shoeing existing, upon completion with and without development and improvement, and future traffic projection
	b) Trip generation for the proposed development
Plan 3	a) Comparison table of Level of Service (LOS) on junction analysis showing existing, 10 years upon completion with and without development and improvement, and future traffic projection
	b) Junction Analysis Plan
Plan 4	a) Comparison table of LOS and mid-block analysis showing existing, 10 years upon completion without improvement and with improvement and future traffic projection
	b) Mind Block Analysis Plan
Plan 5	a) Existing traffic and road arrangements of development site and its surrounding
	b) Proposed improvement traffic and road of development site and its surrounding
	c) Linkage to public facilities and infrastructure
	d) People facilities like pedestrian walkway, pedestrian bridge, underground pedestrian passage, bicycle track
	e) Transit Oriented Development (TOD)



Appendix B: TIA application process [33]

Appendix C: Delone and Mclean Information Success model and attributes [35]

Factors	Attributes	Assessment Items	
System quality	Connectivity	Compatible with other software (such as excel, CAD)	
		Connect to other IT tools	
	Usability	Data input/output functions should be operated easily (e.g., up/download, printing)	
		Access to system should be not difficult System should maintain the stable state	
Information quality	Format	System functions and configuration should be related to required information System screen configuration or document formats should be suitable for information use	
		Currency	Search of information should be easy Offer information to users on real time
	Accuracy		Information in system should be reliable Information in system could be used without correction Information in system should be sufficient
		Relevance	Information in system should be related to user's task Information in system should be related to project characteristics. Options for information usage should be various depending on the user's task
	Service quality		Responsiveness
		Follow up service	
Assurance			Service provider should possess knowledge of engineering and field of system interest (traffic) Service provider should be faithful
		Reliability	User should feel safe regarding data security User should trust capability of the system service provider