POLITEKNIK UNGKU OMAR

DATA COLLECTION MOBILE (EDC) FOR TRAFFIC

MASTURA BINTI OMAR

(01BCT21F3009)

CIVIL ENGINEERING DEPARTMENT

SESSION II 2023/2024

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A project report/thesis submitted in partial fulfilment of the requirement for the award of the Bachelor of Civil Engineering Technology with Honours

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DECLARATION OF ORIGINAL AND OWNERSHIP

DATA COLLECTION MOBILE (EDC) FOR TRAFFIC

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

3. Hereby agree to let go of the intellectual property ownership of this project to Ungku Omar Polytechnic in partial of the requirement for the award of the **Bachelor of Civil Engineering Technology with Honours.**

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APPRECIATION

In the Name of Allah SWT, Lord of the Universe. All Praise is only for Him. Thanks to God for His abundant grace and His permission, the writer was given good health and strength. So, this final year project was named Modernize Traffic Data Collection: A Mobile Application Approach for Construction Project Efficiency. My deepest appreciation to my final year project supervisor Dr. Seri Bunian binti Mokhtar and Dr Panbarasi A/P Govindasamy for all the motivation, encouragement, help given and notes that really helped me produce a better final year project report. Without the encouragement, motivation and references that were given, it would be quite difficult for me to finish this project well. I also want to express my gratitude to the staff of Prima Reka Konsultan for providing information and shared their experience for the implementing. And I would like to express my appreciation and gratitude to my family for their support and empathy, which helped me to complete this project mentally. Finally, I would also like to say a million thanks to any party who helped me in the production of this final year project directly or indirectly. Your help is greatly appreciated. May Allah SWT reward you all for your services. Thank you.

ABSTRACT

Traffic data collection is crucial for transportation planning and traffic engineering projects. However, traditional manual counting methods are time-consuming and labour-intensive. With large and complex construction projects involving traffic management, delays in obtaining traffic data can significantly impact project schedules and budgets. Modern construction demands efficient, scalable and cost-effective traffic data collection solutions. Mobile and sensor technologies now enable automated, real-time traffic data collection over a large area. However, challenges remain such as integrating data from diverse sources, addressing privacy and security issues, and justifying value through standardized metrics. This research aims to address limitations of current manual traffic data collection practices through development and evaluation of a mobile application for real-time collection and analysis of traffic data. A mixed-methods approach is utilized involving review of literature on emerging traffic data technologies, collection of primary traffic data through the developed application, and solicitation of user feedback via online survey. The mobile app is iteratively designed and tested following prototyping and agile methodology. Thus, the goal of this research was to create a digital data collecting tool. The E-Data Collection Application was produced using the Android Studio development tool. This application's usability and effectiveness were evaluated among the company's employees using an online survey modified from the Technology Acceptance Model (TAM) questionnaire, which comprises the three most well-known TAM variables—Perceived Ease of Use, Perceived Usefulness, and Behavioural Intention to Use. Data were examined using the mean and paired T-test. The paired t-test revealed that the E-Data Collection Application deviates greatly from the existing method. This implies that in terms of usability the E-Data Collection Application exceeded the existing method. This product was highly recommended to be used in collecting data for traffic count as it eases the project management on collecting data.

ABSTRAK

Pengumpulan data trafik adalah penting untuk perancangan pengangkutan dan projek kejuruteraan trafik. Dan jika, kaedah pengiraan manual tradisional memakan masa dan intensif buruh. Dengan projek pembinaan yang besar dan kompleks yang melibatkan pengurusan trafik, kelewatan dalam mendapatkan data trafik boleh memberi kesan ketara kepada jadual dan belanjawan projek. Pembinaan moden memerlukan penyelesaian pengumpulan data trafik yang cekap, berskala dan kos efektif. Teknologi mudah alih dan penderia kini membolehkan pengumpulan data trafik masa nyata automatik di kawasan yang luas. Meskipun cabaran kekal seperti menyepadukan data daripada pelbagai sumber, menangani isu privasi dan keselamatan, dan mewajarkan nilai melalui metrik piawai. Penyelidikan ini bertujuan untuk menangani had amalan pengumpulan data trafik manual semasa melalui pembangunan dan penilaian aplikasi mudah alih untuk pengumpulan dan analisis data trafik masa nyata. Pendekatan kaedah campuran digunakan melibatkan semakan literatur tentang teknologi data trafik yang muncul, pengumpulan data trafik utama melalui aplikasi yang dibangunkan, dan permintaan maklum balas pengguna melalui tinjauan dalam talian. Apl mudah alih direka bentuk dan diuji secara berulang mengikut prototaip dan metodologi tangkas. Oleh itu, matlamat penyelidikan ini adalah untuk mencipta alat pengumpulan data digital. Aplikasi Pengumpulan E-Data telah dihasilkan menggunakan alat pembangunan Android Studio. Kebolehgunaan dan keberkesanan aplikasi ini dinilai dalam kalangan pekerja syarikat menggunakan tinjauan dalam talian yang diubah suai daripada soal selidik Model Penerimaan Teknologi (TAM), yang terdiri daripada tiga pembolehubah TAM yang paling terkenal—Kemudahan Penggunaan yang Dirasai, Kebergunaan yang Dirasai, dan Niat Tingkah Laku untuk Menggunakan Data diperiksa menggunakan min dan ujian-T berpasangan. Ujian-t berpasangan mendedahkan bahawa Aplikasi Pengumpulan E-Data jauh menyimpang daripada kaedah sedia ada. Ini membayangkan bahawa dari segi kebolehgunaan Aplikasi Pengumpulan E-Data melebihi kaedah sedia ada. Produk ini amat disyorkan untuk digunakan dalam mengumpul data bagi kiraan trafik kerana ia memudahkan pengurusan projek mengumpul data.

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LIST OF ABBREVIATION

ADAS	Advanced Driver Assistance Systems
AVI	Automated Vehicle Identification
AVL	Automated Vehicle Location
BI	The Behavioural Intention of Use
BIM	Building Information Modelling
CCTV	Closed Circuit Television
EDC	E-Data Collection
FCD	Floating Cat Data
FYP	Final Year Project
GPS	Global Positioning System
HTTPS	Hypertext Transfer Protocol Secure
ICT	Information and Communication Technologies
ITS	Intelligent Transportation System
MFA	Multi Factor Authentication
MIMD	Multiple Instruction Multiple Data Construction
ML	Machine Learning
PCU	Passenger Car Unit
PEOU	Perceived Ease of Use
PU	Perceive Usefulness
TAM	The Technology Acceptability Model
TIA	Traffic Impact Assessment
UAT	User Acceptance Testing
V2I	Vehicle to Infrastructure

V2V	Vehicle to Vehicle
V2X	Vehicle to Everything

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Construction engineering is a very complicated and always-changing field, and good paperwork management is essential to the success of any project. From the beginning of planning a project to the end of building, accurate and well-organized documentation is very important for many reasons. It makes sure that the law is followed, that people are held accountable, that quality is controlled, that parties can communicate clearly, that risks are managed, and progress is tracked, and that budgets are kept. In this context, documentation management is the most important thing in construction engineering and how it helps projects succeed right away and last for a long time (Zwikael, 2009).

Technology is very important for traffic data collection because it provides improved tools and methods that make gathering data faster and more accurate. Technology makes a big difference in this area by letting us use technology like Intelligent Transportation Systems (ITS). ITS is a collection of innovative applications and methods that incorporate information and communication technologies (ICT) to enhance the efficiency, sustainability, safety, and environmental friendliness of the existing transportation system. Presently available in the marketplace are ITS of the initial iteration, including Advanced Driver Assistance Systems (ADAS), electronic tolling systems, and traffic information systems (Alam, Ferreira, & Fonseca, 2016).

New studies show that the way we move will change a lot when information and communication technologies are added to vehicles and transportation infrastructure. The goal of the enabling technologies is to create frameworks that will lead to a wide range of applications and use cases in the areas of traffic efficiency, road safety, and driver aid. For these applications to work, a lot of work needs to go into putting these practices into place so that useful information can be sent and collected between vehicles and between transportation facilities and vehicles (Alam, Ferreira, & Fonseca, 2016).

ITS and other technologies have made traffic flow analysis much more accurate and faster. These improvements give transport planners and authorities more information to help them make decisions about how to handle traffic and build new infrastructure. We will likely be able to better analyse and handle traffic numbers as time goes on because new technologies are constantly being added.

Traffic efficiency applications try to make traffic flow better by cutting down on trip times and traffic jams. They do this by giving users information about traffic, which is usually spread by infrastructures on the side of the road. Inter-urban efficiency applications, urban traffic efficiency applications, and freight/fleet apps are all types of traffic efficiency applications. Frequency, latency, reach, media download, and email are all needs that these apps have in common. Value-added apps, like infotainment, flight information, trip planning, and Internet access, make life easier and more comfortable for users. Depending on the type of application, these requirements can be very different. However, most common applications can handle long waits and may sometimes need a lot of data (Alam, Ferreira, & Fonseca, 2016).

Traffic volume analysis is crucial in transportation planning and traffic projects to ensure the smooth and successful execution of the entire project. A manual count, sometimes referred to as a manual traffic survey or count, is a technique used to gather information about the quantity and kind of vehicles passing through a given area at a certain time. The common issue faced in this phase is time and human labour. For a variety of reasons, delays in traffic volume analysis might be caused by time and human labour.

Acquiring accurate information on traffic flow can be hard since manual methods are prone to mistakes and technological solutions have their limits. Also, the fact that traffic trends change all the time, that traffic flow dynamics are complicated, and that delays change all the time are big problems. Adding multimodal travel data, considering how different people may perceive delays, and looking at the bigger environmental and social effects of delays make things even more complicated. Experts in transportation, urban planning, data science, and politics need to work together to solve these issues. They should use advanced modelling tools, real-time data, and share their knowledge. To come up with good ways to deal with and cut down on delays in traffic volume studies, we need to fully understand these issues.

1.2 PROBLEM STATEMENT

Conflict is a common issue in construction projects, often leading to increased project costs, delays, reduced productivity, lost profits, and damage to business relationships. Conflict and disputes are inevitable in the construction industry due to the complex, relational, and lengthy process of designing and building. Common sources of construction disputes include variation, extension of time, payment, quality of technical specification, availability of information, administration and management, unrealistic client expectations, and determination. Limited resources, such as time, money, labour, materials, and equipment, can also contribute to conflicts (Jaffar, 2011).

Mobile devices are increasingly being used in construction projects as they provide accurate information and enhance connectivity and efficiency. Major construction management companies like Autodesk are working on making building data models accessible on mobile devices for workplace use (Parikh, 2021). There are also applications like network traffic analysis. Securely identify smartphone apps by analysing encrypted network data. Machine learning methods are used to find smartphone apps. Another part looks at how app fingerprints change over time, between devices, and between app versions. There are also new methods added to help the app classification system find and lessen the impact of unclear traffic, like traffic that is common among apps like ad traffic (Tatlor, Spolaor, Conti, & Martinovic, 2018).

Next is modelling and prediction of mobile-app traffic using Markov models. The study discusses and experimentally evaluates the suitability of the provided modelling approaches for various tasks, including network traffic characterization (at various granularities, such as application, application category, and application version) and network traffic prediction at both the packet and message levels. They offer a reasonable and intelligible baseline as well as a practical and theoretically solid set of traffic analysis tools to aid in machine learning evaluation and potentially its design. The authors contend that network operators must comprehend traffic peculiarities, forecast its characteristics, enforce traffic engineering, and carry out network planning. But given the nature of network traffic today, which is influenced by user behaviour, interaction, and access, precise characterization, modelling, and predictability of network traffic produced by mobile devices are required at the fine-grained level. The creation and evaluation of Machine Learning (ML) algorithms for traffic modelling, characterization, and prediction is challenging due to the diversity and dynamic nature of mobile apps, as well as privacy considerations (Aceto, et al., 2021).

Another mobile app project is developing an iterative analyser for real-time in-app activity analysis in encrypted internet traffic streams. Researchers choose the best set of features for discrimination from raw features taken from traffic packet sequences using a Multiple Instruction Multiple Data (MIMD) measurement. The online analyser represents a traffic flow with a series of time windows, which are described by the optimal feature vector and updated iteratively at the packet level. Experiments on real-world traffic data from WeChat, WhatsApp, and Facebook demonstrate the effectiveness and efficiency of the approach. The results show that the proposed analyser provides high accuracy in real-world scenarios, has a low storage cache requirement, and has fast processing speed (Liu, et al., 2017)

To sum up, mobile technology has emerged as a hot topic for study in the construction sector, with a wide range of solutions and apps being created to solve different problems and boost productivity. Analysis application is a useful technology that can save project costs and time while improving document quality and speeding up document retrieval. This may result in lower project costs and times, higher quality, and quicker document retrieval. Therefore, the aim of this study is to develop an application for analysis that focuses design phase of construction in Traffic Engineering to offer an easy-to-access application for data analysis on the company project.

1.3 OBJECTIVE

The main goal for this project is to create an application for traffic data collection that focus on design phase of construction in Traffic Engineering to offer an easy access application to the company. Since this application will be used for traffic engineering, it will focus on roads, input data and data analysis. This will allow the workers to easily access the application anytime and anywhere. Among the objectives that will be targeted are as follows:

i. To identify the constraint of the current method of collecting data traffic.
ii. To develop an application for traffic data collection.
iii. To evaluate the effectiveness of the E-Data Collection Application

1.4 SCOPE OF STUDY

The scope of this study for the final year project will be the office of Prima Reka Konsultan. Which is located at Jalan Ampang Baru 6a. This project focuses project that Prima Reka Konsultan involved with. Workers at Prima Reka Konsultan can easily access this application.

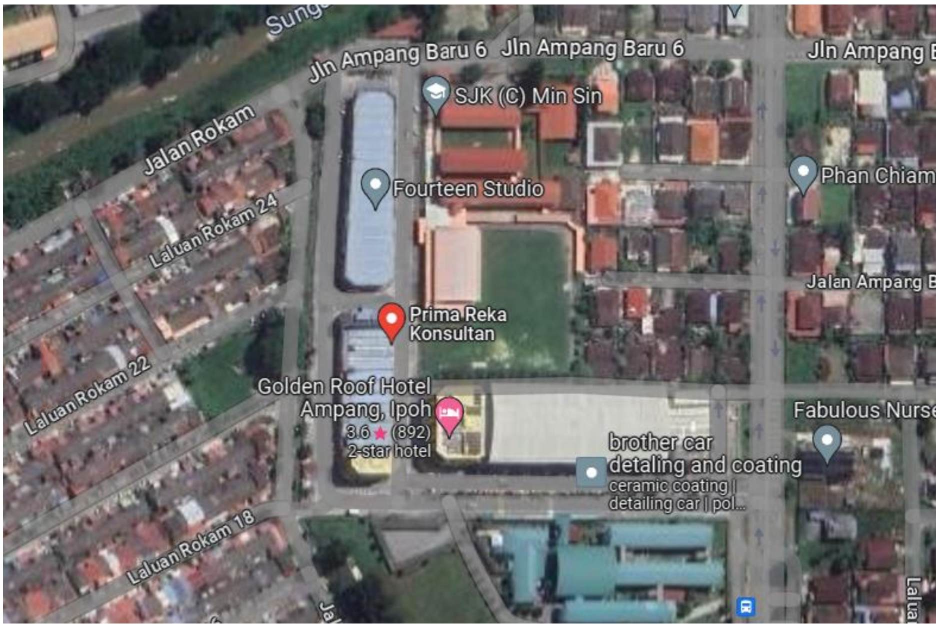

Figure 1.1 Prima Reka Konsultan Office Location (Google Map, 2023)

1.5 SIGNIFICANCE OF THE STUDY

Based on the study, delay work is one of the company's problems when handling a big project because of time and worker labour. Traffic data collection is still using the manual count, which is why there is a delay when involving a big project as there is not enough time and workers. This final-year project is an application that can be helpful to the company project because of the features available on the application. This app can be accessed regardless of time and place for all workers. And all the workers can key in the data anywhere and anytime. This will save time and prevent project delays.

The significance of the study lies in its potential to revolutionize traffic data collection processes within the construction industry. By developing a user-friendly mobile application that leverages Intelligent Transportation Systems (ITS) and mobile technology, the study aims to address the limitations of manual traffic data collection methods. This has the potential to enhance the efficiency of construction projects by providing real-time traffic data collection and analysis. The study's findings and the successful development of the mobile application could offer valuable insights for transitioning from manual to technology-enabled traffic data collection practices, ultimately contributing to the advancement of traffic engineering and construction project management practices.

1.6 EXPECTED OUTCOME

The expected outcomes for a traffic data collection mobile application focused on improving construction project efficiency are multifaceted. The application aims to modernize traffic management and minimize delays and disruptions. The application's user-friendly interface should facilitate easy data input and access to real-time information. Seamless integration with other construction software is crucial for a holistic approach, while scalability ensures adaptability to various project sizes. Ultimately, the success of the mobile application is contingent on its ability to streamline traffic data collection.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The Internet of Things (IoT) has become a significant aspect of the Industrial Revolution 4.0, with its application in various industries. However, its adoption in the construction industry is still limited. (Gamil, Abdullah, Rahman, & Asad, 2020). An application refers to a software program or a collection of programs specifically created for the purpose of being used by the end user. Applications software, often known as end-user, programs, encompasses database programs, word processors, web browsers, and spreadsheets. Application software is separated from the underlying technology, which enhances the accessibility and usability for users. Abstraction in programming refers to the concept where the end output does not expose all the intricate elements that exist beneath its surface. Applications are positioned above systems software, which comprises of fundamental programs that interface with computers at a basic level. Operating systems oversee fundamental instructions for computers and impact the downloading and execution of apps on a computer or mobile device. Certain apps may lack compatibility with outdated operating systems as a result of the underlying system software's incapacity to accommodate the application or its specific version (Beal, 2022)

The literature review is an essential part of the application process for traffic data collection, and it has several uses. In this literature review there will be topics such as historical context and evolution of traffic data collection, current methods in traffic analysis, role of technology in traffic engineering, mobile technology on construction and traffic engineering and impact of mobile application on project efficiency,

2.2 HISTORICAL CONTEXT AND EVOLUTION OF TRAFFIC DATA COLLECTION

Traffic data collection began in the 1950s-1960s with manual counts using pneumatic road tubes or observers recording vehicle movements. Inductive loop detectors emerged in the 1960s and became standard in the 1970s, automating data collection and providing continuous traffic counts, speed, and classification information. Wide-scale deployment of CCTV cameras began in the late 1980s and 1990s, providing video data for incident detection and manual extraction of traffic parameters. GPS and wireless technologies emerged in the late 1990s, enabling probe-based data sources like location data from mobile phones and vehicle GPS units. Modern traffic sensors emerged in the 2000s using technologies like Bluetooth/Wi-Fi scanning, remote microwave sensors, and advanced dual-loop detector configurations. In recent years, connected vehicle technologies, automated vehicle probe data, traffic video analytics, and crowdsourced GPS apps have expanded the types, scale, and timeliness of traffic data, driving the development of new analytic techniques (Zhu, Yu, Wang , Ning, & Tang, 2018).

2.2.1 Early Method of Traffic Data Collection and Their Limitation

The first semi-actuated signal placement was at an intersection in Baltimore in 1928. It was the first known installation of a vehicle detection device. Another device that was introduced during this period was a pressure-sensitive pavement detector. This detector utilised two metal plates that functioned as electrical contacts. The weight of a passing vehicle would cause these plates to be pressed together. The treadle-type detector surpassed the horn-activated detector in popularity, being widely utilized for over three decades and became the predominant method of vehicle detection at actuated signs. The persistent issues with the contact plate detector prompted the development of an electro-pneumatic detector, which, despite its high cost and limited functionality in just detecting passage or motion, did not provide a definitive answer. Inductive loops were implemented as a means of detecting vehicles in the early 1960s and have since become the most prevalent detection method in use today (Battelle, 2003).

2.2.2 The Evolution of Traffic Data Collection Method Over Time

The development of Intelligent Transportation Systems (ITS) necessitates real-time, high-quality traffic information. As demand for improved traffic management grows, collecting data methods have evolved, making access to real-time information routine worldwide. Traditional on-road sensors are insufficient due to limited coverage and high costs. Alternative data sources, such as Floating Car Data (FCD), are emerging as a cost-effective solution. The FCD market is growing worldwide with various applications and benefits. This would improve traffic management and satisfy the growing demand of drivers who are willing to pay for real-time information. The data collected from in-vehicle devices, such as mobile phones or GPS, should be accurate, reliable, timely, and complete to meet the needs of drivers who want to know if there will be congestion on their route today, how to avoid it, and how long it will last.

2.3 CURRENT METHODS IN TRAFFIC ANALYSIS

Advancements in sensors, communication technology, and data analytics have greatly improved the collection of traffic data. An effective approach involves the utilisation of Intelligent Transportation Systems (ITS), which amalgamate diverse technologies to enhance the effectiveness and security of transportation networks.

Intelligent Transportation Systems (ITS) utilize several sensor technologies, including video cameras, radar, lidar, and inductive loops, to gather up-to-the-minute traffic data. These technologies provide the surveillance of traffic flow, vehicle velocity, and levels of congestion. Moreover, the extensive implementation of Global Positioning System (GPS) devices in automobiles aids in the accumulation of location-specific data, providing valuable information on travel patterns and route preferences.

2.3.1 Traffic Sensor Technologies

Traffic sensors can be classified into three categories: point sensors, point-to-point sensors, and area-wide sensors. Point sensors are the predominant form of detector now employed, encompassing several technologies including inductive loop detectors, radar, infrared, acoustic, and video sensors. Inductive loop detectors are generally inexpensive sensors, although they may have reliability and accuracy concerns. Non-intrusive roadside technology such as radar, infrared, microwave, acoustic, and ultrasonic sensors are employed to minimize disturbance to regular traffic operations. These sensors do not require installation within or on the pavement. Video image detection systems capture traffic images, which are then examined by machine vision software to observe motorway conditions, gather data at intersections for traffic management reasons, identify incidents, and categorize vehicles. Although these systems may entail significant upfront expenses, they necessitate less upkeep, hence reducing traffic disturbances.

Point-to-point sensors can detect cars at various locations throughout the network, enabling the process of reidentification and tracking. Technologies in this category encompass Automated Vehicle Identification (AVI) systems, Vehicle identification without driver "cooperation," and License plate recognition. The functionality of these technologies is constrained by the vulnerability of cameras to adverse weather and lighting conditions. Area-wide sensors encompass cellular phones, smartphones, and Global Positioning Systems (GPS). Aerial sensors, such as unmanned aircraft, conduct continuous surveillance of a transportation network to gather traffic data using photogrammetry, video recording, and Light Detection and Ranging (LIDAR) techniques. The GPS sensors installed in the car gather position data, which is then sent to a central centre for further analysis and computation. Wireless service providers could automatically gather geo-location data from wireless phones, which can then be utilized to extract information regarding the movement and velocity of the phones.

The transit industry utilizes Automated Vehicle Location (AVL) systems, which rely on GPS or differential GPS technology, frequently supplemented by dead reckoning, to gather data on vehicle location, speed, and other relevant information. The objective of the Mobile Century project was to demonstrate the feasibility of utilizing smartphones equipped with GPS capabilities to gather traffic data and employ it for the purpose of estimating and predicting real-time traffic conditions. The research will concentrate on individuals who often travel to and from the San Francisco Bay Area.

To summarize, traffic sensors are essential for delivering instantaneous traffic surveillance, data, and forecasting. Emerging technologies such as point sensors, point-to-point sensors, and area-wide sensors have the potential to enhance traffic management and safety. Nevertheless, the precision of these technologies is constrained by other factors, such as the dimensions and concentration of GSM cells (Antoniou, Balakrishna, & Koutsopoulos, 2011).

2.3.2 Active Stationary and Mobile Measurement Devices

For gathering traffic statistics, both mobile and fixed traffic measurement devices can detect, identify, and forward acquired data to the appropriate authorities. Fixed devices are strategically positioned inside a network, monitoring exclusively the cars that traverse them. They offer valuable information on the temporal evolution of traffic flow patterns, but mobile devices exhibit broader geographical coverage and higher rates of identification. Stationary devices are costly since they must be positioned beside roads, necessitating building permissions and manpower for operation.

Mobile devices are cost-effective due to their inclusion of vehicle detecting technology such as cameras, GPS, and Bluetooth. Private entities have the ability to utilise their vehicles as probe vehicles, however, the expense per device for mobile devices is typically less than that of stationary sensors. The quantity of gadgets employed is contingent upon financial limitations and motivations to utilize privately owned automobiles as probe vehicles. While the implementation of stationary devices may be impractical due to their exorbitant expenses, leveraging the synergistic potential of current technologies can help mitigate the necessity for new stationary devices. The quantity of mobile gadgets is contingent upon the drivers' motivation to enable their autos to function as probe vehicles.

2.3.3 Comparative Analysis of Manual Counting Methods Versus Automated Systems.

For efficient urban planning and traffic management, timely and reliable traffic data collecting is essential. Manual counting techniques have historically been essential to this procedure, depending on human observers equipped with tally counters or using video analysis to track and document traffic patterns. Although manual techniques produce accurate results, they are frequently linked to disadvantages including labor intensity, time consumption, and human mistake susceptibility. The environment of traffic data gathering has changed recently due to the incorporation of automated systems, which include technology such as sensors, machine learning algorithms, and video analytics. Some of the clear benefits of automated systems are increased productivity, real-time data collection, and less reliance on human labor (Chen, Shu, & Wang , 2017).

Other advantages of this automation trend include scalability and cost-effectiveness. Notwithstanding these benefits, there are still issues to be resolved, such as implementation and maintenance issues with the system and possible biases in algorithmic decision-making. To ensure unbiased and dependable data collecting, these problems must be carefully considered before deploying automated systems. Given these factors, a system that strikes a balance between the benefits of automated and human processes seems like a good way to go. This strategy could combine the efficiency and scalability of automated systems with the accuracy of manual counting techniques in certain scenarios. metropolitan planners and transport managers can gain a thorough and sophisticated grasp of traffic dynamics in various metropolitan contexts by doing this. Maximizing the accuracy, efficiency, and cost-effectiveness of traffic data collection operations will depend on determining the best balance between manual and automated approaches as technology develops (Chen, Shu, & Wang , 2017).

2.3.4 Advantages And Drawbacks

To analyse traffic volume and help transportation planners and engineers optimize road networks, traffic data collection systems are essential. An important benefit of these technologies is their capacity to offer real-time data, enabling dynamic traffic management and prompt interventions to ease congestion. Loop detectors, radar sensors, and video cameras provide a thorough understanding of traffic patterns, facilitating the detection of peak hours and areas of congestion (Maerivoet & Moor, 2008).Moreover, these technologies enhance safety by aiding in the identification of traffic events and enable prompt reactions. Nevertheless, a significant drawback arises from the possibility of privacy issues linked to video surveillance systems. The utilization of cameras for the purpose of gathering traffic data gives rise to concerns regarding personal privacy, thus requiring meticulous examination of ethical consequences and the establishment of safeguards to safeguard personal data. Additionally, the financial burden of implementing and upkeeping sophisticated traffic surveillance systems can pose difficulties for towns with limited resources (Leduc, 2008)

2.4 ROLE OF TECHNOLOGY IN TRAFFIC ENGINEERING

Technology plays an important role in modern traffic engineering, revolutionizing the way transportation systems are managed and optimized. Intelligent transportation systems (ITS), real-time data analytics, and smart traffic management solutions are some of the new technologies that have made traffic flow, safety, and general efficiency much better. Real-time traffic data can be collected and analysed with these technologies. This makes it possible for dynamic traffic light control, adaptive traffic management, and predictive modelling. For example, combining sensors, cameras, and information networks makes it easier to keep an eye on traffic, which lets people respond quickly to problems and traffic jams. Improvements in vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) connection also make traffic safer and easier to manage. Optimizing current infrastructure and paving the way for smart cities and sustainable transportation systems are both made possible by the incorporation of technology in traffic engineering (Oladimeji, et al., 2023).

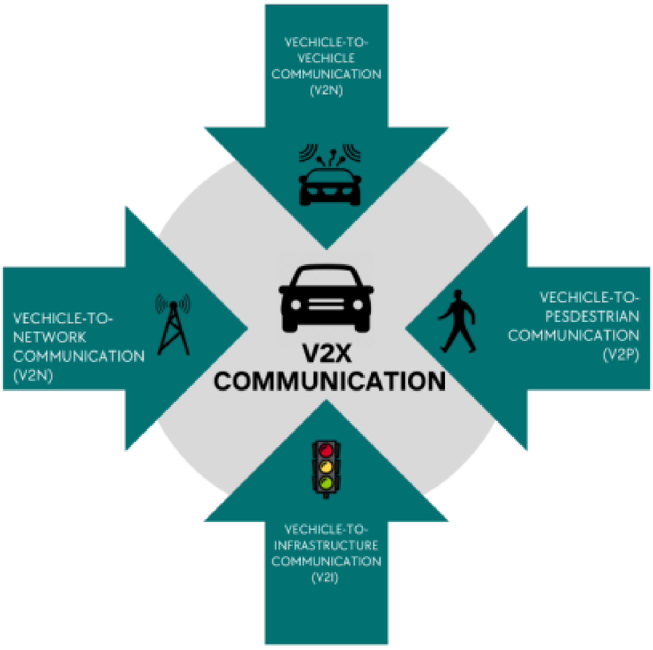

Figure 2.1 Vehicle-to-Everything Communication (V2X) Protocol

The interaction of Information and Communication Technology (ICT) in traffic engineering has brought about significant advancements in enhancing transportation systems. Intelligent Transportation Systems (ITS) leverage ICT tools such as sensors and cameras to monitor and manage traffic in real time, leading to reduced congestion and improved overall efficiency (Wang et al., 2018). Moreover, Vehicle-to-Everything (V2X) communication systems facilitated by ICT contribute to enhanced traffic safety by enabling real-time information exchange between vehicles and roadside infrastructure, aiding in accident prevention (Liang et al., 2017). The implementation of smart traffic management systems, incorporating data analytics and machine learning algorithms, further optimizes traffic flow and signal timings, as demonstrated by studies like Han et al. (2019). In summary, ICT in traffic engineering significantly improves transportation systems by minimizing congestion, enhancing safety through real-time communication, and optimizing traffic control strategies.

The Intelligent Transportation System (ITS) is a technology that connects vehicles and infrastructure to central control, aiming to improve flow efficiency, reduce congestion, prevent accidents, and provide drivers with real-time information on road conditions. It gathers data from various sources, including satellite systems, traffic detectors, weather stations, emergency services, and computers. ITS also includes self-diagnosis capability for vehicle parts, enabling proactive monitoring. It informs motorists of hazards, provides optimal routes, and delivers traffic data to cities for analysis. It offers four major benefits: improved accident management, enhanced traffic management, reduced air and noise pollution, congestion, and energy consumption, and live road information broadcasting. It helps businesses reduce transport costs, increase security, and provide peace of mind for travellers. ITS not only saves lives but also improves the bottom line by reducing transport costs and increasing security (Yan, 2022).

Research explores emerging data collection technologies and their impact on traffic management applications. Various surveillance technologies are being used for traffic data collection, each with different technical characteristics and operating principles. Automated Vehicle Identification data has several applications in traffic management, and more are expected to emerge as these data become more widely available, reliable, and accessible. Point sensors are the most widely used detector in traffic management, with technologies like inductive loop detectors, radar, infrared, acoustic, and video sensors being developed. Area-wide sensors, such as cell phones, smartphones, and GPS, are being explored for real-time traffic monitoring, information, and prediction. Automated Vehicle Location (AVL) systems are used in the transit industry, based on GPS or differential GPS. Emerging data collection technologies offer a diverse range of data from diverse sources, creating new opportunities in dynamic traffic management and traffic simulation and prediction (Antoniou, Balakrishna, & Koutsopoulos, 2011).

2.5 MOBILE TECHNOLOGY IN CONSTRUCTION AND TRAFFIC ENGINEERING

Mobile technology increases quality control by making it easier for personnel to document and track inspections. During inspections, workers can utilize mobile devices to take photos, videos, or notes, and these records can be easily shared with project managers, contractors, or engineers (PlanRadar, 2023). The construction sector is a labour-intensive industry with various trades and craftsmen using hand tools. Human error can significantly impact efficiency, making it challenging for construction management team members. Mobile computing technology, such as smartphones and wearable computers, offers opportunities to improve construction management processes. The main objectives of the construction sector are productivity and efficiency improvement. Mobile applications can standardize methods, manage errors, improve quality, supervisor productivity, and create accurate photographic recordings. The use of mobile devices has increased significantly since the 1990s, with major US construction companies providing mobile devices for project managers and supervisors (Yilmaz, Basaga, & Temel, 2019).

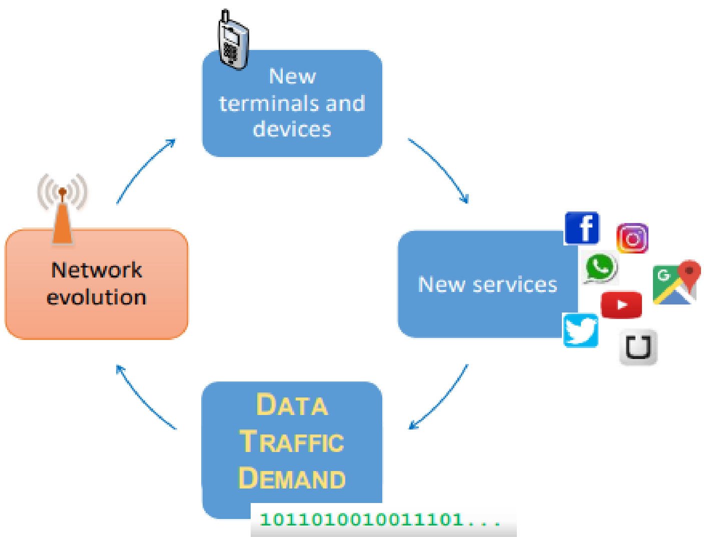

Figure 2.2 The typical innovation cycle in ICT

Professionals in engineering and construction are finding that mobile devices are indispensable tools because they offer instant access to project data, collaboration, plans, drawings, and schedules. These gadgets make it possible to do things like track RFIs, provide images, read and annotate digital plans, log site activity, and interact with project teams. Mobile access to building information modelling (BIM) models makes it possible for teams in the field and the office to collaborate and solve problems together by enabling them to examine 3D renderings and extract data on the spot. On construction sites, GPS and location tracking increase visibility of tools, vehicles, supplies, and labourers, streamlining workflows and keeping an eye on output. Contractors and engineers are assisted in adhering to safety, quality, and regulatory standards by mobile-enabled inspection, auditing, and compliance applications. Throughout the project lifecycle, mobile technology is improving collaboration, productivity, data-driven insights, and decision making in real time (Yilmaz, Basaga, & Temel, 2019).

Smartphones and mobile apps have revolutionized data collection by enabling the tracking of user behaviour and activities within apps. This data, which was previously difficult to access, provides rich insights into user interactions over time. Location data from mobile devices provides insights into movement patterns and physical activities, useful in urban planning, transportation, and public health. The constant connection of mobile apps allows for continuous and passive data collection, unlike discrete web visits or surveys on computers. Combining mobile data with other digital and traditional datasets offers a more comprehensive view of individuals and populations than any single dataset alone (Anderson , 2019).

Mobile technology is rapidly transforming the way construction and project management is done. It allows workers to do their jobs more efficiently and effectively. Smartphones have become an integral part of the construction industry, and Table 1 shows some of the features and applications that are used in this sector (Yilmaz, Basaga, & Temel, 2019).

Table 2.1 Mobile construction applications examples and uses

No	Apps	Uses
1	SmartBidNet	• create and track bid process. • provide accessible information to make bid projects easier and on time.
2	GoBIM	• application allows you to navigate 3D BIM models and their associated data.
3	FingerCAD	• This application is for technical drawing with your fingers. • CAD designs are made at the site or at your favorite location and can be saved in different formats. • The final design will be saved, and it can be sent via e-mail or printed.
4	PlanGrid	• Remote team collaboration on plans, markups, photos, and reports • Plan viewer • Life cycle management of RFIs with blueprints attached. • Issue logging and tracking, with direct input to punch lists of photos, locations, and on-site notes • Automatic hyperlinks from plan callouts for faster navigation through drawings • Management of progress photos by all team members, with automatic tagging, syncing, and archiving • rolling log for creation and distribution of issue reports
5	Carpenter's Helper Lite	• The app has a graphical interface that will calculate stair, roof, and floor projects.
6	Truckast	• set up your ready-mix concrete order directly from your smartphone/tablet. • maintain a complete record of how much concrete has been placed. • maintain a complete record of how much is on its way.

		• support photos being uploaded to the platform
7	Fast Concrete Pad Calculator	• This app will calculate quantities needed of concrete and rebar for your next project. • calculate waste materials, concrete, and rebar costs. • The app will get you all the information you need to order concrete.
8	OSHA Heat Safety Tool	• This app will send users reminders about • to drink enough fluids • schedule rest breaks • plan for and know what to do in an emergency. • adjust work operations. • gradually build up the workload for new workers • train on heat illness signs and symptoms.
9	Roofing Calculator	• calculate • the number of roofing shingles, • the number of squares, and • the number of bundles for a given job.
10	Procore	• review, create, modify, and share project data with team members, locally and remotely. • manage RFIs (requests for information, i.e., project technical queries) and construction project submittals on site and in real time. • mark up drawings, link RFIs, and manage punch lists. • track drawing set versions automatically and prioritize the most recent set. • access project directory and schedules • record minutes of meetings • Log daily site activities, weather, labor, and productivity

		• take photos and attach them to drawings and punch list items. • scan QR codes to easily locate relevant building project submittals from Procore in the cloud
11	Aconex	• sharing plans, documents, and correspondence on mobile devices • capturing data on site • marking up images and documents • coordinate bids, permits, RFIs, and change orders
12	BuilderStorm	• manage building project schedules. • access and store drawing files in the cloud • manage construction procurement. • track project RFIs • send and receive project messages. • create reports. • track construction RFIs
13	BuilderTrend	• scheduling, to-do lists, daily site logs, punch lists, plan markups, warranty, document and photo management, and messaging • management of budgets, purchase orders, payments, lien waivers, timesheets (mobile clocking in and out for employees) and change orders. • Mobile touch signatures for creating change orders on site. • Microphones for logging and then converting voice to text, for daily site logs and other files. • Cameras for attaching photos directly to files and logs. • Customer management tools include change order and selection management, warranty requests and payment processing.
14	CoConstruct	• select materials and designs for custom project change

		management and enhancement. • add comments and photos to selections (including photos taken by the smartphone or tablet running the app) • manage task lists. • adjust and coordinate schedules with subcontractors and clients. • communicate with clients to inform them directly of progress and changes, and reply to emails and text messages, all from the app. • manage budgets, with automatic updates and information for clients. • keep employee time accounts
15	e-Builder	• Cost management to eliminate cost overruns. • Document management, putting all documents into a centralized location. • Business intelligence reporting, which allows users to visualize performance across a project. • Tabular reporting like Microsoft Excel • Form builder for creating customizable forms. • Workflow manager, which allows users to drag and drop workflows, so everyone is accountable
16	Fieldwire	• add markups, annotations, and progress photos directly on drawings while in the field. • Automatic sheet hyperlinking • A blueprint management system that • allows you to import a lot of drawings quickly
17	Newforma	• recording task lists, punch lists, building site notes, with possibilities to tag items using information fields such as what, where, and who is responsible for resolution.

		• for viewing project documents (latest version displayed automatically), zooming, and panning on documents, and marking up documents to then send them by email, all from the mobile device. • combines several field and site management functions, including managing task and punch lists, notes, consulting action items (overdue or imminent) for team members, adding photos, and adding comments and consulting the comment history
18	PlanRadar	• create a punch list, record defects with the smartphone or tablet, and assign them to the responsible subcontractor on the construction site. • collaborate on projects from any Internet- connected device with access to projects, defect data (photos, memos, location on digital blueprints and more), drawings, and documentation saving up to 7 hours of work time weekly per construction project. • Filter features allow a search for deadlines, tasks, subcontractors, and much more.
19	Time Equipment Production (TEP)	• daily monitoring and administration tasks • provide quick identification and management of risks at your construction project. • managing schedule performance, • analysing production and documenting your project data.
20	Fall Safety	• It can detect falls and issue automated alerts to your emergency contacts programmed in your smartphone. • It will also provide your location data using GPS to ensure that your emergency contact will find you.
21	RedTeam	• manage all tasks from pre-construction to project closeout. • The creation of customer proposals (time, qualification, and conditions) • The cost estimation (piece calculation and pricing)

		• select suitable suppliers for your construction business and build a qualified team
22	Autodesk Site Scan	• It is an aerial drone platform for automatically capturing and working with construction site data. • get images, point clouds, and detailed information of your construction site area
23	GenieBelt	• access daily reports on progress immediately • assigning tasks to construction workers and monitoring their progress in Gantt charts
24	Pacific Timesheet	• track employee hours using an employee request and approval system
25	Plexxis Foreman	• allows employees to add and approve timesheets on the construction field in offline mode. • Contractors can store their employee information or create custom forms, • purchase orders, make calls, and more.
26	CCS Safety	• This mobile application features are used in the construction industry to review safety questions quickly.
27	FINALCAD	• document management • project tracking • incident reporting • drawings integration • quality control checklist • collaboration and task administration
28	Esticom	• Contractors manage construction projects with real-time access to labour, pricing, plans and material database
29	UDA ConstructionOnline	• The project management module provides photo management features, includes document control and helps with budgeting and cost management.

		• The customer management program provides • contract management, and home configuration.
30	Raken	• keep track of construction projects and provide users with site updates in real time. • provide daily work logs, schedule, and assign jobs to employees, send updates to field agents, generate, and share snapshots of a project's progress. • The voice-to-text functionality allows field agents to record observations verbally. • The built-in photo gallery can be used to store and categorize site photos and videos. • Automatic weather capture, alerts and notifications, customizable surveys, and third-party integrations.

Source: (Yilmaz, Basaga, & Temel, 2019).

2.6 DATA MANAGEMENT AND SECURITY IN MOBILE APPLICATIONS

In today's digital landscape, when mobile devices have become a vital part of our lives, mobile app security is critical. With the increased use of mobile apps for a variety of purposes, it is critical to prioritize app security to protect sensitive user data and prevent unauthorized access or cyber-attacks. The following are some best practices and strategies for improving mobile app security:

i. Source Code Encryption: Encrypting the source code is essential to prevent hackers from reversing engineering and extracting sensitive information.
ii. Perform Penetration Tests: Conducting thorough penetration tests helps identify vulnerabilities in the app by simulating real-world attacks. Regular testing helps detect and address potential vulnerabilities before they are exploited by malicious actors.

iii. Secure Data-in-Transit: Implementing secure communication protocols like SSL/TLS encryption can protect data during transmission and prevent unauthorized access.

iv. Secure Backend Systems: Securing backend systems involves strong authentication mechanisms, enforcing access controls, and regularly updating and patching backend servers.

v. Implement Secure Authentication: Strong and secure authentication is crucial to protect user accounts and prevent unauthorized access. Implementing multi-factor authentication (MFA) and biometric authentication methods can enhance user credentials security and make it harder for attackers to gain unauthorized access.

vi. Secure Data Storage: Mobile apps often store sensitive user data locally on the device, so ensuring secure storage is essential. Implementing data encryption and using secure storage mechanisms provided by the operating system can help protect sensitive user data.

vii. Regularly Update Dependencies: Keep third-party libraries and frameworks updated to reduce the risk of security breaches.

viii. Educate Users on App Security: User awareness plays a significant role in mobile app security.

Educating users about best practices, such as strong passwords, avoiding downloading apps from untrusted sources, and being cautious about granting app permissions, can help them make informed decisions and reduce the risk of falling victim to malicious activities (LLP, 2023). Mobile app security is crucial for user privacy and app integrity. Encryption, strong encryption algorithms, and HTTPS are essential. Advanced authentication mechanisms like multi-factor authentication and adherence to least privilege in authorization practices further enhance security. Regular security audits and code reviews, along with penetration testing, provide valuable insights into vulnerabilities, enabling timely remediation (Grassi, Garcia, & Fenton, 2017).

Traffic data collection apps face significant challenges in ensuring data privacy and security. One of the primary challenges is the collection of sensitive location data, which can potentially lead to the identification of individuals. Unauthorized secondary use of data, such as selling user data to third parties, also poses a risk. Additionally, the storage of traffic data makes it susceptible to data breaches and leaks, potentially exposing users' private information. To address these challenges, traffic data collection apps can implement anonymization techniques to protect user identities, limit the use of data to its intended purpose, and minimize the collection of unnecessary data. Encryption of sensitive data, local processing, and providing users with transparency and control over their data are also crucial for enhancing privacy and security in traffic data collection apps (Eckhoff & Wagner, 2018).

2.7 IMPACT OF MOBILE APPLICATIONS ON PROJECT EFFICIENCY AND DECISION MAKING

The New Zealand construction industry is increasingly adopting mobile apps to improve productivity. With nearly 13,000 available apps, the study found a positive attitude from top and middle management. Top management focused on strategic applications like long-term client relationship management and satisfaction, while middle managers focused on operational and tactical levels like task or project-level productivity improvement. The findings have implications for policy formulation and implementation in the use of mobile apps for productivity improvement in the sector (Liu & Mathrani, 2018). Despite the increasing proliferation of apps, little information is available on the value of mobile apps to the workforce. The construction sector employs over 194,000 people and is a key driver of economic growth. The study explored 519 mobile apps recommended by online recommender websites, ranging from project management to safety, integrated construction cost and accounting, and CAD (Liu & Mathrani, 2018).

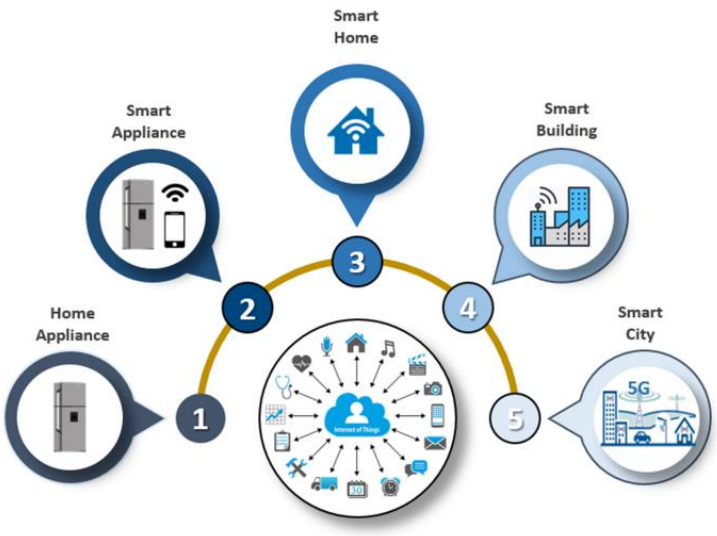

Figure 2.3 IoT enable portfolio towards digital transformation.

The efficiency gains from using mobile applications in construction projects include real-time and historical data visualization, communication with equipment and machinery, monitoring and control functionalities, access to diagnostic capabilities, and personalization features. These applications enable seamless integration over secure network connections, empower users with real-time monitoring and controlling of equipment, and provide access to advanced maintenance and affordable system upgrades. Additionally, mobile applications can facilitate data collection, analysis, and predictive maintenance, leading to improved productivity, cost savings, and higher customer satisfaction (Aheleroff, et al., 2020)

Real-time data plays a crucial role in enhancing decision-making in traffic engineering. The ability to collect and analyse real-time data allows for immediate and adaptive decision-making in response to changing traffic conditions. This includes the use of advanced technologies such as sensing, processing, reacting, and learning, as depicted in the decision informatics paradigm. Real-time data enables traffic engineers to monitor and analyse traffic patterns, identify congestion or accidents, and make timely adjustments to traffic signal timings or route guidance systems. Additionally, real-time data can support the development of intelligent transportation systems, including autonomous vehicles, which rely on real-time decision-making to navigate and react to dynamic traffic conditions. Overall, real-time data is essential for improving the efficiency, safety, and reliability of traffic engineering systems (Tien, 2017).

2.8 GAPS IN CURRENT RESEARCH AND FUTURE TRENDS

The current literature on mobile technology applications in construction and traffic engineering faces several gaps. These include a lack of evaluation and assessment of application effectiveness, limited comprehensive frameworks, a focus on Western contexts like the US and Europe, insufficient attention to user experience and design factors, integration and interoperability issues, security, privacy, and data protection, and the impact of emerging technologies like AR, VR, drones, robots, and AI. Additionally, there is a lack of standardized evaluation metrics to quantify outcomes like productivity gains, efficiency impacts, and safety improvements. Research on mobile apps in developing countries and the global South is also lacking. Furthermore, there is a lack of research on the integration and interoperability of different mobile and backend systems, and the potential implications of emerging technologies like AR, VR, drones, robots, and AI in construction and traffic management.

There are a lot of trends and future directions in mobile technology for collecting traffic data. The use of drones and unmanned aerial vehicles (UAVs) for the purposes of traffic monitoring, data collection, and site inspections has become increasingly common. The use of unmanned aerial vehicles (UAVs) allows for the rapid acquisition of aerial photos, films, and 3D models. more widespread usage of Bluetooth and Wi-Fi sensors for the purpose of automatically identifying and classifying vehicles in order to count the volume of traffic. Continuous monitoring capabilities are provided at a minimal cost by this provision. Through agreements with wireless carriers and GPS data providers, there has been an increase in the collection of data from probe vehicles and crowd-sourced technologies. This adds to the data collected by fixed sensors. The integration of traffic data with building information modelling (BIM) to simulate the effects of construction zones on traffic and to plan logistics. Real-time updates can be applied to BIM models. Applications for augmented and virtual reality that make use of data from building sites and traffic environments are being developed. This improves the ability to visualise as well as training and planning. The application of computer vision and deep learning for the purpose of automatically detecting incidents from video feeds with the goal of identifying problems such as accidents or congestion. Adoption of 5G cellular technology, which enables high-speed data transfer from an increasing number of Internet of Things sensors, will be beneficial. In this way, real-time analytics are supported. To facilitate monitoring, integrate data on traffic with information on schedules and resources into dashboards for construction management that are displayed on mobile devices (Oladimeji, et al., 2023).

2.9 CONCLUSION

The literature review covered the historical context and evolution of traffic data collection methods, from manual counts in the 1950s and 1960s to the various technologies used today like sensors, cameras, GPS, etc. Early methods had limitations that prompted the development of new automated methods. Current methods for traffic analysis employ technologies like sensors, cameras, and GPS to collect real-time data and enable dynamic traffic management. Technologies like Bluetooth and WiFi are also being used more for automatic data collection. Mobile technology is increasingly being used in construction and traffic engineering to improve productivity, access real-time project data, track inspections, and facilitate communication. Many constructions mobile apps were identified. Emerging technologies like drones, computer vision, and deep learning offer new opportunities for tasks like traffic monitoring and site inspections. Adoption of 5G could further support real-time analytics. The review highlighted gaps, like the need for standardised evaluation metrics to quantify the ROI of mobile apps. Privacy and data security challenges with apps collecting sensitive location data were also noted.

The literature review supports the research objectives of developing a mobile app for traffic data collection by identifying constraints of current manual methods and technologies to facilitate real-time data collection and evaluating the app's potential impact on project efficiency through metrics. It informed feasible technology options and challenges to address in app development and implementation. Overall, the review provided relevant background and justification for this research.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Some people think that research is only about getting information, but that's not true. Instead, it's about finding answers to questions that still need to be answered or making things that don't exist yet. Also, discoveries and creations lead to more discoveries and creations, and so on. study is sometimes called either "pure" study or "applied research." People believe that pure research is study that is only done to learn more. (Goddard & Melville, 2007).

Methodology is important for reaching the objectives of research because it gives researchers a way to do their work in a planned way. It points out the exact steps, methods, and techniques for gathering, analysing, and making sense of data. This makes sure that the research is done in an organised and thorough way. Researchers can collect useful data, analyse it correctly, and come to useful conclusions with the help of a well-defined approach, which helps them reach their research goals. Additionally, a good methodology increases the accuracy, validity, and credibility of the research results, which eventually helps the research project succeed. (Woodside, 2010).

3.2 RESEARCH DESIGN

Quantitative research derives conclusions about a population that are statistically significant through the examination of a representative sample, comprising all individuals that meet the criteria for the group under investigation. Constraints on resources and frequent employee attrition render censuses impractical; therefore, a representative sample is selected from the population. When the sample is appropriately selected, it will possess statistical similarity to the population, allowing conclusions to be extrapolated to the entire population. Typically, quantitative research falls into one of two categories: descriptive or experimental. Experimental research evaluates the validity of a theory through the observation of whether the dependent variable, which is being measured for change, is influenced by the independent variables that are under the control of the researcher. Surveys, correlation studies, and experimental outcome measures are frequently assessed to establish causality with a reasonable degree of confidence. Descriptive research merely provides a momentary description of the sample's demographics and measures the sample. While not considered a challenging or statistically resilient endeavour, providing a thorough explanation of the variables enables the researcher to assess the statistical results within the appropriate framework. Quantitative research is considered superior to qualitative research in establishing causality by some researchers due to the controlled environment and precise measurements inherent in experiments. Nevertheless, causality can also be established through qualitative research, albeit with diminished external validity. Laboratory experiments are employed in situations where it is necessary to regulate all extraneous variables to ascertain the precise action and effect of the independent variable. Field experiments are undertaken in situations where quantifying the actual actions of the research element is more crucial than relying on its purported capabilities (Lowhorn, 2007).

Qualitative research is an endeavour to explain the behaviour under investigation through a subjective approach to studying life as it is experienced. It studies participants through the application of anthropological and ethnographic techniques, with minimal intrusion and an emphasis on unobserved observation. Often conducted in the field, qualitative research attempts to explain a current situation for a particular group. In contrast to qualitative research, which is more inductive, quantitative research is more deductive. The alternative, which entails conducting personal interviews and observation to ascertain the causes of increased attrition, entails conducting a case study. Qualitative research disregards ethnographic considerations in favour of determining the group's version of reality; instead, it seeks to ascertain the group's unique perspective (Lowhorn, 2007).

3.2.1 Application Development Process

3.2.1.1. Phase 1: Requirement Analysis

For a consultant company like Prima Reka Konsultan, there are a lot of different projects that the company received. So based on the observation, there is a lot of projects that the company had at one time. I find that the workers also had difficulties with managing the data collection as the company has many projects. After that, I immersed myself into the situation and I tried to understand the problem with data collection. And then I engaged with the worker and approached them and interviewed them about the data collection problem in the office. Table 3.1 show the ways for gathering information. Then table 3.2 show the insight of the observations.

Table 3.1 Methods for gathering information.

Approaches employed	Details
Observation	Observation was made when I in the first two weeks on Work-Based Learning (WBL) to identify the issue in the company. Based on my observation, the company has a problem involving documents in the office
Immerse	As a WBL student, I immerse myself as a worker in the office ang try to understand the situation in the office,
Engage	Interviews were conducted for the workers at the office. Based on the interview, the workers had several issues with the data collection method in the office.

Table 3.2 Insight of the observations.

Aim Person	1. Traffic engineer 2. Site supervisor 3. Workers
Documentation	1. Document management 2. Data collection
Productivity Rate	1. To track the progress data

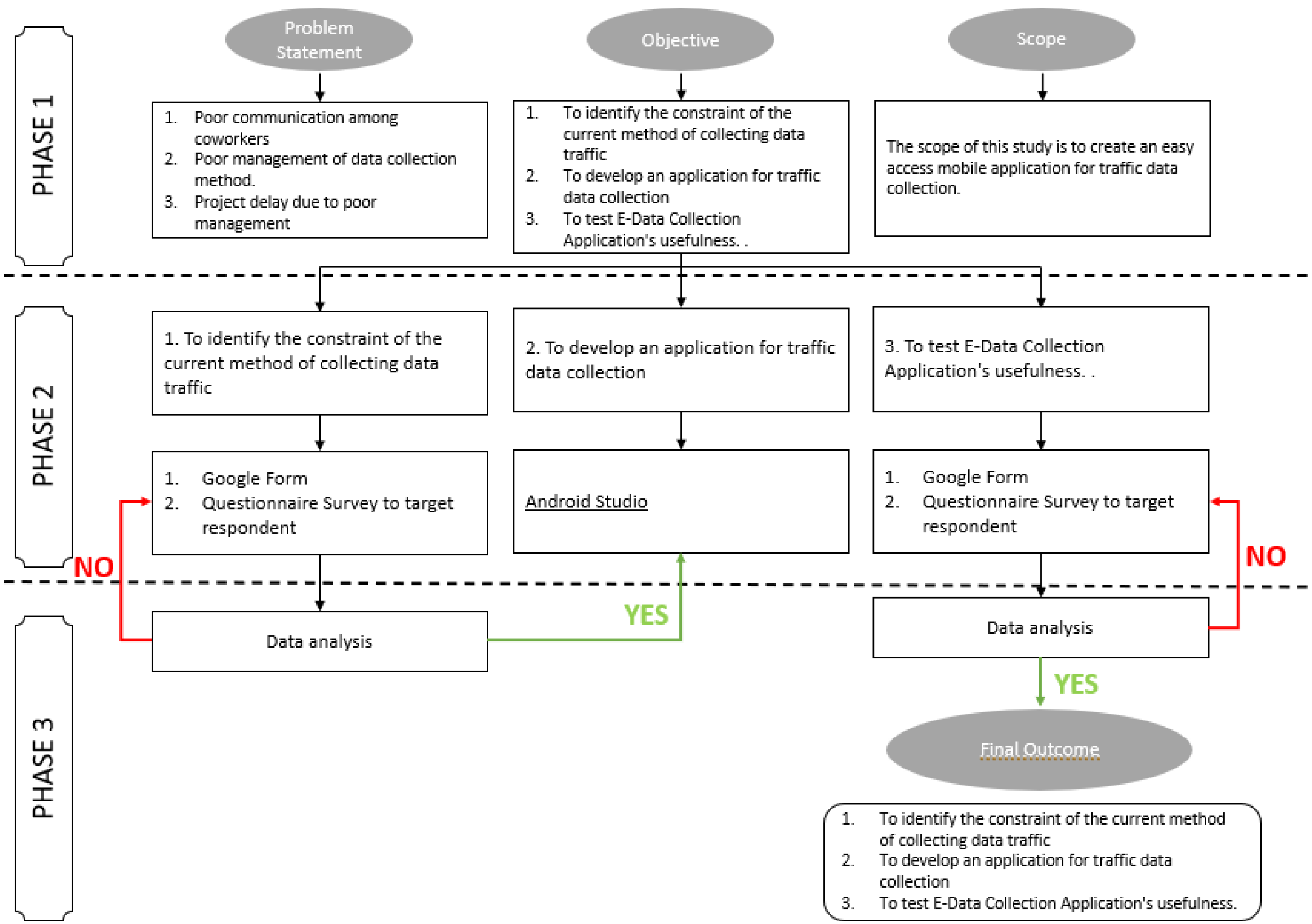

Figure 3.1 Research Framework (Methodology Chart)

3.2.1.2. Phase 2: Design

For the prototype design, I am using the application called Canva. Canva is a user-friendly graphic design platform that allows users to create various visual content, including presentations, posters, and social media graphics. Its intuitive drag-and-drop interface allows users to customize professionally designed templates. Canva offers a diverse library of elements like text, images, icons, and illustrations, facilitating aesthetically pleasing designs. It supports collaboration and allows users to integrate with other platforms. Canva offers a free version and a paid subscription called Canva Pro, providing enhanced features and resources for more advanced design capabilities. Overall, Canva caters to a wide range of users, from businesses to students, allowing them to bring their creative ideas to life.

Figure 3.2 Canva Logo

To make the application I use Android Studio. Android Studio is a specialized integrated development environment (IDE) created for the purpose of developing Android applications. Android Studio, created by Google and built on JetBrains' IntelliJ IDEA software, provides a variety of capabilities specifically designed for Android app development. The software comprises a rich user interface designer for graphically constructing app layouts, a code editor with Java and Kotlin support, an emulator for app testing on virtual devices, and a strong build system with Gradle. Android Studio offers debugging and profiling tools, testing frameworks to ensure app quality, and deployment tools to package programs into APK files for distribution on app stores such as Google Play. Android Studio facilitates and optimizes the app development process by consolidating all essential tools and resources inside a unified environment.

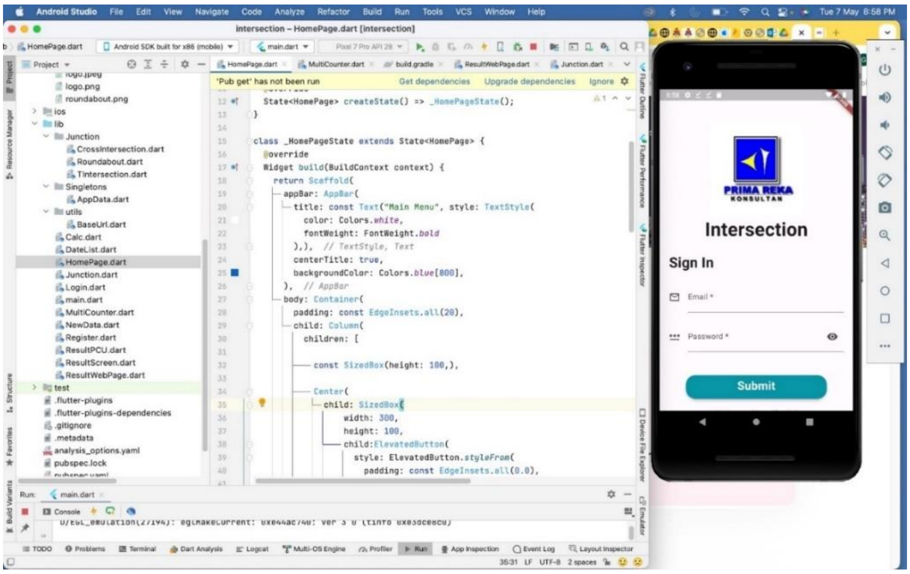

Figure 3.3 Android Studio

3.2.1.3. Phase 3: Development

Prototyping is an important part of the design thinking process. It includes making real versions of the ideas for solutions that were generated during the ideation phase. There are many types of prototypes, from simple sketches and paper models to more complex physical or digital prototypes, based on the project. Prototyping's main goal is to bring ideas to life in a way that lets designers and other important people try and interact with the ideas in the real world. This hands-on, iterative method helps find bugs, make features better, and get useful feedback early in the planning process.

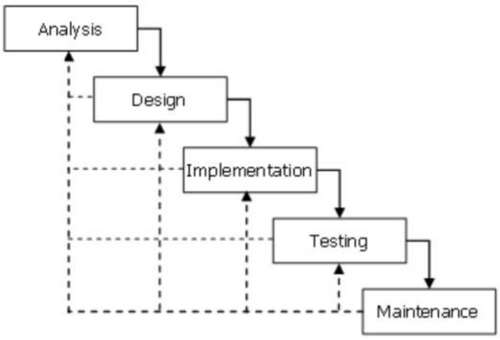

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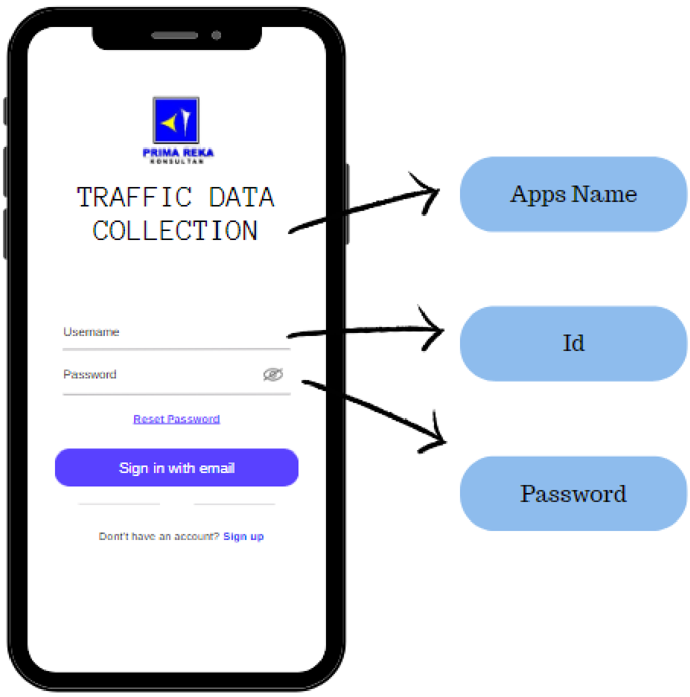
Figure 3.4 The Waterfall models.

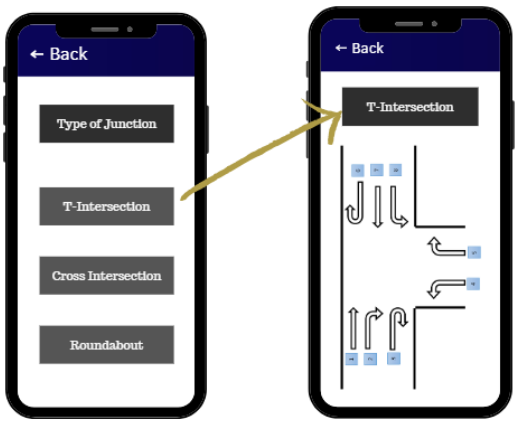
Prototypes help designers see and talk about their ideas, and they let them test whether their ideas are practical and useful before putting a lot of time and money into full-scale development. The feedback from testing prototypes helps the design team make more changes and improvements that will lead to a better answer that works better and is more focused on the user. A key part of the design thinking method is prototyping, which encourages a flexible and user-cantered way of handling problems. Table 3.1 shows the prototype and the explanation about the prototype.

Table 3.3 Traffic Data Collection Application Prototype

Prototype	Explanation
	1. Key in id and password to access the application

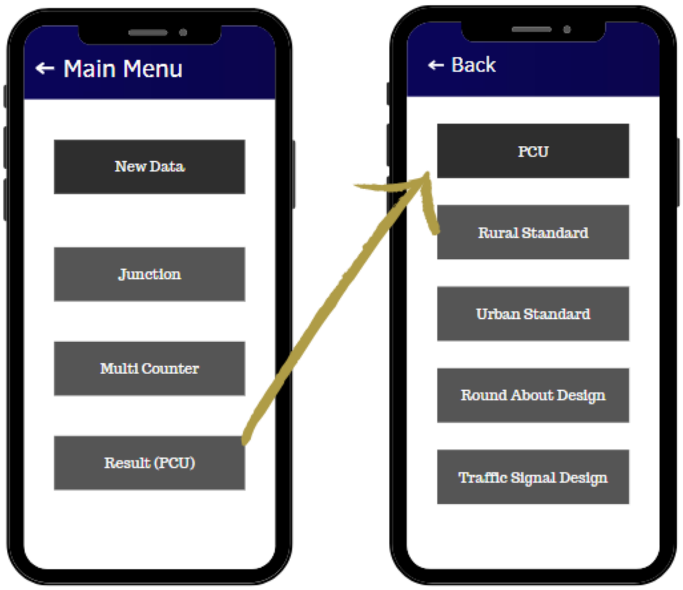
2. Next is the main menu, where we can choose new data to input new data or load data to see the past data

3. And then, for the new data, there is option for junction, multi counter and result (PCU)



4. For the junction key, it leads to the type of junction available. There are t-intersection, cross intersection and roundabout.

5. For the multi counter key. It leads to the number of junctions available. And can manually add the number of vehicles.



6. For the Result (PCU) button. It will lead to which type of PCU value.

7. After selected type of PCU. It will show the value, and then click proceed. Then the result will show. The result can be download in excel.

The term "passenger car unit," or "PCU," refers to a vehicle or car unit used to quantify the speed of traffic on a highway. Stated differently, PCU represents the quantity of automobiles circulating on a highway at a specific moment in time. The movement of cars on a road from one point to another at a certain moment is measured as traffic flow (Yard, 2022). The flow of traffic on the highway is made up of many types of vehicles, table 3.2 shows which are classified.

Table 3.4 Conversion factors to PCU's (Arahan Teknik Jalan 8/86)

Type of Vehicle	Equivalent Value in p.c.u's			
	Rural Standards	Urban Standards	Round About Design	Traffic Signal Design
Passenger Cars	1.00	1.00	1.00	1.00
Motorcycle	1.00	0.75	0.75	0.33
Light Vans	2.00	2.00	2.00	2.00
Medium Lorries	2.50	2.50	2.80	1.75
Heavy Lorries	3.00	3.00	2.80	2.25
Buses	3.00	3.00	2.80	2.25

3.2.1.4. Phase 4: Testing

Testing an application requires a comprehensive methodology to guarantee its operation, dependability, and security. Unit testing examines separate components in isolation, but integration testing evaluates their seamless collaboration. Functional testing ensures compliance with defined criteria. User Acceptance Testing (UAT) is the process of using end-users to validate the application and get feedback based on real-world experiences. Usability testing evaluates the ease of use and user-friendliness of a system. Implementing a thorough testing approach guarantees a strong, dependable, and user-friendly application at every stage of the development process.

The Traffic Data Collection Application was created to facilitate workers and increase the efficiency of a project. This application will be used when making the traffic count for Traffic Volume Analysis. The implementation in this application is data collection that can accessed easily. This application will be tested for its effectiveness by giving a trial period to the company’s worker. After that, the worker will be given a form, which is questionnaire to collect their opinion from testing the innovation.

3.3 DATA COLLECTION AND ANALYSIS

To gather data for evaluating the E Data Collection Application, a questionnaire was given to the 9 Prima Reka Konsultan employees that took part in the testing process. The questionnaire was derived from the Technology Acceptance Model (TAM) developed by (Davis, 1989), which emphasizes the perceived usability and ease of use as crucial elements influencing the inclination to adopt new technology. The Technology Acceptance Model (TAM) is a conceptual framework established by Fred Davis in 1986 and subsequently published in 1989. The Technology Acceptance Model (TAM) aims to elucidate and forecast individuals' inclination to accept and adopt novel technologies by considering their perceived utility and perceived simplicity of use. The paradigm has been extensively utilized in the realm of information systems and technology research to comprehend users' attitudes and actions towards technology. The essential elements of the Technology Acceptance Model (TAM) comprise:

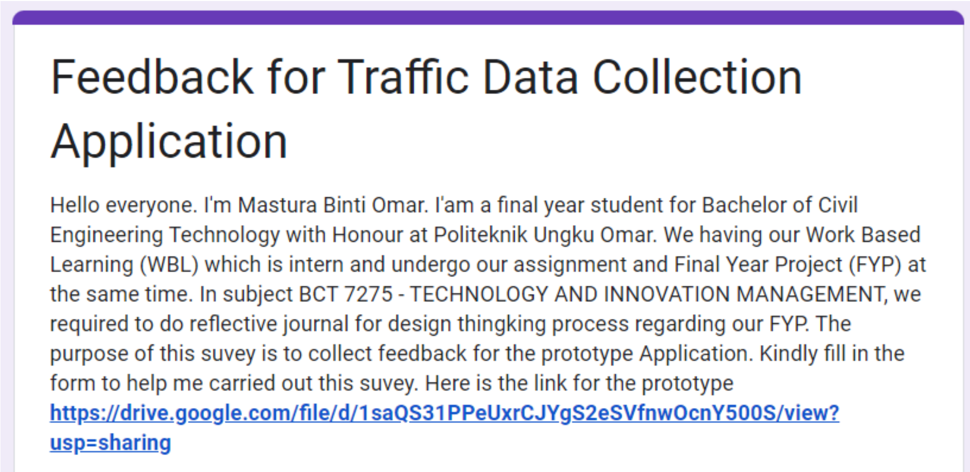
i. Perceived Usefulness (PU): This relates to the degree to which a person feels using a particular technology will improve their output or performance.

ii. Perceived Ease of Use (PEOU): This aspect shows how much one thinks using a technology will need little effort. It covers factors including the user's impression of the technological complexity, the simplicity of learning and understanding, and the availability of help and direction.

iii. The Behavioural Intention to Use (BI): component is a person's plan of acceptance and application for a technology. Since the attitude toward using, it immediately affects the technology use, it is a major antecedent to real technological use.

The Technology Acceptance Model (TAM) has been widely used to investigate the acceptance and reception of many technologies, including software applications, e-commerce systems, mobile applications, and other similar technologies. The Technology Acceptability Model (TAM) provides a valuable framework for understanding customers' attitudes and behaviours towards technology. This comprehension can subsequently be utilized to steer the development, progression, and incorporation of novel technologies to enhance user receptiveness and adoption. The researchers referred to the 1970 Krejcie and Morgan study to ascertain the appropriate sample size. Based on their results, a population of nine would require a sample size of nine as well. 2013 Winter and F.; Using a conventional t-test has no inherent limitations, according to a simulated study even with very small sample sizes. He underlined that there were no issues whatsoever even with a sample size as low as 2. Data was gathered with a Google form. To finish the questionnaire, the researchers gave the subjects the URL of the Google form. For data collecting for study, Google forms provide a practical and user-friendly method. The researchers extracted and examined the acquired data using Microsoft Excel programme. The Paired T-test then was done with an online statistical analysis tool. The Paired T-test program is selected for its efficiency and easy-to-use characteristics so that the gathered data may be practically useful for researchers.

Next, a questionnaire will be used to test the finished product online. Figure 3.5 show the example of questionnaire from Google Form Platform that will collect the feedback of Traffic Data Collection Application. When researchers are aware of the study's criteria, the questionnaire is a useful tool for data collection. This feedback will consist of the respondent personal information and respondent opinion on the application. The survey will be distributed to respondents by providing them the URLs of the Google forms.



Feedback for Traffic Data Collection Application

Hello everyone. I'm Mastura Binti Omar. I'am a final year student for Bachelor of Civil Engineering Technology with Honour at Politeknik Ungku Omar. We having our Work Based Learning (WBL) which is intern and undergo our assignment and Final Year Project (FYP) at the same time. In subject BCT 7275 - TECHNOLOGY AND INNOVATION MANAGEMENT, we required to do reflective journal for design thingking process regarding our FYP. The purpose of this suvey is to collect feedback for the prototype Application. Kindly fill in the form to help me carried out this suvey. Here is the link for the prototype https://drive.google.com/file/d/1saQS31PPeUxrCJYgS2eSVfnwOcnY500S/view?usp=sharing

Figure 3.5 An example of the questionnaire's

And then, has to undertake reliability analysis. Reliability analysis helps one to study the features of measuring scales and the individual items forming such scales. Computes several widely used indicators of scale dependability and provides understanding of the interrelationships among individual objects inside the scale using the Reliability Analysis method. The study used the reliability test based on Cronbach's alpha. Calculating the average inter-item correlation presented in table 2.2 below helps one to determine internal consistency of this model. Asserts that a Cronbach's alpha value greater than 0.6 is seen to have excellent dependability and is considered an acceptable index (Bonett & Wright, 2014). Alpha Cronbach is extremely good when it falls within the range of 0.8 to 1.00. Hence, the calculation of Alpha Cronbach values for the instruments used in this study demonstrated a high level of reliability, with 5 variables exceeding a value of 0.8 and 1 variable above a value of 0.7.

Table 3.5 Reliability Test

Variables	Cronbach's Alpha
PU Existing	0.941
PE Existing	0.906
1U Existing	0.956
PU Product	0.869
PE Product	0.795
1U Product	0.958

3.4 PILOT STUDY IMPLEMENTATION

The pilot study of a new application should consider location, participant selection, implementation process, and data collection methods. The selection criteria include selecting one to two typical locations, recruiting a small sample of end consumers, and considering diversity in factors like age, gender, and technology experience. The implementation process should involve obtaining site leadership and participants' support, providing training on program functionality, conducting a "soft launch," addressing early problems, gradually increasing consumption at pilot sites, and maintaining open communication with pilots (Pearson, et al., 2020).

Data collection methods include using application logs to monitor logins, time spent, and functionalities used, surveys to gather feedback on usability and desired improvements, interviews to gain in-depth understanding of participants' experiences, and focus groups for group discussions. Data for comparison can be obtained by accessing different methods for comparison, recording problems to identify necessary improvements, and understanding the difficulties encountered in real-world implementation. The objective is to gain an understanding of the difficulties encountered in real-world implementation, the possibilities for enhancement, and preliminary evidence of the application's intended role, which can be implemented before reaching a wider audience (Pearson, et al., 2020).

3.5 EVALUATION OF APPLICATION EFFECTIVENESS

The application of traffic data collection plays a pivotal role in enhancing the efficiency of traffic volume analysis. Authorities and planners can make smart choices to improve traffic flow and get rid of bottlenecks by collecting real-time data on. This data-driven method lets you improve the efficiency to make analysis. Traffic count and PCU analysis are two examples of new technologies that can be added and improved based on the information gathered from the data. Additionally, using predictive modelling and machine learning techniques can help predict how traffic will be in the future, allowing for proactive actions to be taken. This not only cuts down on commuters' trip times, but it also uses less fuel and releases fewer carbon emissions. In conclusion, collecting traffic data in a smart way allows transportation officials to make systems that work better and respond faster.

3.6 ETHICAL CONSIDERATIONS

Data collecting and application development are heavily reliant on ethical issues. Throughout the entire process, developers must put user privacy, informed consent, and transparency first. Responsible data usage in application development is making sure that user data is handled securely and that users are properly informed about the uses of their data. Users must have access to clear, concise privacy rules that are easy to understand to build confidence and provide them the knowledge they need to make wise decisions. Fairness and equity are important ethical factors to consider, particularly in applications that employ machine learning or algorithms. To make sure that the application does not maintain or worsen already-existing inequities, developers must be cognizant of any potential biases in the data used to train these algorithms. To find and address any potential biases, algorithmic decision-making processes must undergo routine audits and reviews.

In addition, developers must give consumers the option to see, edit, or remove their data and be open and honest about how they handle it. In order to ensure that consumers are informed and have the option to opt out, this transparency also extends to the sharing of data with third parties. In the end, ethical issues in data collecting and application development entail a dedication to upholding fairness and transparency standards, protecting privacy, and respecting user liberty. It is recommended that developers adopt a proactive approach towards resolving ethical dilemmas, maintain continuous communication with relevant parties, and be up to date with the latest ethical guidelines and legislation pertaining to technology and data privacy.

Privacy and data security are crucial in applications to build user trust and comply with ethical standards. Robust measures are implemented throughout the development lifecycle, including data encryption techniques, access controls, and authentication mechanisms. Regular security audits and vulnerability assessments are conducted to identify and address potential weaknesses in the application's infrastructure. Developers prioritize secure coding practices and the principle of least privilege, granting access only to minimal data and functionalities. Intrusion detection and prevention systems are implemented to monitor system activities for suspicious behaviour. Compliance with data protection regulations is essential, with clear consent mechanisms and data collection practices aligning with legal requirements. Regular updates and patches are issued to address vulnerabilities, and secure communication protocols like HTTPS are implemented. Privacy by design principles is embedded into the application's architecture, empowering individuals to understand and manage their privacy settings.

3.7 CONCLUSION

The chapter begins by reiterating that methodology is important for achieving research objectives as it provides a systematic plan for collecting, analysing and understanding data. This helps ensure the research is conducted thoroughly and efficiently to meet the goals. The objectives of this research project are then outlined, which are to identify constraints of the current traffic data collection method, develop a new application for real-time traffic data collection, and evaluate its impact on improving construction project efficiency. The research design section explains that a quantitative approach will be used, involving collecting data through a developed application and questionnaire. This data will then be statistically analysed.

The application development process is explained across four phases - requirement analysis, design, development and testing. In the requirement analysis phase, methods like observation, immersion and interviews were used to understand current issues. Prototyping using Canva and the App Inventor platform is discussed for the design and development phases. Testing will involve unit, integration, functionality and user acceptance testing. Data collection and analysis methods involving categorizing traffic data and assigning levels of service are also outlined. Feedback will be collected through an online questionnaire.The chapter concludes by discussing evaluation of the application's effectiveness and important ethical considerations around privacy, security, transparency and informed consent that will be followed.In summary, the methodology provides a systematic plan aligned with research objectives to develop and evaluate a new traffic data collection application through quantitative research and user testing

CHAPTER 4

RESULTS

4.1 INTRODUCTION

Information about data analysis, result interpretation, and some comments are covered in this chapter. This initiative was designed to help traffic professionals by integrating innovation and technology into their daily tasks, particularly in the implementing of traffic analysis. The following goals were listed as ones that the Data Collection Mobile (EDC) For Traffic was thought to have achieved:

i. To identify the constraint of the current method of collecting data traffic.
ii. To develop an application for traffic data collection.
iii. To evaluate the application's impact on improving the efficiency of construction projects.

4.2 IDENTIFY THE CONSTRAINT OF THE CURRENT METHOD OF COLLECTING DATA TRAFFIC.

The method that the company has been for data collection is by using the traditional method by counting every vehicle manually. The workers are manually collecting data on paper, as seen in figure 4.1. So, from my observations that had been done. There are several problems that occur when running a project. The first problem that I noticed was lack of workers. When there is a big project, the company had the problem with completing the project at the given time. For large-scale projects, numerous intersections will need to be considered when conducting vehicle counting. More workers are needed when there is big project involved. The solution that the company had was to hire a parttime the problem. However, despite the presence of the part-time worker, the delay still occurred.

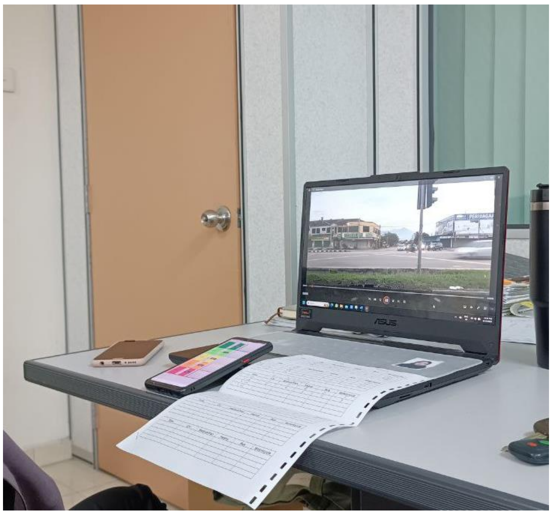


Figure 4.1 Worker doing data collection.

The delay happened is because of the second problem, which is the management of the time. The lack of the management of time cause project to delay. Therefore, in response to this difficulty, I have devised a solution in the form of an application that can speed up data collection. Figure 4.2 shows the flowchart of Design E Data Collection Application (EDC).

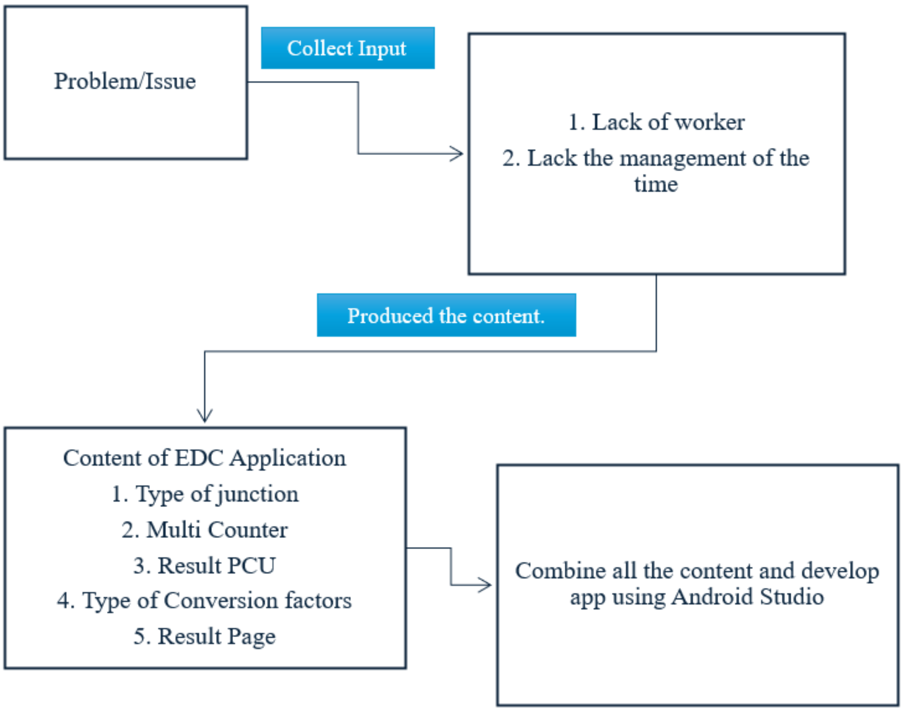


Figure 4.2 Flowchart of Design E Data Collection Application (EDC).

4.3 TO DEVELOP AN APPLICATION FOR TRAFFIC DATA COLLECTION

The development of the "E Data Collection" was using Android Studio. The process of developing an app for Android is fundamentally like that of other app platforms. The process of creating an application involves various stages such as setup, develop, execute, testing, and publishing. Figure 4.3 shows the process of developing an application using android studio Here is an overview of the development process:

i. Setup workplace

This marks the initial phase of the Android application development procedure. For additional information, please refer to the Android Studio installation page and the guide on how to create a project.

ii. Develop your application.

After establishing workspace, it may commence the process of developing the application. Android Studio incorporates a diverse range of tools and advanced features to enhance productivity, facilitate the creation of high-quality code, enable efficient UI design, and generate resources tailored for various device categories.

iii. Compile and execute

During the build and run phase, compile the project into an APK package that can be debugged. This package can be installed and executed on either an emulator or an Android-powered device. In this phase, it has the option to personalize and modify the project according to own preferences. One way to illustrate this is by creating build variants that generate several versions of application using the same project.

iv. Perform debugging, profiling, and testing.

During this phase, proceed with the development of the app while simultaneously addressing any bugs and enhancing the performance of the app. To obtain assistance in debugging and optimizing your application, it is advisable to do testing within the Android Studio environment. And then processing with the debugging and observe and examine different performance measures, such as memory use, network data flow, CPU influence, and others.

v. Publish

In order to make the application available to consumers, it must create an Android program Bundle, digitally sign it with a security key, and make preparations for publishing it on the Google Play Store.

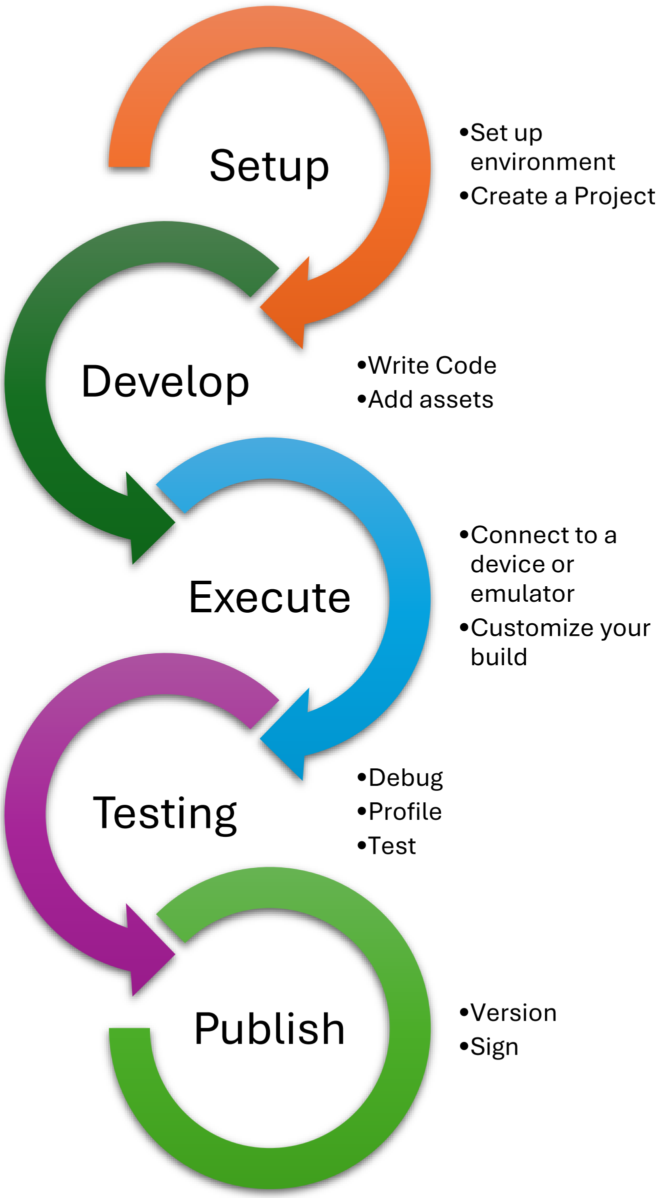
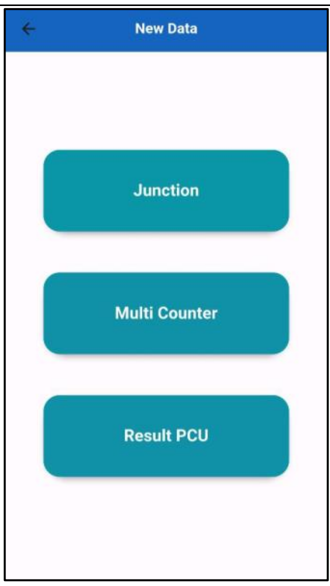
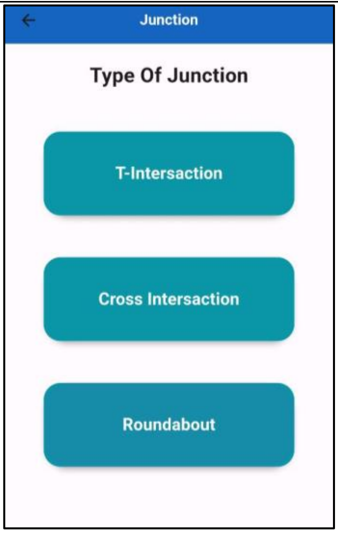
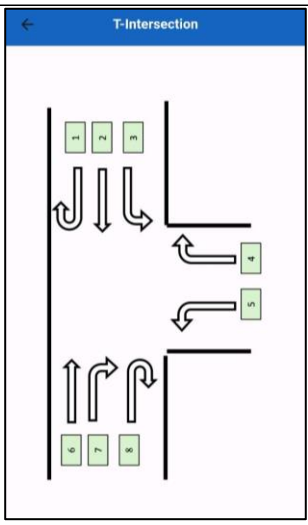
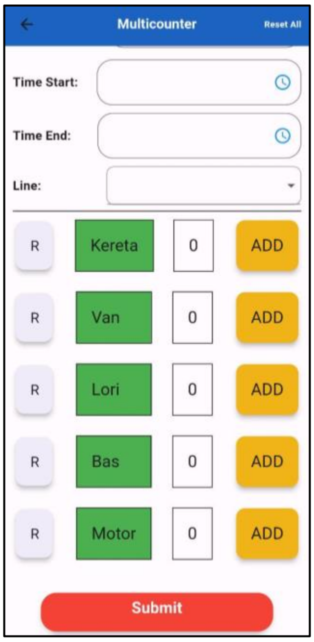


Figure 4.3 Process of Developing an application using Android Studio

Table 4.1 Development of Data Collection Mobile (EDC) For Traffic

No	Dashboard	Work Explanation
1.		The first screen generated is the login section for the application's users who are staff members of the Prima Reka company. For this, there are two text box elements put for the user to enter the company email and password and login buttons to enter in the next screen.
2.		The second screen is the EDC content. Which is Junction. Multi Counter and Result PCU.

3.		For the junction button. There will be three types of junctions available. Which is T-intersection, Cross Intersection and Roundabout
4.		For the type of junction, there will be number that will be used as reference for the multi counter
5.		This is the Multi counter section. Where there is the time start, time end and the line. The line is which in the number in as referred at the junction. And there is the counter for car, van, lorry, bus and motorcycle. Lastly the button submit, where the data will be collected to the result

<table>
<tr>
<td></td>
<td>
</td>
<td>For the result PCU button. There will be option on what type of highway are using the project.</td>
</tr>
<tr>
<td></td>
<td>
</td>
<td>After choosing the type of highway, there will be confirmation of the detail. And then proceed button will get you the result on the next page.</td>
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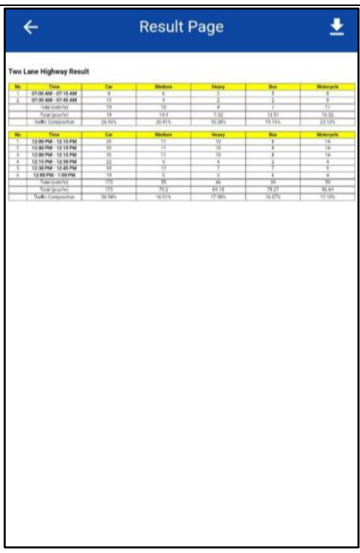
<tr>
<td></td>
<td>
</td>
<td>Finally, the result will be showed here, and there is button on the top corner for download option. It can be downloaded to excel.</td>
</tr>
</table>

4.4 TO EVALUATE THE APPLICATION'S IMPACT ON IMPROVING THE EFFICIENCY OF CONSTRUCTION PROJECTS.

Following the production of a product or innovation, the following step involves gathering input from users, the company's own workers, as a crucial means of validating the innovation. The creation of this survey form is conducted online using Google Forms. The questionnaire is divided into two sections. Part A refers to the respondent's demographic information, while Part B consists of inquiries regarding the respondents' level of acceptability towards the current method, record the number of vehicles on the physical form and their approval of the Application E-DC (Electronic Data Collection) for Traffic is also important. The questionnaire was answered by Site Engineer 33.33% (3), 3 Assistant Engineer 33.33% (3) and Design Engineer 33.33% (3)

Five (5) respondents, or 55.56% of the total respondents, are women, according to the demographic of the respondent in table 4.2 below. A total of four (4) respondent or 44.44% of the total were men in the company. There are more women than men employed by the organization based on the statistical analysis of employees by gender.

Further analysis of the data indicates that a total of four (4) participants, which accounts 44.44% of the total the majority of respondents, fall into the age category range between 26 and 35. Out of the total number of responses, two (2) respondents, which accounts for approximately 22.22% of the sample, fall under the age of 25 and between the age range of 26 to 35. One (1) or 11.11% out of the total responses are above the age of 46.

Based on the collected data, 33.33% of respondents, or three (3) respondents have less than two years of experience in the company. Next, two (2) respondents or 22.22% have 2 to 5 years of experience. One (1) respondent or 11.11% of the respondent have 6 to 10 years of experience and lastly there are three (3) respondents or 33.33% of the respondent have more than 10 years of experience in the company.

Table 4.2 Respondents Background

	Gender	No of respondent	Percentage (%)
1	Male	4	44.44%
2	Female	5	55.56%
	Age	**No of respondent**	**Percentage (%)**
1	< 25	2	22.22%
2	26 - 35	4	44.44%
3	36 - 45	2	22.22%
4	> 46	1	11.11%
	Work Experience	**No of respondent**	**Percentage (%)**
1	< 2 years	3	33.33%
2	2 - 5 years	2	22.22%
3	6 – 10 years	1	11.11%
4	> 10 years	3	33.33%
	Position	**No of respondent**	**Percentage (%)**
1	Site Engineer	3	33.33%
2	Design Engineer	3	33.33%
3	Assistant Engineer	3	33.33%

The second component of this survey pertains to research on conventional or current systems. Respondents will assign scores based on the predetermined grading scale by placing a slash (/) in the designated empty place inside the table. Table below is the proposed scoring system:

Table 4.3 Marking Scale in Questionnaire

Opinion Scale	Marking Scale
Strongly Agree	5
Agree	4
Slightly Agree	3
Disagree	2
Strongly Disagree	1

The survey results provide a detailed assessment of the perceived effectiveness of an existing method, evaluated across various dimensions: Perceived Usefulness (P.U), Perceived Ease of Use (P.E), and Intention to Use (I.U). For Perceived Usefulness, respondents generally did not find the method effective in enhancing their work. Specifically, none of the respondents strongly agreed that the method enhances work effectiveness, improves performance, or increases productivity. Only 22.22% slightly agreed that the method enhances their effectiveness, while 55.55% disagreed and 11.11% strongly disagreed. Similarly, only 22.22% agreed and slightly agreed that the method improves their performance, with 44.44% disagreeing. When it comes to productivity, 33.33% slightly agreed on its improvement, but 44.44% disagreed. Overall, the method's usefulness was not well-regarded, with 33.33% slightly agreeing it was useful, while 44.44% disagreed.

In terms of Perceived Ease of Use, the responses indicated that users found the method challenging to use. For instance, while 22.22% slightly agreed that the method is easy to use, an equal percentage disagreed, and 11.11% strongly disagreed. Learning to use the method was perceived as difficult by 44.44% of respondents, and none strongly agreed it was easy to learn. Interaction clarity fared somewhat better, with 44.44% slightly agreeing that their interaction with the method was clear and understandable, but 33.33% disagreed or strongly disagreed. Managing projects using the method was also seen as difficult, with 44.44% disagreeing it was easy, and only 11.11% slightly agreeing.

Regarding Intention to Use, responses were mixed. While 44.44% slightly agreed they intended to use the method, 33.33% disagreed. The frequency of intended use showed that 55.55% were neutral about using the method often, but 22.22%

disagreed. Similarly, the intention to use the method frequently had 33.33% slightly agreeing, but 33.33% were neutral and 22.22% disagreed. Overall, the survey results indicate a general dissatisfaction with the existing method, with significant portions of respondents expressing disagreement or neutrality regarding its usefulness, ease of use, and intention to use it frequently. This suggests that the method may require substantial improvements to better meet the needs and expectations of its users.

Table 4.4 Existing Method Survey Data

No.	**Survey to identify effectiveness of Existing Method**	**Strongly Agree (5)**	**Agree (4)**	**Slightly Agree (3)**	**Disagree (2)**	**Strongly Disagree (1)**
1(a)	Using the existing method enhances my effectiveness in work. (P.U 1)	0%	22.22%	11.11%	55.55%	11.11%
1(b)	Using existing method would improve my performance in work (P.U 2)	0%	22.22%	22.22%	44.44%	11.11%
1(c)	Using existing method would increase my productivity. (P.U 3)	0%	33.33%	11.11%	44.44%	11.11%
1(d)	I found existing method useful. (P.U 4)	0%	33.33%	11.11%	44.44%	11.11%
2(a)	I found existing method easy to use. (P.E 1)	0%	22.22%	33.33%	33.33%	11.11%
2(b)	Learning to use existing method would be easy for me. (P.E 2)	0%	22.22%	33.33%	44.44%	0%
2(c)	My interaction existing method was clear and understandable. (P.E 3)	0%	44.44%	22.22%	22.22%	11.11%
2(d)	It would be easy for me to manage my project using existing method. (P.E 4)	0%	11.11%	33.33%	44.44%	11.11%
3(a)	I intend to use existing method during my work (I.U 1)	0%	44.44%	22.22%	33.33%	0%
3(b)	I will use the existing method often. (I.U 2)	0%	11.11%	55.55%	22.22%	11.11%
3(c)	I intend to use existing method frequently. (I.U 3)	0%	33.33%	33.33%	22.22%	11.11%

The next survey, known as the post-FYP survey, applies to the review of an innovative product within the existing system. The purpose of this survey is to gather data from respondents who have used the products that were produced. Similarly to the previous survey, the respondents will provide scores based on the predetermined scoring scale by marking (/) in the designated spot inside the table. Table 4.5 is the recommended scoring system:

Table 4.5 Marking Scale in Questionnaire

Opinion Scale	Marking Scale
Strongly Agree	5
Agree	4
Slightly Agree	3
Disagree	2
Strongly Disagree	1

The survey results provide a comprehensive evaluation of the Electronic Data Collection (E-DC) application's effectiveness, indicating a highly positive reception among users. In terms of Perceived Usefulness (P.U), respondents overwhelmingly agree that the E-DC application enhances their work effectiveness, with 33.33% strongly agreeing and 66.67% agreeing. Similarly, 55.55% strongly agree and 44.44% agree that the application improves their performance, and the same percentages believe it increases their productivity. The overall usefulness of the E-DC application is affirmed, with 44.44% strongly agreeing and 55.55% agreeing.

When it comes to Perceived Ease of Use (P.E), users find the E-DC application exceptionally user-friendly. A significant majority, 44.44% strongly agree and 55.55% agree, that the application is easy to use. Learning to use the E-DC application is perceived as straightforward, with 44.44% strongly agreeing and 55.55% agreeing. Additionally, 55.55% strongly agree and 44.44% agree that their interaction with the application is clear and understandable. Managing projects using the E-DC application is also seen as easy, with the same high levels of agreement.

Regarding Intention to Use (I.U), the survey results show strong intentions to use the E-DC application. Most respondents, 55.55%, strongly agree they intend to use the application in their work, with 22.22% agreeing and another 22.22% slightly agreeing. The frequency of intended use is high, with 66.67% strongly agreeing they will use the E-DC application often, 22.22% agreeing, and 11.11% slightly agreeing. Similarly, 55.55% strongly agree they intend to use the application frequently, with 33.33% agreeing and 11.11% slightly agreeing.

In summary, the survey highlights the E-DC application's strong performance in enhancing work effectiveness, improving performance, and increasing productivity. Users find the application easy to use, easy to learn, and clear in interaction, making project management straightforward. The high levels of intention to use the application both often and frequently reflect users' overall satisfaction and the perceived value of the E-DC application in their work.

Table 4.6 Survey After Using EDC Application

No.	**Survey to identify effectiveness of EDC Application**	**Strongly Agree (5)**	**Agree (4)**	**Slightly Agree (3)**	**Disagree (2)**	**Strongly Disagree (1)**
1(a)	Using E-DC (Electronic Data Collection) enhances my effectiveness in work. (P.U 1)	33.33%	66.67%	0%	0%	0%
1(b)	Using E-DC (Electronic Data Collection) would improve my performance in work (P.U 2)	55.55%	44.44%	0%	0%	0%
1(c)	Using E-DC (Electronic Data Collection) would increase my productivity. (P.U 3)	55.55%	44.44%	0%	0%	0%
1(d)	I found E-DC (Electronic Data Collection) useful. (P.U 4)	44.44%	55.55%	0%	0%	0%
2(a)	I found E-DC (Electronic Data Collection) easy to use. (P.E 1)	44.44%	55.55%	0%	0%	0%
2(b)	Learning to use E-DC (Electronic Data Collection) would be easy for me. (P.E 2)	44.44%	55.55%	0%	0%	0%

2(c)	My interaction with E-DC (Electronic Data Collection) was clear and understandable. (P.E 3)	55.55%	44.44%	0%	0%	0%
2(d)	It would be easy for me to manage my project using E-DC (Electronic Data Collection). (P.E 4)	55.55%	44.44%	0%	0%	0%
3(a)	I intend to use E-DC (Electronic Data Collection) during my work. (I.U 1)	55.55%	22.22%	22.22%	0%	0%
3(b)	I will use E-DC (Electronic Data Collection) often. (I.U 2)	66.67%	22.22%	11.11%	0%	0%
3(c)	I intend to use E-DC (Electronic Data Collection) frequently. (I.U 3)	55.55%	33.33%	11.11%	0%	0%

4.4.1 Usability Level of Traffic Data Collection with EDC Application

Table 4.7 displays how well respondents thought of usability when using the current method. The study reveals that for all variables studied, the mean scores were below 3.50. This indicates that the usability level of the existing method was low. Table 4.8 displays the respondents' level of usability when using the E Data Collection (EDC) Application. The study reveals that for all investigated variables, the mean scores were over 4.00. This indicates that the usage of the EDC Application is significantly easier compared to the existing approach.

Table 4.7 Usability Level of existing method among respondents

Variables	Mean	Interpretation
Perceived Ease of Use	2.5833	Low
Perceived Usefulness	2.7222	Low
Intention to Use	2.8889	Low

Table 4.8 Usability Level of E Data Collection Application among respondents

Variables	Mean	Interpretation
Perceived Ease of Use	4.4722	High
Perceived Usefulness	4.5000	High
Intention to Use	4.4444	High

4.4.2 Significance differences between EDC Application compared with the existing method.

A paired sample t-test was used to assess the efficacy of the E Data Collection (EDC) Application in the project. The results presented in Table 4.9 indicate that respondents showed a preference for using the EDC Application. In all measured variables, namely Perceived Ease of Use (Mean = 4.4722), Perceived Usefulness (Mean = 4.5000), and Behavioral Intention to Use (Mean = 4.4444), the scores were higher compared to the existing method. On the other hand, the scores for Perceived Ease of Use (Mean = 2.5833), Perceived Usefulness (Mean = 2.7222), and Intention to Use (Mean = 2.8889) were lower for the existing method. A paired sample t-test revealed a statistically significant difference for all measured variables. Specifically, the t-value for Perceived Ease of Use is 4.673, and the p-value is less than .00001. The outcome is statistically significant at a significance level of $p < .05$. The Perceived Usefulness has a t-value of 4.787 and a p-value of less than 0.00001. The outcome is statistically significant with a p-value less than 0.05. The t-value for the Intention to Use variable is 3.300, and the p-value is less than 0.00001. The outcome is statistically significant with a p-value of less than 0.05. This indicates that the utilization of the EDC Application was significantly more convenient and efficient in comparison to the current way. This indicates that the EDC Application was more efficient in comparison to the current technique

Table 4.9 Paired sample t-test

Pair	Paired Different Mean	t	Significant (two tailed)
Perceived Ease of Use - Existing Method	1.88889	4.673	.002
Perceived Usefulness - Existing Method	1.77778	4.787	.001
Intention to use- Existing Method	1.55556	3.300	.011

4.5 CONCLUSION

Even with its lengthy history, the traffic construction sector has had trouble implementing new technologies on construction sites. Outdated methods and broken communication have slowed down the sector, which has made projects less efficient. It shows how important technology is for improving quality and productivity in a company. Engineers know that putting in place the right technologies can make the workplace more effective.

A survey of engineers at Prima Reka Konsultan found that all of them agreed that the E-Data Collection Application works better than the current way. People thought that the current way of using paper for submission are hard to handle. The people who answered (with a mean score of more than 4.00) agreed that the E-Data Collection Application is easy to use and that they plan to use it to collect data on the Traffic Impact Assessment (TIA) project.

A paired t-test, which was done on the Social Science Statistics website, was used to figure out how well the E-Data Collection Application worked. The results showed a big difference between the application and the old way of doing things. This shows that the E-Data Collection Application is not only better, but it's also simpler to use. So, it is strongly suggested that you get all the information you need about construction places.

In general, people who work in the traffic construction industry know that technology is important for making things better and faster. With the E-Data Collection Application, problems in the industry can be solved in a useful way. It makes things run more smoothly, cuts down on using old tools like paper, and boosts productivity. Because of these benefits, the app is strongly suggested for managing information on building sites.

CHAPTER 5

CONCLUSION, DISCUSSION & SUGGESTION

5.1 INTRODUCTION

The project aimed to resolve the common problem of data collection delays in traffic impact assessment reports by creating an E-Data Collection (EDC) Application. The application was developed using the Android Studio development tool and its usefulness was evaluated among the company's employees using a survey conducted online. The survey incorporated three variables extracted from the Technology Acceptance Model (TAM) questionnaire: Perceived Ease of Use, Perceived Usefulness, and Behavioural Intention to Use.

The data collected were analysed using paired T-Test and mean calculations. The paired t-test findings demonstrated a significant difference between the E-Data Collection Application and current method. This implies that the program demonstrated superior usability in comparison to the current method. Therefore, the study strongly recommends using the E-Data Collection Application to effectively coordinate personnel and processes in managing the traffic impact assessment report.

Engineers may effectively address project delays and improve their time management methods by using this application. The E-Data Collection Application serves as a platform for gathering data specifically utilized for conducting the traffic effect assessment. It provides elements that enhance the user-friendliness, use, and general view of applying technology in projects. The staff's positive feedback from the survey shows that the application has the capacity to efficiently and effectively simplify the management of time and labor in creating traffic impact assessment reports.

The use of the E-Data Collection Application can result in increased productivity, less errors, and greater coordination among team members participating in projects. By using technology and solving the limitations of traditional methods, consultants can gain advantages from a more efficient and structured approach to collecting data. The survey results provide additional evidence of the application's usability, which further supports its acceptance in the traffic construction company.

Ultimately, the study effectively created and evaluated the E-Data Collection Application, showing its superiority in terms of usability compared to the current method. The program has the capacity to significantly advantage consultants with the effective organization and management of workers and time processes within projects. Implementing this approach is strongly advised to enhance project results and address the difficulties arising from inadequate data collection planning.

5.2 DISCUSSION

From my observation and studies on all the problem that the company had, effort were made to solve the problem by referring to a concept of design thinking method. This idea is a technique that addresses all the fundamental components of every creation made into a small chart. Every suggested idea in the first phase must go through the empathy process, which is the process of interviewing staff members of the company to get what are the issues and shortcomings still seen as not having a good impact and should be developed or made adjustments to the issue. By means of this task, brainstorming can generate ideas and encouragement from people engaged in the manufacturing of the newest product to be launched. Every comment they provide is quite valuable since it marks the first stage in product development. The next step in product development is testing the company's staff to ensure it meets their needs. Two surveys should be developed in the meantime as a sample of data analysis covering before execution and after implementation of the suggested product to ascertain its usability degree among workers.

Two questionnaires were designed to gather feedback on the existing method to collect data for traffic flow and the newly developed E-Data Collection Application. The analysis of the questionnaire results showed that the usability level of the existing method was low, with respondents expressing difficulties in executing their work. On the other hand, the feedback on the Interactive E-Data Collecting Application indicated that it was significantly easier to use compared to the previous approach. The mean scores for variables such as Perceived Ease of Use, Perceived Usefulness, and Behavioural Intention to Use were all higher for the application.

According to the findings in Table 4.8, respondents preferred using E-Dara Collection, with all variables measured Perceived Ease of Use (Mean = 4.50), Perceived Usefulness (Mean = 4.50), and Behavioural Intention to Use (Mean = 4.44) being significantly higher than the existing method. Perceived Usefulness (Mean = 2.72), and Behavioural Intention to Use (Mean = 2.90). A paired sample t-test revealed that this difference was significant for all variables studied. The value of t for Perceived Ease of Use is 4.673 and the value of p is $< .002$. The result is significant at $p < .05$. Perceived Usefulness has a t value of 4.787 and a p value of.001 The outcome is noteworthy at p.05. The t value of Behavioural Intention to Use is 3.30, while the p value is.011. significant at $p < .05$. This suggests that using E-Data Collection Application was much easier and resourceful compared with existing method. This mean that E-Data Collection Application was more effective compare with the existing method.

The E-Data Collection Application proved to be a valuable tool for the company. Additionally, it could be utilized for work progress. Based on the positive feedback and significant improvements observed, the application was recommended for use in the company. It offered increased organization, usefulness, and user-friendliness, eliminating the need for paper-based processes and enabling personnel to stay updated on data collection with a reliable internet connection.

5.3 RECOMMENDATIONS

The researcher suggests numerous suggestions based on the given results to improve the use of the E-Mega Column Management Application and target the following initiatives such as:

1. Enhancing Security Measures for Sensitive Information Applications: Enforce tight access restrictions to guarantee that only authorized users are able to access and edit data. the RBAC system is a useful method for efficiently managing rights, ensuring that users are granted access only to the specific data and functionalities that are relevant to their assigned job.

2. Increase the Applicability Range: Currently, the application is limited to traffic count and traffic volume calculations. To benefit multiple stakeholders, it would be advantageous to extend the application coverage on the calculation.

3. Use advanced application development tools: Incorporating advanced application development tools for Augmented Reality (AR) can significantly enhance the capabilities and user experience of your application, particularly when working with data visualization and interactive calculations.

4. Integration Capabilities: The data within the application is exclusively accessible within the application itself. It would be beneficial if the data could be imported or exported in several formats such as CSV, Excel, JSON, and XML to simplify the process of exchanging data. Users can import data from external sources and export it for use in other programs, ensuring both flexibility and compatibility.

5. User Experience (UX): Provide dynamic visualizations of data, such as charts, graphs, and dashboards, to aid users in understanding and analysing the data and real-time updates which deliver immediate updates and feedback during the process of inputting data and conducting calculations. This includes the incorporation of instantaneous data validation, graphical representations of current calculations, and the capability to dynamically change material without having to reload the entire page.

By applying these suggestions, the company can enhance the efficiency of the E-Data Collection Application, enhance data collection management across different locations, ensure data security, and utilize technology to improve project processes and results.

5.4 CONCLUSION

The results showed that workers of Prima Reka Konsultan, including engineers and site supervisors, unanimously acknowledged that the E-Data Collection Application was significantly more efficient than the existing way. The existing method of relying on manual writing and paper-based references and submissions is considered outdated and challenging to handle. The respondents all agreed that the application was user-friendly and expressed their intention to use it for accessing information on site progress preparation, as indicated by the average ratings over 4.00.

The efficacy of the E-Data Collection Application was assessed by a paired t-test conducted with the aid of the Social Science Statistics online platform. The findings demonstrated a significant difference between the utilization of the application and the present method, thereby verifying that the application was not only more efficient but also more user-friendly. Thus, it was strongly advised to use this method for effectively managing all data related to traffic count for data gathering purposes.

In addition, the E-Data Collection Application can be used as a mobile application, offering convenience and user-friendliness for all employees. It is also asserts that technology is crucial in the traffic project, facilitating the creation of projects of superior quality. By the E-Data Collection Application, the organization can save expenditures on paper, conserve time, and build a more methodical approach. Furthermore, the implementation of technology can effectively entice a larger consumer base to engage with the company's offerings.

REFERENCES

Aceto, G., Bovenzi, G., Ciuonzo, D., Montieri, A., Pescape, A., & Persico , V. (2021). Characterization and Prediction of Mobile-App Traffic Using Markov Modeling. *IEEE Transactions on Network and Service Management*, 907-925.

Aheleroff, S., Xu, X., Lu, Y., Aristizabal, M., Velasquez, J. P., Joa, B., & Valencia, Y. (2020). IoT-enabled smart appliances under industry 4.0: A case study. *Advanced Engineering Informatics*.

Alam, M., Ferreira, J., & Fonseca, J. (2016). Chapter 1 Introduction to Intelligent Transporation Systems. In *Intelligent Transportation Systems Dependable Vehicular Communications for Improved Road Safety* (pp. 1-17). Springer.

Anderson , M. (2019). *Mobile Technology and Home Broadband 2019*. Retrieved from Pew Research Center: https://www.pewresearch.org/internet/2019/06/13/mobile-technology-and-home-broadband-2019/

Antoniou, C., Balakrishna, R., & Koutsopoulos, H. N. (2011). A Synthesis of emerging data collection technologies and their impact on traffic management applications. *Eur. Transp. Res Rev.*

Battelle. (2003). *Advances In Traffic Data Collection and Management.* Washington, DC: Texas Transportation Institute.

Beal, V. (22 July, 2022). *Application Software*. Retrieved from webopedia: https://www.webopedia.com/definitions/application-software/

Bonett, D. G., & Wright, T. A. (2014). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior, J. Organiz. Behav.* doi:doi.org/10.1002/job.1960

Chen, Y., Shu, L., & Wang , L. (2017). Poster abstract: Traffic flow prediction with big data: A learning based time series model. *IEEE Conferences on Computer*

Communications Workshops.

Davis, F. D. (September , 1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 319-340. doi:https://doi.org/10.2307/249008

Eckhoff, D., & Wagner, I. (2018). Privacy in the Smart City - Applications, Technologies, Challenges and Solutios. *IEEE Comunication Surveys & Tutorials*.

Gamil, Y., Abdullah, M. A., Rahman, I. A., & Asad, M. M. (2020). Internet of things in constrcution industry revolution 4.0 Recent trends and challenges in the Malaysia context. *Emerald Insight*, 2.

Goddard, W., & Melville, S. (2007). *Second Edition Research Methodology An Introduction.* Lansdowne: Berne Convention.

Grassi, P. A., Garcia, M. E., & Fenton, J. L. (2017). Digital Identity Guidelines. *NIST Special Publication*.

Jaffar, N. (2011). Factors of Conflict in Construction Industry: A Literatur Review. *The 2nd International Building Control Conference 2011*.

Krejcie, R. V., & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement*, 607-610. doi:10.1177/001316447003000308

Leduc, G. (2008). Road Traffic Data: Collection Methods and Applications. *Institute Propectives Technological Studies*.

Liu, J., Fu, Y., Ming, J., Ren, Y., Sun, L., & Hui Xiong. (2017). Effective and Real-time In-app Activity Analysis in Encypted Intenert Traffic Streams. *KDD Research Paper*, 335-344.

Liu, T., & Mathrani, A. (2018). Benefits and barriers in uptake of mobile apps in New Zealand construction industry. *Emerald Insight*.

LLP, A. (21 September, 2023). *Enhancing Mobile App Security: Best Practises and*

Techniques. Retrieved from Linkedin: https://www.linkedin.com/pulse/enhancing-mobile-app-security-best-practices-techniques

Lowhorn, G. L. (2007). Qualitative and Quantitative Research : How to Choose the Best Design. *Acedemic Business World International Conference* (pp. 1-5). Nashville, Tennessee: Pensacola Christian College.

Maerivoet, S., & Moor, B. D. (2008). Transportation Planning and Traffic Flow Models. *Department of Electrical Engineering ESAT-SCD (SISTA)*.

Oladimeji, D., Gupta, K., Kose, N. A., Gundogan, K., Ge, L., & Liang, F. (2023). Smart Transportation: An Overview of Technologies and Applications. *MDPI*.

Pallant, J. F., Haines, H. M., Green, P., Toohill, J., Gamble, J., Creedy, D. K., & Fenwick, J. (2016). Assesment of the dimensionality of the Wijma delivery expectancy/experience questionnaire using factor analysis and Rasch analysis. *BMC Pregnancy and Childbirth*, 1-11. doi:10.1186/s12884-016-1157-8

Parikh, J. H. (2021). Effective Project Management Using Mobile Application For Construction Project: A Review. *International Research Journal of Modernization in Engineering Technology and Science*, Volume 3.

Pearson, N., Naylor, P.-J., Ashe, M., Fernandez, M., Yoong, S. L., & Wolfenden, L. (2020). Guidance for condcuting feasibility and pilot studies for implementation trials. *Pilot and Feasibility Studies*.

PlanRadar. (22 April, 2023). *From blueprints to smartphones: How is mobile tchnology transforming the construction industry?* Retrieved from Plan Radar: https://www.planradar.com/sa-en/transforming-construction-industry-mobile-technology/#:~:text=Mobile%20technology%20improves%20quality%20control,managers%2C%20contractors%2C%20or%20engineers.

Tatlor, V. F., Spolaor, R., Conti, M., & Martinovic, I. (2018). Robust Smartphone App Identificatio Via Encrypted Network Traffic Analysis. *IEEE Transaction on Infromation Forensic and Security*, 1-16.

Tien, J. M. (2017). Internet of Things, Real-Time Decision Making, and Artificial Intelligence. *Ann. Data*.

Winter, D., & F., J. C. (2013). Small sample sizes, overextraction, and unrealistic expections: A commentary on M. Mattson. *Accident Analysis and Prevention*, 776-777. doi:10.1016/j.aap.2012.07.003

Woodside, A. G. (2010). Bridging the chasm between survey and case study research: Research method achieving generalization, accuracy, and complexity. *Industrial Marketing Management*.

Yan. (10 March, 2022). *Intelligent Transportation System: Why It is Important and How You Can Benefit From It*. Retrieved from SENLA SOFTWARE ENGINEERING LABORATORY: https://senlainc.com/blog/intelligent-transportation-system-importance/

Yard, C. (1 April, 2022). *What is Passenger Car Unit (PCU)?* Retrieved from CivilYard Constructing Future!: https://civilyard.com/what-is-passenger-car-unit-pcu/

Yilmaz, G. K., Basaga, H. B., & Temel, B. A. (2019). The Use of Mobile Technology in the Construction Industry. *3rd International Conferences on Advanced Engineering Technologies.* Turkey: ResearchGate.

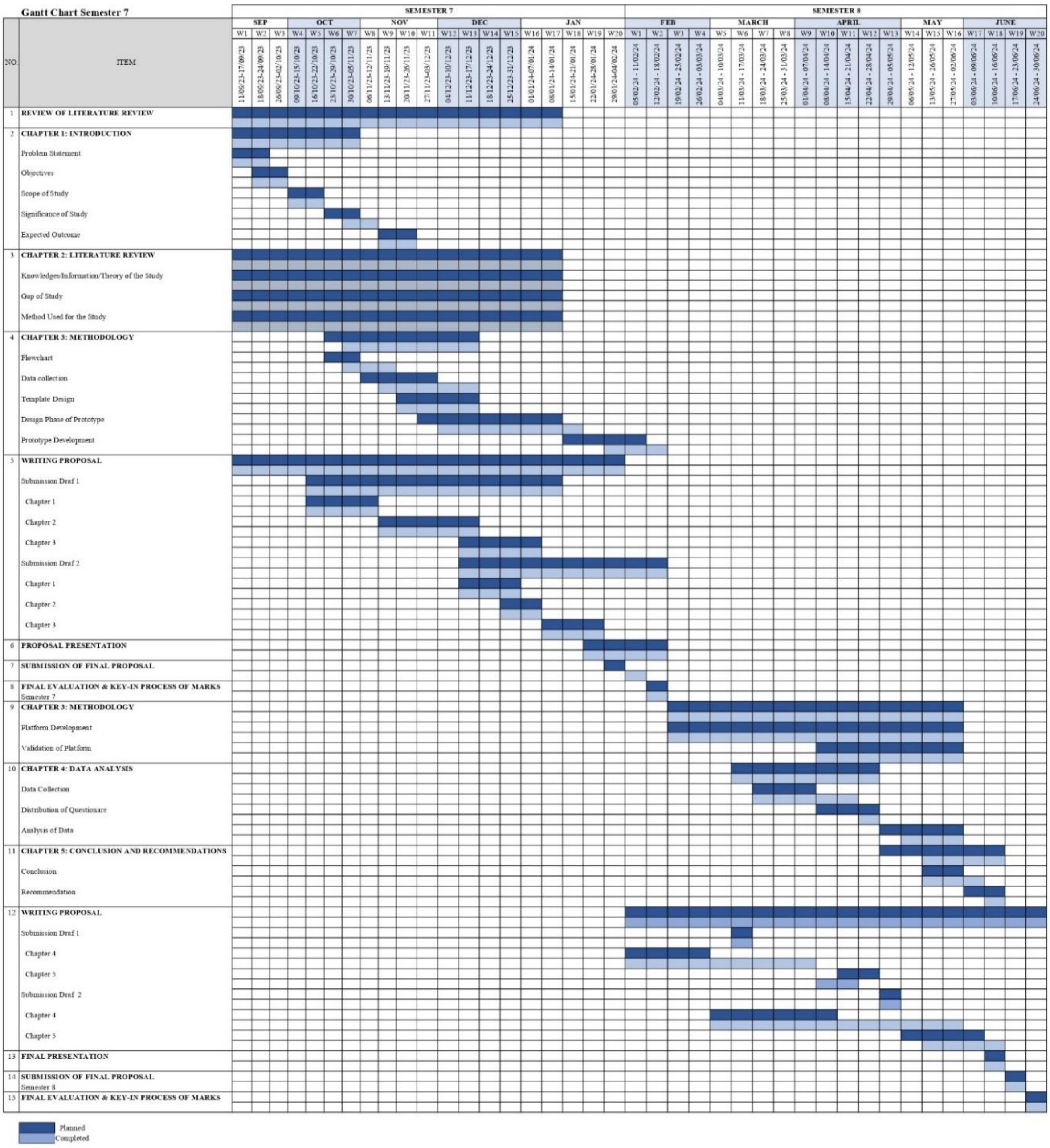
Zhu, L., Yu, F., Wang , Y., Ning, B., & Tang, T. (2018). Big Data Analytics in Intelligent Transportation Systems: A Survey. *IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS*.

Zwikael, O. (2009). Critical Planning Processes in Construction Projects. *ResearchGate*.

APPENDIX

APPENDIX A

GANTT CHART



CIVIL ENGINEERING DEPARTMENT
POLITEKNIK UNGKU OMAR
SURVEY FORM FOR FINAL YEAR PROJECT
BCT 83010 – FINAL YEAR PROJECT

DATA COLLECTION MOBILE (EDC) FOR TRAFFIC

Questionnaire 1: The Respondent Point of View Regarding the Using the existing method (record the number of vehicles on the physical form) for Traffic flow rate on Traffic Engineering

---

Please tick [/] the box that applies on each questions below.

SECTION A

a) Gender

Male [ ]

Female [ ]

b) Age

≤ 25 [ ]

26 – 35 [ ]

36 – 45 [ ]

≥ 46 [ ]

c) Work Experience

< 2 years [ ]

2 – 5 years [ ]

6 – 10 years [ ]

> 10 years [ ]

d) Position / Post

Site Supervisor	
Site Engineer	
Construction Manager	
Project Engineer	
Design Engineer	
Safety &Health Officer	

SECTION B

Questions 1 to Question 4 are outlined in the table below: -

No	Effectiveness Categories	Issues Related to Existing Method	Level of Agreement				
			Strongly Disagree	Disagree	Slightly Agree	Agree	Strongly Agree
			1	2	3	4	5
1.	Perceived Usefulness	Using the existing method (record the number of vehicles on the physical form) enhances my effectiveness in work.					
		Using existing method (record the number of vehicles on the physical form) would improve my performance in work					
		Using existing method (record the number of vehicles on the physical form) would increase my productivity.					
		I found existing method (record the number of vehicles on the physical form) useful.					
2.	Perceived Ease of Use	I found existing method (record the number of vehicles on the physical form) easy to use.					
		Learning to use existing method (record the number of vehicles on the physical form) would be easy for me.					
		My interaction existing method (record the number of vehicles on the physical form) was clear and understandable.					
		It would be easy for me to manage my project using existing method (record the number of vehicles on the physical form).					

No	Effectiveness Categories	Issues Related to Existing Method	Level of Agreement				
			Strongly Disagree	Disagree	Slightly Agree	Agree	Strongly Agree
			1	2	3	4	5
3.	Intention to Use	I intend to use existing method (record the number of vehicles on the physical form) during my work					
		I will use the existing method (record the number of vehicles on the physical form) often.					
		I intend to use existing method (record the number of vehicles on the physical form) frequently.					
4.	Attitude Toward Using it	existing method (record the number of vehicles on the physical form) makes work more interesting.					
		I feel comfortable using existing method (record the number of vehicles on the physical form)					
		I look forward to those aspects of my job that require me to use existing method (record the number of vehicles on the physical form)					

CIVIL ENGINEERING DEPARTMENT
POLITEKNIK UNGKU OMAR
SURVEY FORM FOR FINAL YEAR PROJECT
BCT 83010 – FINAL YEAR PROJECT

DATA COLLECTION MOBILE (EDC) FOR TRAFFIC

Questionnaire: The Respondent Point of View Regarding the Using the Application E-DC (Electronic Data Collection) for Traffic flow rate on Traffic Engineering

---

Please tick [/] the box that applies on each questions below.

SECTION A

a) Gender

Male [ ]

Female [ ]

b) Age

≤ 25 [ ]

26 – 35 [ ]

36 – 45 [ ]

≥ 46 [ ]

c) Work Experience

< 2 years [ ]

2 – 5 years [ ]

6 – 10 years [ ]

> 10 years [ ]

d) Position / Post

Site Supervisor	
Site Engineer	
Construction Manager	
Project Engineer	
Design Engineer	
Safety &Health Officer	

SECTION B

Questions 1 to Question 4 are outlined in the table below: -

No	Effectiveness Categories	Issues Related to Existing Method	Level of Agreement				
			Strongly Disagree	Disagree	Slightly Agree	Agree	Strongly Agree
			1	2	3	4	5
1.	Perceived Usefulness	Using E-DC (Electronic Data Collection) enhances my effectiveness in work.					
		Using E-DC (Electronic Data Collection) would improve my performance in work					
		Using E-DC (Electronic Data Collection) would increase my productivity.					
		I found E-DC (Electronic Data Collection) useful.					
2.	Perceived Ease of Use	I found E-DC (Electronic Data Collection) easy to use.					
		Learning to use E-DC (Electronic Data Collection) would be easy for me.					
		My interaction with E-DC (Electronic Data Collection) was clear and understandable.					
		It would be easy for me to manage my project using E-DC (Electronic Data Collection).					

No	Effectiveness Categories	Issues Related to Existing Method	Level of Agreement				
			Strongly Disagree	Disagree	Slightly Agree	Agree	Strongly Agree
			1	2	3	4	5
3.	Intention to Use	I intend to use E-DC (Electronic Data Collection) during my work					
		I will use E-DC (Electronic Data Collection) often.					
		I intend to use E-DC (Electronic Data Collection) frequently.					

APPENDIX C

DATABASE

```
}

@override
void initState() {
  super.initState();
  // Enable hybrid composition.
  if (Platform.isAndroid) WebView.platform = SurfaceAndroidWebView();
}

@override
Widget build(BuildContext context) {
  return Scaffold(
    appBar: AppBar(
      title: const Text('Result Page', style: TextStyle(color: Colors.white),),
      backgroundColor: Colors.blue[900],
      iconTheme: const IconThemeData(color: Colors.white),
      centerTitle: true,
      actions: [
        Padding(
            padding: const EdgeInsets.only(right: 10.0),
            child: GestureDetector(
              onTap: () async {
                 _Export();
                },
              child: const Icon(
                Icons.download,
                size: 26.0,
```

APPENDIX D

POSTER TEMPLATE