POLITEKNIK UNGKU OMAR

APPLICATION DEVELOPMENT OF PREMIX CALCULATION AND PROGRESS TRACKING IN ROAD MAINTENANCE (PERIODIC PAVEMENT):
ON- SITE CALCULATION PREMIX (OC Premix)

UMMI ATHIRAH BINTI AZIZAN

(01BCT21F3017)

JABATAN KEJURUTERAAN AWAM

SESSION II 2023/2024

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

JABATAN KEJURUTERAAN AWAM

SESSION II 2023/2024

DECLARATION OF ORIGINAL AND OWNERSHIP

APPLICATION DEVELOPMENT OF PREMIX CALCULATION AND PROGRESS TRACKING IN ROAD MAINTENANCE (PERIODIC PAVEMENT) : ON-SITE CALCULATION PREMIX (OC Premix)

1. I **UMMI ATHIRAH BINTI AZIZAN (01BCT21F3017)** a final year student pursuing a **Bachelor's Degree of Civil Engineering Technology** at the **Civil Engineering Department, Politeknik Ungku Omar.**

2. I acknowledge that 'The Above Project' and the intellectual property contained therein are the work of my original work/invention without taking or imitating any intellectual property from any other party.

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Made and truly acknowledged by the said :	)
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In front of me, PN. SAMIKHAH BINTI MUHAMMAD@MUNIR	) …………………………………...
As the project supervisor, on date: …………	) PN.SAMIKHAH BT MUHAMMAD @ MUNIR

APPRECIATION

While writing this thesis, development of application premix calculation and track progress in road maintenance (Periodic Pavement) :On -Site Calculation Premix(OC Premix) there are some ups and downs.

Nevertheless, while working hard to solve this matter project, it would not have been possible without the help and guidance of important people. I will be content to thank each of them for their support. Thanks to Allah SWT for giving me the opportunity to complete this assignment while I was completing this thesis. I would like to thank my supervisor Mrs. Samikhah Binti Muhammad @ Munir for always monitoring and giving advice in completing this thesis. She gave full attention to help this thesis and provided me with important information in the effort to complete the thesis project. I will always be grateful to my family and friends for their encouragement in completing this thesis.

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Thank you.

ABSTRACT

The construction industry is important for national development, which involves the planning, design and construction of infrastructure. It has a positive impact on socio-economic growth and sustainable development. Road maintenance ensures longevity and safety. However, there are potential problems that delay road maintenance activities and require faster progress tracking and data recording for analysis. The aim of the study is to develop an application namely On-Site Calculation Premix (OC Premix) to calculate premix and progress tracking activities on site. The study's scope is focused on the periodic paving project for maintaining Kedah state federal roads for the Kubang Pasu district. The effectiveness of the developed mobile application was tested through a quantitative study and analyzed using SPSS Statistics software. The reliability test produced a score of 0.913, showing excellent internal consistency and reliability of the data collected following the descriptive test calculating a mean score of 4.32 which is a high interpretation with a standard deviation of 0.9023 using the SPSS method comparing towards the T- Test method. Based on the mean variable average of 0.3232, it implies that the use of OC Premix has an overall beneficial effect. The study concludes with recommendations to improve the benefits of OC Premix and make it more useful in future road maintenance projects.

Keywords: Road Maintenance, Progress Tracking, Calculate, Technology IR 4.0, Application

ABSTRAK

Industri pembinaan adalah penting untuk pembangunan negara, yang melibatkan perancangan, reka bentuk dan pembinaan infrastruktur. Ia memberi kesan positif kepada pertumbuhan sosio-ekonomi dan pembangunan mampan. Penyelenggaraan jalan raya memastikan jangka hayat dan keselamatan. Walau bagaimanapun, terdapat potensi masalah yang melambatkan aktiviti penyelenggaraan jalan dan memerlukan pengesanan kemajuan yang lebih pantas dan perekodan data untuk analisis. Matlamat kajian adalah untuk membangunkan aplikasi iaitu On-Site Calculation Premix (OCPremix) untuk mengira pracampuran dan aktiviti pengesanan kemajuan di tapak. . Skop kajian tertumpu kepada projek penurapan berkala bagi penyelenggaraan jalan persekutuan negeri Kedah bagi daerah Kubang Pasu. Keberkesanan aplikasi mudah alih yang dibangunkan telah diuji melalui kajian kuantitatif dan dianalisis menggunakan perisian SPSS Statistics. Ujian kebolehpercayaan menghasilkan skor 0.913, menunjukkan ketekalan dalaman yang sangat baik dan kebolehpercayaan data yang dikumpul berikutan ujian deskriptif mengira skor min 4.32 iaitu tafsiran tinggi dengan sisihan piawai 0.9023 menggunakan kaedah SPSS membandingkan ke arah Ujian-T. kaedah. Berdasarkan purata pembolehubah min 0.3232, ia menunjukkan bahawa penggunaan OCPremix mempunyai kesan yang bermanfaat secara keseluruhan. Kajian ini diakhiri dengan cadangan untuk menambah baik manfaat OCPremix dan menjadikannya lebih berguna dalam projek penyelenggaraan jalan pada masa hadapan.

Kata kunci: Penyelenggaraan Jalan, Penjejakan Kemajuan, Kira, Teknologi IR 4.0, Aplikasi

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LIST OF ABBREVIATION

OC Premix	On-Site Calculation Premix
IR 4.0	Industry Revolution 4.0
PMS	Pavement Management System
GIS	Geographical Information System
GDOT	Georgia Department of Transportation
DVM	Dart Virtual Machine
RDBMS	Relational Database Management System
LAMP	Linux, Apache, MySQL, PHP/Python/Perl
SDGs	Sustainable Development Goals
GDP	Gross Domestic Product
IDOT	Information, Digital and Operational Technology
AGV	Automated Guided Vehicles
AVR	Augmented and Virtual Reality
HPC	High Performance Computer Aided Design and Manufacturing
IoT	Internet of Things
RFID	Radio Frequency Identification Tags
GPL	General Public License
CRUD	Create, Read, Update and Delete
JWT	JSON Web Tokens
SEM	Standard Error of Mean

APPENDIX

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Industry 4.0 is the fourth industrial revolution, integrating digital technologies such as IoT, AI, machine learning and automation to create intelligent interconnected systems in manufacturing, aiming to increase efficiency, productivity and flexibility in production, in addition to sustainability by reducing downtime and maintenance costs in manufacturing (Zonta et al., 2020). Industry 4.0, a revolution and digital transformation, is rapidly changing the lives and jobs of individuals, offering sustainability opportunities and reshaping people's views (Ghobakhloo, M., 2020). In view of the expanding Industrial Revolution 4.0 and the fast expanding technical innovation in construction, the Internet of Things has been identified as a critical component for enhancing productivity outcomes in the sector (Ibrahim et al., 2021). The construction industry is crucial for national development, involving the planning, design, and construction of structures and infrastructure. It is an economic investment and positively impacts socio-economic growth, creating sustainable development. Road maintenance activities are integral to this industry, ensuring longevity and safety (Hasmori et al., 2020).

Construction industry activities involving roads are high-risk projects due to the economic, social and political interests of developing countries. (Rahman et al., 2020). Heavy construction activities also include roads maintenance projects, which require lot of materials and a high level of mechanization. Delays may be due to resource shortages and failures. One of the main blocking issues regional development and road infrastructure than meet the demand is that period of time needed to complete a construction project. Unmet expectations can lead to end users dissatisfaction (Muda et al, 2020). This is due to the fact that roads are one of the infrastructures that provide services and benefits to the community because they function to connect cities, as well as improve the economic and social standards of the community (Adzar et al., 2019).

Road construction and maintenance delays are common problems that can be attributed to a variety of causes. Among them are the inaccurate material consumptioncalculations made at the project site and the ineffective machine operation. The incapacity of state transportation departments to finish transportation projects on schedule is one thing in common. Errors in the design, unforeseen site circumstances, expansions in the scope of work, climate, and other project modifications also have animpact (Honrao et al, 2015). The success of road projects in Malaysia is influenced by two aspects, internal factors, which include labour, materials, equipment, and process variables, and external factors, which include variables pertaining to the construction site and outside parties (Rahman et al., 2020).

Machine broken while working is one of the factor , the arrival of heavy machinery will be delayed. If the material does not match the criteria, use on the site can be slowed down. Because asphalt is very sensitive to temperature, building materials such as asphalt used in road projects cannot be preserved before construction begins (Muda et al., 2020). In relation to the above, road maintenance delays are absolutely necessary more careful monitoring by the main contractor, therefore to help in faced this problem, the use of technology is one of the alternatives that move in tandem with a sustainable country development planning. Insufficient premix is caused by subcontractor mistakes, inefficient tandem machine control, and inefficient time management, leading to project delays. To address issues, such as insufficient or excessive premix, to ensure smooth project implementation. A robust monitoring system is required to accurately track and calculate premix consumption during maintenance activities. Site supervisors must update superiors about project work using WhatsApp and manuals. Mobile apps can effectively monitor work and minimize problems. Labor organizations use industry 4.0 technology for a sustainable nation. Technical support is needed to improve operator activities and stay a head of the technological revolution (Enrique et al., 2021).

The objective of this paper is to identify current issues in premix calculation and progress tracking at road construction sites. To achieve the first objective is to identify individuals through questionnaires with supervisors, routine inspectors, technical executives and some people involved in road maintenance activities at THB Maintenance Sdn. Bhd Alor Setar branch. Next, develop a mobile-based application for on-site premix calculations, progress tracking and data recording. The third objective is to evaluate the effectiveness of (OC Premix). The purpose of this study is to develop an application for calculating the use of premix at the project site, tracking word progress and recording work activities.

1.2 PROBLEM STATEMENT

Road maintenance is an important aspect of the construction industry, with road paving being one of the most common activities. This process depends a lot on raw materials such as aggregates. Before a road paving project can begin, a preliminary mapping procedure is essential. During this stage, road chain measurements are taken at the project site, allowing the contractor to calculate the amount of premix required. These estimates are usually recorded manually, with premix and Bill of Quantities (BQ) calculations performed using Microsoft Excel. Unfortunately, these calculations cannot be continuously updated on site, which presents a significant challenge.

Monitoring by the main contractor is important to ensure the smooth progress of the road paving project. However, issues often arise due to mistakes made by subcontractors in calculating the required premix, inefficient tandem machine control during paving, and poor time management, all of which can cause project delays. The current approach requires project site supervisors to constantly update superiors on any issues, such as premix shortages or excesses, to maintain project continuity according to initial mapping and cost estimates.

The lack of a robust monitoring system for the use of premixes on construction sites has resulted in inefficiencies and frequent shortages of premixes, especially towards the end of project implementation. Based on the figure below shows where there is a shortage of premix, the premix becomes a large lump due to delays and idling for too long at the project site as well as machine damage that occurs during the work carried out at the project site. There is an urgent need for a comprehensive system that accurately tracks and calculates the amount of premix used throughout maintenance activities. Such a system will mitigate these issues, ensuring that project run smoothly and efficiently from start to finish.

Figure 1.1 : Shortages of material at the end of section

Figure 1.2 : Large lump of premix due to delay on site

1.3 OBJECTIVE OF THE STUDY

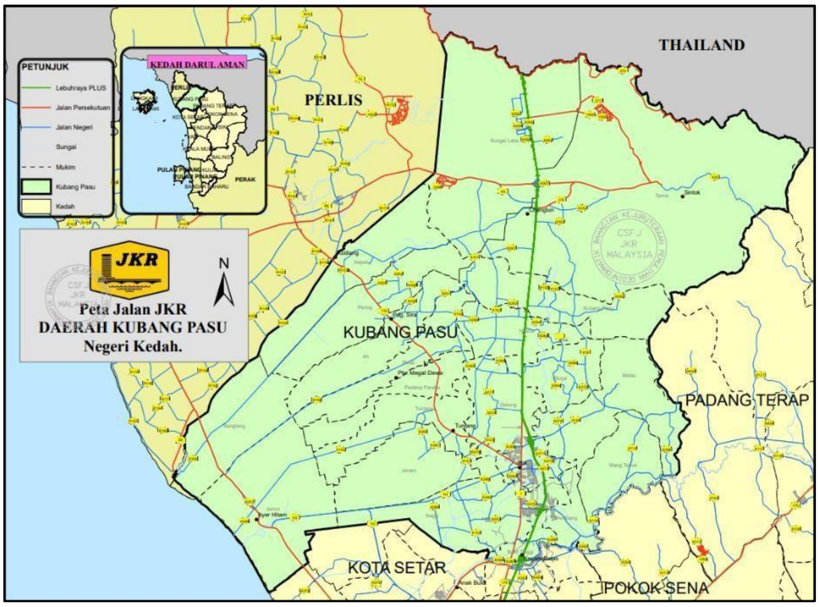
Aim of this project to develop an application namely On-Site Calculation Premix(OC Premix) to calculate premix and progress tracking onsite.

Objective of this study are :-

1. To identify the current issues in premix usage tracking and progress work at road construction sites.
2. To develop a mobile-based application for onsite premix calculation, progress tracking and data recording.
3. To evaluate the effectiveness of On-Site Calculation Premix (OC Premix) application

1.4 SCOPE OF THE STUDY

In this study, focusing on the periodic pavement project for the maintenance of Kedah state federal road for Kubang Pasu district based on figure 1.3. For this study, the focus is on accurately recording the premix calculation data used as well as progress tracking the quality of the work that can be done on the project site. For this study, will involve site supervisors who monitor throughout the implementation of the project.



(Source : Jabatan Kerja Raya, Kubang Pasu)

Figure 1.3 : Federal road at Kubang Pasu, Kedah.

Based on table 1.1 and figure 1.4 and figure 1.5 , the study location chosen to carry out the run test on the developed OC Premix application is federal road which is Jalan Jitra - Kodiang in Kubang Pasu district on route FT176, section 8.000 - 9.500. The project was implemented for 7 days starting on 19.03.2024 to 25.03.2024. The use of pre-mixed materials for the project which is Macrebur (MR6) which is a mixture of bitumen together with plastic.

Table 1.1 : List of Federal Road at Kubang Pasu, Kedah.

FEA_CODE	**RTN (Route Number)**	**NAME**	**Length (KM)**
TA0060	FT270	Jln. Pager Keselamatan ke Bkt. Tangga	20.774
TA0060	Tiada	Jln. Pagar Keselamatan ke Chuping, Bkt. Kayu Hitam	8.574
TA0060	FT1050	Jalan Masuk Felda Bukit Tangga	1.700
TA0060	FT1058	Felda Laka Selatan	8.260
TA0060	FT1050	Felda Bukit Tangga	7.677
TA0060	FT276	Jalan Changlun/Sintok	3.519
TA0060	FT277	Jalan Bukit Tangga/Sintok	13.215
TA0060	FT176	Jalan Jitra/Kodiang	21.634
TA0060	FT7	Jalan Alor Setar/Kangar	13.607
TA0060	FT1	Jalan Kepala Batas/Kemunting	11.034
TA0060	FT194	Jalan Laka Selatan – UUM Sintok	16.671
TOTAL			**126.665**

(Source : THBM SDN, BHD)

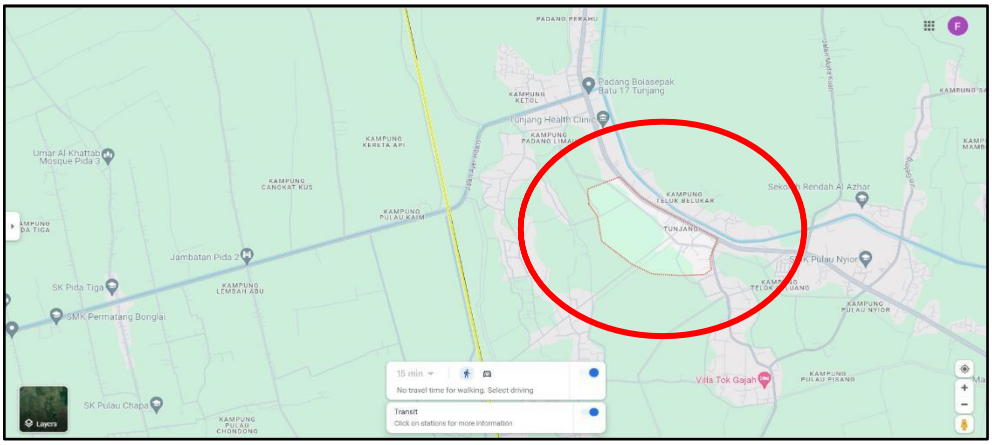


Figure 1.4 : Site Project at Tunjang, Kubang Pasu, Kedah.

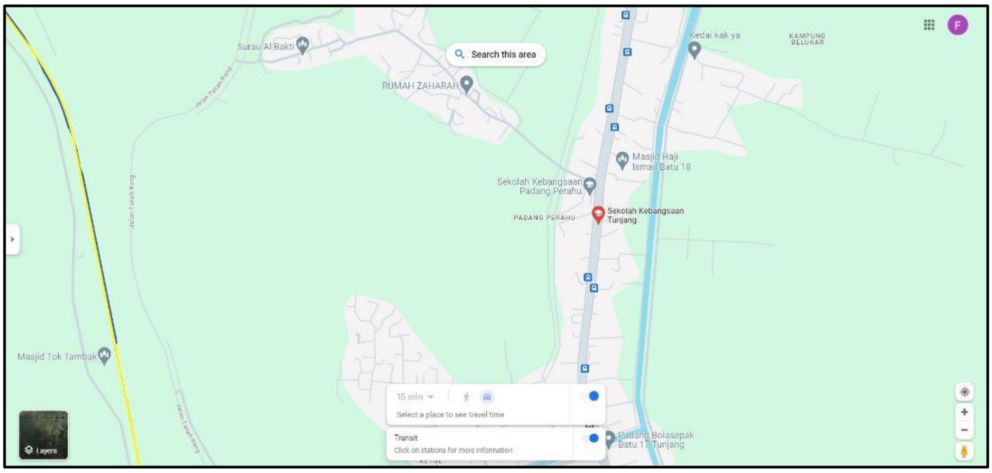


Figure 1.5 : Location of study


Figure 1.6 : Site project before maintenance


Figure 1.7 : Site project during maintenance

Figure 1.8 : Site project after maintenance.

1.5 SIGNIFICANCE OF STUDY .

The study of developing a mobile application for premix calculation and progress tracking in road maintenance has importance in improving efficiency and accuracy in the construction industry. By delving into these areas, professionals can streamline their workflows and optimize resource allocation, ultimately leading to improved project timelines. The mobile app’s premix calculation feature facilitates quick and accurate calculation of required materials, ensuring road construction projects are adequately supplied and comply with established standards. This not only avoids wastage but also improves the sustainability of the entire construction process. Additionally, progress tracking functionality empowers on-site teams to monitor and report real-time progress, providing project managers with valuable insight into the status of each phase. This not only helps in project coordination but also enables proactive decision making, reducing the possibility of delays or issues. Basically, this study is one of the forward-looking initiatives in line with the growing demand for technological solutions in the construction industry. It not only fosters efficiency and accuracy but also contributes to the overall evolution of construction practice towards a more sophisticated and digitally driven future.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In principle, road maintenance is essential to ensure infrastructure by promoting safety, longevity, cost-effectiveness, environmental responsibility and the overall well- being of society. It is a proactive strategy that protects investment and supports the function of critical transport networks. This is because good road maintenance can lead to the economic development of a country. Infrastructure, including roads, is a key driver of economic development. Well-maintained roads facilitate trade, commerce and tourism, providing important connections for businesses and communities. The state of the road reflects the overall perception of the infrastructure of a region. Well-maintained roads contribute to positive public opinion, satisfying community satisfaction and trust in local governance. Road infrastructure is essential for the social and economic development of a country, facilitating transportation, information transfer and access to essential services in a modern economy (Ruiz et al,2020).

In developing a country towards sustainability, evolution involves a shift from basic maintenance to a more sophisticated and technology-driven approach to meet the demands of a growing economy and population. At the end of the 20th century, not to be left behind, Malaysia began to use technology for road maintenance. This includes the use of advanced machinery to resurface, repair and maintain roads. In addition, the use of technology can help in terms of progress tracking to deal more effectively with issues that are often raised such as project implementation delays or development expenditure problems.

Therefore to facilitate people’s ability to manage their job and lifestyle, new innovations are constantly being introduced at the same time as the technology revolution. Technology adoption has greatly benefited people and many other businesses, including the building sector (Maskuriy et al, 2019). Through digitising systems or applications, project managers and project teams can more efficiently manage and track the whole construction project progress by utilising technology in the construction sector (Nagy et al., 2018).

2.2 DELAY IN ROAD CONSTRUCTION PROJECT.

Time and expense overruns are widespread issues in the building industry worldwide. However, it is one of the major problems facing this industry in Malaysia. Usually, a number of unexpected circumstances that the client and contractor may not have anticipated cause delays. Natural disasters are among them, and they have an impact on both the timetable for building and the materials used for road projects. Road projects are a component of heavy construction, and because they need for a lot of materials and a high degree of mechanisation, delays may result from resource shortages and failures. One of the main issues that prevents regional development and road infrastructure from meeting demand is the length of time it takes to complete construction projects and delay also lead to traffic problem (Muda et al., 2020).

2.3 WEATHER

Bad weather or the rainy season worsens one of the factors that are difficult to avoid during the implementation of road maintenance projects (Honrao and Desai, 2015). The use of building materials such as asphalt used in road projects cannot be stored before construction begins, as asphalt is quite sensitive to temperature. In addition, the use of a prime coat before the premix is paved is a material that is sensitive to water. If it rains heavily while the project is underway, the paving work will have to be stopped. This is because of limited workability where certain maintenance tasks, such as paving, sealing or painting, require dry and stable conditions. Rain or extreme temperatures can inhibit the workability of building materials, making it difficult to carry out these activities.

2.4 MACHINERY

As stated by Aziz and Abdel-Hakam (2016), site accessibility is considered an obvious issue that causes delays in projects. Due to space constraints, the arrival of heavy machinery will be delayed. Long trailers require a wide location to enter and exit the site. In addition, one of the reasons for the delay is damage to machinery that occurs during work. Machinery breakdowns can be caused by mechanical failures, such as engine damage, hydraulic system problems or transmission problems. These failures may require extensive repair and replacement parts.

2.5 SHORTAGES OF MATERIALS.

According to (Rahman et al., 2020) materials should be immediate during road construction. In addition, the proposed highway project faces difficulties in obtaining materials on time due to several reasons including the unavailability of the required materials in the local market. This is one of the factors that lead to the problem of traffic movement. It follows that only 1 lane will be open causing traffic to slow down and leading to road congestion. If this continues, it may cause the contractor’s performance to decline as it is certain that complaints about road maintenance have disrupted traffic flow. The availability of materials during construction is one of the internal material-related issues. While materials should theoretically be available at any time during construction, highway projects are likely to face delays due to a variety of factors, including a lack of required materials in local markets, suppliers unable to provide materials due to material shortages, unreasonable pricing for monopolizing practices, and insufficient ground transportation to transport materials to the site.

2.6 POOR ESTIMATION MATERIAL QUANTITY

Inaccurate quantities result in either an excess or shortage. Shortages of supplies impede building progress on site since reorders can result in expensive delays and extra expenses, particularly if the materials need to be imported from overseas. Reordering may also result in inconsistent colour and size tolerances, among other issues. Conversely, an overabundance of supply results in extra expenses or losses for the contractor (Rahman et al, 2017).

2.7 PAVEMENT MATERIAL

Pavement material in road maintenance refers to the numerous materials and combinations used to construct, repair, and maintain the road surface to ensure its longevity and functionality. These materials include asphalt, concrete, aggregates, and a variety of binding agents. The choice of pavement material is determined by criteria such as road type, estimated traffic load, environmental conditions, and maintenance techniques. The proper selection and use of pavement materials are critical for effective road maintenance since they directly affect the pavement's ability to withstand wear and tear, prevent environmental degradation, and offer a smooth and safe driving surface.

2.7.1 Crumb Rubber Modified Asphalt (CRMA)

According to Federal Highway Administration (FHWA, 2013) Crumb Rubber Modified Asphalt (CRMA) is a type of asphalt pavement material that incorporates recycled tire rubber into an asphalt binder. This process involves blending finely ground rubber particles (crumb rubber) obtained from discarded tires with conventional asphalt binders to improve the properties of the asphalt mixture. This modification is usually done through a wet or dry process where rubber particles are mixed with an asphalt binder either at an asphalt plant or on site. CRMA offers several benefits over conventional asphalt mixtures, Enhanced Performance is The inclusion of rubber powder increases the elasticity and flexibility of the asphalt binder, improving resistance to cracking and rutting. Durability CRMA exhibits enhanced durability and resilience, which can extend pavement service life, especially in areas with high traffic loads or severe environmental conditions. Powder rubber modified mixtures were found to be less susceptible to moisture damage than conventional mixtures as indicated by higher retained Marshall stability, higher stress-to-strength ratio, and better stripping characteristics (Palit et al, 2004) . Noise Reduction The rubber particles in CRMA can help reduce road noise, providing a quieter driving experience than traditional asphalt pavement. Environmental Sustainability by Using recycled tire rubber in CRMA promotes sustainability by reducing waste from used tires and reducing the demand for virgin asphalt binders.

2.7.2 Super Fiber Mixed (SFM)

Super mix fibers in road maintenance materials are advanced synthetic fibers incorporated into ordinary asphalt or concrete mixes used in road construction and maintenance. These fibers, often composed of polypropylene or polyester, are intended to improve the mechanical quality and performance characteristics of road pavements. Fibers help manage and minimize cracking by bridging micro-cracks that form in the pavement structure, thereby maintaining the integrity of the road surface over time. Previous studies have found that fibers reduce binder drainage while increasing moisture sensitivity and compressive strength in stone-matrix asphalt (SMA) mixtures. Furthermore, several studies have found that fibers improve drainage in porous asphalt mixtures (Acevedo et al., 2019).

Super fibers increase the tensile strength and toughness of pavements, prevent cracking, and resist fatigue and ruts generated by repeated traffic loads. Superfiber increases the flexibility of the road material, allowing it to tolerate thermal expansion and contraction while reducing the possibility of surface deformation and stress. Environmental Benefits Depending on the type of fiber used, such as recycled materials or bio-based fibers, there may be environmental advantages such as a lower carbon footprint and increased sustainability in road construction procedures. Coconut coir, a low-cost dense natural fiber, is gaining popularity as an environmentally friendly alternative to synthetic materials due to its lower cost and availability (De Oliveira et al, 2017, Mulinari et al, 2011).

2.8 DESIGN THINKING PROCESS.

One method of approaching problem-solving creatively is design thinking. It is interactive, non-linear, and structured for idea generation and 20ecognize20ion. Anyone using this method must comprehend the five stages of design thinking in order to 20ecognize design obstacles and develop solutions. In design thinking, there are five steps: identify, define, brainstorm, prototype, and test. Because of their reputation for using and teaching design thinking, the Hasso Plattner Design Institute at Stanford University (often known as the "d.school") came up with this thinking approach (Dam., 2023). Figure 1 shows the 5 stages of design thinking process. After the design firm IDEO devised and displayed the design process that has drawn attention from the Stanford curriculum in 1991, the d.school at Stanford started using the design thinking process as a formal approach in 2005. In his 2007 TED talk, Sir David Kelly said that the user experience is more important to product design than hardware (Camacho., 2016).

Figure 2.1 : Design Thinking Process

The concept of design has long been explored by design theorists in design and architecture schools. In 1987, Peter Rowe who was a professor of architecture and urban planning at Harvard's School of Design published a book that provided a systematic account of the design process in architecture and urban planning. It is interesting if we are interested in making design thinking a solution to a design problem and not a noun (Liedtka et al,. 2013). The majority of American businesses that include design concepts into their innovation and business plans have seen a sharp rise in success. Numerous publicly traded corporations, like Apple, Coca-Cola, Nike, Starbucks, Walt Disney, and others, were examined by DMI and MotivStrategies. Their success is undeniable due to their well-known brands across the globe. At 2014 analysis found that during the previous ten years, the company had outperformed the S&P 500.

In conclusion, Design thinking is a flexible, human-focused approach to problem-solving that emphasizes empathy, innovative concepts, and iterative testing. It encourages creativity by understanding user demands, clarifying issues, and allowing unrestricted ideas to flow. It fosters a mindset accepting failure as a step towards success and ensures realistic, user-focused ideas through testing and prototyping.

2.9 APPLICATION APPS TO ROAD MAINTENANCE

There are several applications and software tools used in road maintenance to streamline processes, increase efficiency and improve overall project management. Here are some types of applications that are commonly used in road maintenance. The application helps road maintenance teams improve their planning, implementation and monitoring processes, ultimately contributing to more effective and sustainable infrastructure management.

2.9.1 ArcGIS

Figure 2.2 : ArcGIS Logo

A Pavement Management System (PMS) is a set of tools or methods that can assist decision makers in finding cost-effective strategies to prepare, evaluate and maintain pavements in a serviceable condition. ArcGIS software is used as a decision support tool for road network maintenance. The database developed in EXCEL software was imported into ArcGIS Software to facilitate database analysis and querying and facilitate visual and graphical display of results. The developed package which can be easily updated is suitable for simple and multiple database queries such as „what is where and where is what‟ (Adeleke et al, 2015).

Many stages of creating and implementing pavement management systems are covered by the application of Geographical Information Systems (GIS) at various levels in road pavement management (Adeleke et al, 2015). The PMS database is designed using GIS, and it is also used in the data integration process (inventory, history, condition, etc.) and, finally, in the communication of PMS results (Smadi, 2004). Geographic technologies such as GPS and GIS have become quite popular because the data used in the PMS decision-making process has a geographic component. For example, since 2000, the Georgia Department of Transportation (GDOT) has embraced and actively used GIS technology to improve highway pavement maintenance along its 28,962 kilometer system (Robert, 2011).

An Oracle client/server and GIS-based pavement management module are part of the GDOT plan. This study shows how GIS can analyze geographic pavement condition rating data and produce graphical and visual representations of the findings. Because GIS is so flexible in terms of data analysis, query capabilities, and visual and graphical representation, using it as a support tool for managing pavements and other geographic assets is recommended.

2.9.2 Microsoft Excel

Figure 2.3 : Microsoft Excel

Microsoft Excel is often used in road maintenance. This programme is used to map roads that need to have drainage treated because they are damaged. Furthermore, a lot of people utilise Microsoft Excel to automatically compute the Bill of Quantities. Utilising Microsoft Excel primarily involves data analysis. A study has been conducted regarding the maintenance costs of equipment used in road repair. Regression model trees, for instance, outperformed other models when it came to estimating maintenance costs, with equipment running hours being the most crucial component. This was evident from case study data. Queries were run using the gathered data sets to extract various equipment maintenance cost components. A few tables pertaining to equipment maintenance have been exported to Microsoft Excel for pre-processing and data cleaning, and the data will be imported once the data set has been gathered (Bayzid et al, 2016).

In conclusion, Microsoft Excel is an efficient solution for road maintenance, offering an organized database, streamlined tracking, and comprehensive analysis of road conditions, making it accessible to both technical and non-technical personnel. Excel is an essential tool in road maintenance, assisting in budget management, resource allocation, and scheduling tasks. It generates reports and visual representations, enabling informed decisions about infrastructure improvements. However, it has limitations such as scalability and real-time collaboration. As technology advances, complementary solutions can increase efficiency.

2.9.3 Flutter

Figure 2.4 : Flutter

Flutter is Google's application framework for next-generation operating systems. The Fluteer app is available for Android, iOS and Fuschia. Flutter has a high-performance rendering engine to force each display component to use its own component, allowing you to create high-performance applications that behave like native programs. Dart code is compiled to native code. Flutter's hot refresh feature is known as Stateful hot refresh, and it plays an important role in improving the development cycle. Flutter provides assistance throughout development. A stateful hot refresh is implemented by moving updated source code into a running Dart Virtual Machine (DVM) without affecting the internal structure of the application, ensuring transitions and actions are maintained even after a hot refresh. Flutter's "hot reload" functionality allows developers to see changes instantly while coding, increasing productivity and simplifying debugging (Tashildar., et al, 2020).

Flutter's widget-based architecture allows for the building of customisable and visually appealing user interfaces, fostering a uniform look and feel across platforms. With a focus on native performance, Flutter applications can attain near-native speeds, making them a viable option for mobile app development. Its adaptability extends to both web and desktop platforms, resulting in a unified programming experience. Flutter, which has been embraced by the developer community, continues to improve, contributing to the evolution of cross-platform app development, and its popularity is viewed as a testament to its effectiveness in simplifying and streamlining the software development process.

In conclusion, using Flutter for application development provides an attractive and efficient solution. Flutter's open source nature, backed by Google, empowers developers to create natively compiled applications for multiple platforms such as mobile, web and desktop, all from a single code base. The use of the Dart programming language framework and its widget-based architecture contribute to a streamlined and visually appealing development process.

2.9.4 MySQL Database

Figure 2.5 : MySQL Database

MySQL is an open source SQL database management system developed by Oracle Corporation. It manages structured data, stores it in separate tables and offers a flexible programming environment. MySQL uses the GPL (General Public License) and is a popular choice for accessing databases (Christudas, 2019).

MySQL is a popular open source relational database management system (RDBMS) that is widely used to manage and organize data. It is a popular database for web development to store data in tables, support transactions and allow concurrent access. MySQL is the main component of the LAMP stack, i.e. (Linux, Apache, MySQL, PHP/Python/Perl), which is widely used for web development is versatile and open source, allowing developers to modify its functionality to meet their specific needs. , making it essential for efficient data management in various software applications (Wikipedia contributors, 2023).

In summary, MySQL is a reliable and scalable open source relational database management system for application development. It offers scalability, efficiency, and ease of use, allowing developers to define, manipulate, and retrieve data with flexibility. Despite security and optimization concerns, MySQL continues to adapt to the evolving landscape of data management

2.9.5 Google Drive

Figure 2.6 : Google Drive

Google Drive is a cloud-based file storage and synchronisation service developed by Google that offers users a platform for securely storing and managing digital content. Google Drive, which was launched in 2012, enables individuals and organisations to upload, save, and view files from any Internet-connected device. It functions as a centralised repository for a variety of files, including papers, spreadsheets, photos, and videos (Wikipedia contributor, 2024). Google Drive is a popular service, providing users with cost-effective and, in some circumstances, free access, storage, collaboration, and sharing data (Quick & Choo, 2014).

Google Drive is a public file storage and synchronisation service established by Google. It can also access many devices and communicate with others in real time, and it provides both free and additional storage space that can be purchased as needed. Aside from sharing and authorization, one of the most important features of Google Drive is the ability for users to share files and folders with others by providing numerous benefits such as viewing, sharing, and editing. Close connection with other programmes, such as Google Workspace, i.e. Google forms, Sheets, and Slides, strengthens the Google Drive platform's productivity and collaboration capabilities.

Google Drive is a popular cloud-based file storage and collaboration tool for individuals, businesses, and educational institutions. It offers a secure, accessible, and reliable solution for managing application-related files, fostering accessibility and collaboration across teams. Despite data security concerns, Google Drive remains crucial in shaping the modern application development landscape.

2.9.6 Supa base

Figure 2.7 : Supa base Logo

Supa base is an open-source competitor to Firebase that offers a suite of tools and services to help developers build, manage, and deploy apps more efficiently. A full description of the Supabase database's capabilities, architecture, and use cases. Supabase is built on top of PostgreSQL, a strong and popular relational database. It builds on PostgreSQL's resilience and versatility while introducing features to improve the developer experience, particularly for building modern web and mobile apps. Supabase automatically creates a RESTful API for PostgreSQL databases. This API allows you to interface with your database without building bespoke backend code. The API offers basic CRUD operations (Create, Read, Update, and Delete) and can be secured with JWT (JSON Web Tokens).

Supa base is working on native GraphQL support, which will give developers another option to interact with their data. This is useful for front-end developers that prefer GraphQL over REST.Supabase has a full validation mechanism out of the box. It supports a variety of authentication mechanisms, including email/password, OAuth providers (e.g., Google, GitHub), and third-party authentication. It also supports row-level security settings in PostgreSQL, allowing for fine-grained access control within the database. Supabase offers a storage solution for files, photos, and other static assets. The service seamlessly integrates with databases and authentication systems. Supabase provides serverless capabilities, which enables you to run backend code without managing a server. These routines can be triggered by HTTP requests, database changes, or a schedule. Supabase, with its extensive data handling capabilities and ease of integration, can power the CMS back end by storing content and managing users. Its cross-platform features, combined with real-time data synchronisation, make it excellent for mobile app backend development.

Supa base is a robust open source backend-as-a-service (BaaS) that streamlines modern application development. PostgreSQL is combined with additional capabilities such as real-time subscriptions, RESTful APIs, authentication, and storage to give a comprehensive toolkit for developers. Its open source nature and extensive documentation make it a flexible and attractive choice for a wide range of applications (Supabase website, 2024) . The application's major feature was to give users daily weather reports for the locations they had picked. The goal was met by utilising a variety of back-end services, including authentication, social integration, storage, and scheduled jobs. Supabase provides both a relational database and full-text search capabilities, which might be useful for applications with a high volume of queries (Ayezabu & Zewdie, 2024).

2.9.7 Firebase

Figure 2.8 : Firebase

Firebase is a backend-as-a-service (BaaS) platform that provides a set of cloud-based services for online and mobile application development. Firebase was founded in 2011 and bought by Google in 2014. It has now become part of Google's mobile and online development ecosystem. The main feature for Firebase database is NoSQL cloud database where data storage is in real time and synchronization across users. Data is stored in JSON format and can be synchronized in real time across all clients, making it ideal for collaborative applications. Firebase and Google Cloud Platform provide versatile and scalable databases for mobile, web and server applications. Cloud Firestore provides more query options and improved performance for large datasets. Functionality scales automatically to meet demand, eliminating the need for server management. Firebase Hosting offers fast and secure hosting for web apps, static and dynamic content. On the other hand, Firebase provides a NoSQL database with offline capabilities, making it ideal for developing progressive online applications. Firebase database has a larger load threshold, however this can only be achieved by gradually increasing requests over time. (Ayezabu & Zewdie, 2024)

2.9.8 React Native

Figure 2.9 : React Native

React Native is an open-source framework developed by Facebook for mobile app development. It enables developers to create natively generated apps for iOS and

Android using React and JavaScript libraries. Unlike traditional frameworks, React Native provides a single codebase for both platforms, resulting in performance comparable to native apps. With extensive features, strong community support, and continuous development, it's an ideal choice for modern mobile app development.

React Native is a framework designed to make it easier for app developers who lack the necessary knowledge or must spend a significant amount of time developing mobile apps for both iOS and Android. Different platforms in terms of appearance, feel, and capability do not allow for homogeneous applications across all operating systems. The differences in graphical interfaces do not exclude development with React Native, which uses the same language. React Native operates in an embedded instance of JavaScriptCore (iOS) or V8 (Android) in an application, providing higher-level platform-specific components. JavaScript components are declared using a set of built-in primitives that are compatible with iOS and Android components (Danielsson, 2016).

2.9.9 Visual Studio Code (VsCode).

Figure 2.10 : Visual Studio Code

Microsoft's Visual Studio Code is a lightweight open-source code editor for Windows, macOS, and Linux. It offers robust features, extensibility, and flexibility, and supports various programming languages, debuggers, and tools. Users can customize the editor with themes, key bindings, and workspace settings. It features syntax highlighting, IntelliSense, built-in debugging, and Git support. VS Code runs on all major operating systems and supports remote development. Visual Studio Code is a powerful, flexible, and versatile code editor suitable for a wide range of development activities. Its extensive features and customization options make it a preferred choice for many developers around the world. Whether you are working on web development, system programming, data science, or any other field, VS Code provides the tools and support needed to enhance productivity and streamline the coding. Visual Studio Code is a robust IDE that focuses on developing Web apps and cloud programmes. The tool is lightweight and similar to Visual Studio, but offers advanced revision and compiling features in a modern interface (Code. V.S., 2019).

2.10 SUSTAINABILITY DEVELOPMENT GOALS (SDGS)

Figure 2.11 : Sustainable Development Goals (SDGs)

The United Nations (UN) developed the Sustainable Development Goals (SDGs) in 2015 as part of the 2030 Agenda for Sustainable Development. These objectives are intended to solve a number of interconnected global issues, including as poverty, inequality, climate change, environmental degradation, peace, and justice. The SDGs seek to make the world more sustainable and fair by 2030. The 17 SDGs are acts in one area that effect development results by balancing social, economic, and environmental capabilities. The SDGs aim to eliminate poverty, hunger, AIDS, and gender discrimination against women and girls. To realise the SDGs in any context, all societies must contribute their creativity, knowledge, technology, and financial resources (*Sustainable Development Goals*, n.d).

The avaricious use of energy and materials in the road construction sector can lead to significant financial losses. The implementation of sustainable development in highway building can commence with the reuse of existing resources at the project site and the plan. The assessment of economic and environmental advantages which is accomplished by employing recycled materials in construction is hindered by the absence of quantitative and comparable analysis tools. When building a road, three variables are prioritised are quality, money, and time. These considerations do not account for hazards related to social responsibility, environmental repercussions, or human needs. Sustainable options are an expression of the transport sector, but the use of those options, is not fast enough to accommodate the growing global demand for resources (Ibrahim, A. H., & Shaker, 2021).

2.10.1 Sustainable Development Goals 9 (Industry, Innovation And Infrastructure)

Figure 2.12 : SDGs 9 (Industry, Innovation And Infrastructure)

Sustainable Development Goal 9 (SDG 9) aims to build resilient infrastructure, promote inclusive industrialization, and foster innovation to drive economic growth, job creation and improve quality of life. It requires coordinated efforts from governments, the private sector, civil society and international organizations. Challenges include funding gaps, technology gaps, environmental sustainability and social inequality. SDG 9 aims to create a synergistic relationship between infrastructure development, industrial growth and innovation, contributing to sustainable development and inclusive prosperity. SDG-9 emphasizes the importance of sustainable infrastructure investment, industrial success, and innovative approaches for sustainable economic growth, social development and combating climate change. It emphasizes the need for transport infrastructure, information and communication, industrialization, and the development of new technologies (Küfeoğlu, 2022)

2.10.2 Sustainable Development Goals 11 (Sustainable Cities And Communities)

Figure 2.13 : SDGs 11 (Sustainable Cities And Communities)

SDG 11 strives to make cities and human settlements more inclusive, safe, resilient, and sustainable. These objectives address urbanization concerns and aim to improve the quality of life for all urban dwellers through better urban planning and management, improved infrastructure, and inclusive development. Mobile applications play an essential role in achieving SDG 11, particularly in the fields of building, urban planning, and infrastructure development, because they can improve the efficiency and sustainability of urban development projects. Efficient resource management by developing applications is a target aligned with SDG 11 because it can reduce waste and ensure that resources used for infrastructure development and construction are efficient and can promote the sustainable use of resources based on the goals of SDG 11.

The application provides real-time project progress updates, enabling timely decision-making and ensuring quality infrastructure. It also tracks environmental impact, promoting sustainable practices. The app aims to reduce environmental impact by 2030 and increase integrated policies for inclusion, resource efficiency, climate change mitigation, disaster resilience, and disaster risk management. By leveraging technology, cities can achieve SDG 11 goals and improve the quality of life for all city dwellers, thereby enhancing the efficiency, sustainability, and safety of urban development projects (Küfeoğlu, 202

2.10.3 Sustainable Development Goals 17 (Partnership for the Goals)

Figure 2.14 : SDGs 17 (Partnership for the Goals)

Sustainable Development Goal 17 (SDG 17) aims to strengthen global partnerships for sustainable development, focusing on finance, technology, capacity building, trade, and systemic issues. Target 17.6 focuses on enhancing global partnerships, while target 17.7 promotes the development, transfer, and dissemination of environmentally friendly technologies to developing countries. Mobile applications can facilitate knowledge sharing, facilitate project management, and support capacity building in developing countries. These applications can streamline construction project management, ensure efficient resource use, and facilitate knowledge sharing, ultimately contributing to the achievement of SDG 17 goals worldwide ((Küfeoğlu, 2022).

2.11 INDUSTRY REVOLUTION 4.0

The rise in human population in terms of a more prosperous lifestyle, as well as the rise in Gross Domestic Product (GDP), has resulted in an increase in human needs for renewable and renewable resources. However, issues caused by a lack of resources are unavoidable. Increasing consumer expectations will need the development of innovative manufacturing methods for whole-life products (Nongendzi, S. (2019)).

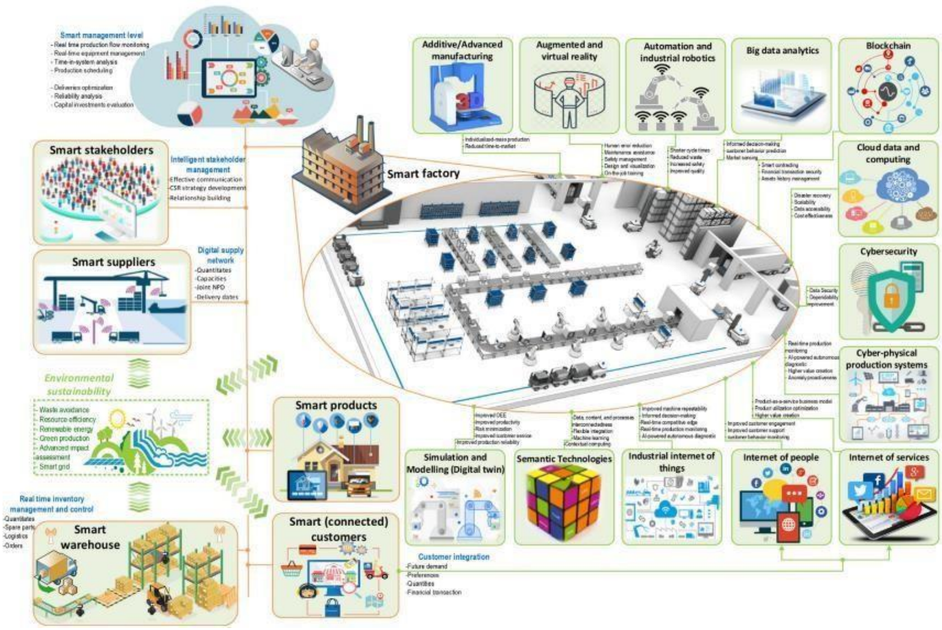


Figure 2.15 : The architecture design of Industry Revolution 4.0 (IR 4.0).

Most Malaysian construction firms have fought technology improvements in Industry 4.0. This is because Industry 4.0 has given birth to the concept of a creative industry. Human-machine collaboration can be helpful in the long run. Furthermore, with the release of information in sustainability, industry 4.0, which is capable of building, estimating, and exploring new ideas and concepts without having to change the world of reality, can be accepted. Industry 4.0 is a well-known idea around the world since it requires academics to consider how the technology employed may be sustainable, reliable, and safe in its use (Moshood, et al., 2020). The fourth industrial revolution, or Industry 4.0, began with the manufacturing industry, and the notion has spread fast in recent years to other industries. As a result of the digital transformation involving the entire market for industry as well as consumers, smart manufacturing emerges for the digitalization of entire value delivery channels. Industry 4.0 is typically built on design concepts and technological advancements (Ghobakhloo, 2020) .

According to (Ghobakhloo.,2018), the principles of Industry 4.0 are fully addressed. The digital transformation of Industry 4.0 depends on the integration of Information, Digital and Operational Technology (IDOT) technologies such as industrial sensors, controllers, Automated Guided Vehicles (AGV), robots, Augmented and Virtual Reality

(AVR), data analysis, cloud computing. , Internet Services. (IoS), and High Performance Computer Aided Design and Manufacturing (HPC) for design fundamentals (Chen et al., 2018;Hofmann & Rüsch, 2017;Lu, 2017).

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2.12 INTERNET OF THINGS

Figure 2.16 : Internet of Things (IoT) network

The Internet of Things (IoT) refers to a network of interconnected devices and objects embedded with sensors, software and other technologies, enabling them to collect and exchange data. The Internet of Things extends network connectivity and computing capabilities to everyday objects, sensors and items, enabling data generation, exchange and consumption with minimal human intervention (Rose., et al, 2015). The Internet of Things (IoT) can collect more data, analyse it via a computational internet connection, and show the data in a complete, easy-to-read and understand format. It may also detect Radio Frequency Identification Tags or Tags (RFID). This tag is now frequently used for product and equipment distribution as one technique of maintaining manufacturing records (Moshood, et al, 2020).

In conclusion, the Internet of Things (IoT) stands as a transformative force reshaping the way we interact with the world. By connecting devices, sensors, and everyday objects to the digital realm, IoT enhances efficiency, automation, and data-driven decision-making across diverse sectors. This interconnected ecosystem holds the promise of revolutionizing industries, from healthcare and agriculture to smart cities and industrial processes. However, with this technological evolution comes challenges such as privacy concerns, security vulnerabilities, and the need for standardize.

2.13 STATISTICAL PACKAGE FOR SOCIAL SCIENCE (SPSS).

Figure 2.17 : IBM SPSS Statistics

SPSS (Statistical Package for the Social Sciences) is a complete software for statistical analysis. IBM developed SPSS, which is a powerful platform for data management, analysis and presentation. This software is widely used in various sectors, including social sciences, healthcare, marketing, education, etc., due to its various tests and statistical processes, user-friendly interface and advanced data handling features. Basic software includes functions such as statistical analysis, data management (case selection, file reconstruction, data output), and data documentation (metadata dictionary stored in data files) (Bala. J, 2016). Users can enter, clean and change data to ensure its integrity and prepare it for analysis. SPSS allows users to efficiently manage large data sets.

The software includes capabilities for creating summary statistics such as mean, median, mode, and standard deviation, as well as a fundamental understanding of data distribution. In addition, the software offers a variety of tests such as the t-test, chi-square test, ANOVA, regression analysis, and others, allowing users to draw conclusions about the population based on sample data. As a result, advanced analysis can be used in this software to support complex procedures including factor analysis, cluster analysis, discriminant analysis, and multivariate analysis, allowing for a better understanding of data patterns and relationships.

SPSS provides a variety of options for visualizing data, including bar charts, histograms, scatter plots, box plots, and more, to make it easier for users to present results more clearly. SPSS system integration with other software is that SPSS can import and export data in various formats, making other SPSS software such as Excel, SQL databases and more. This is proven, there are studies that state receiving data from an Access database and creating SQL queries before transferring the data into Excel for further analysis before uploading to the main data element for analysis into SPSS. So system integration between SPSS and other systems can develop users' ability to navigate software tools, understand statistical concepts and make quantitative decisions (Drougas, A. D., et al, 2015). Thus, SPSS software makes it an essential analysis tool for researchers, analysts and professionals who want meaningful insights from the data they obtain.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In this study, research design is one of the approaches used to gather information regarding the problem statement. One of the methodologies employed is data collecting and analysis utilizing quantitative and qualitative methods. Quantitative methods of numerical data analysis, statistical procedures that provide measured insight. Among them are the demographic section and the question section, which are used to achieve objectives such as problem identification and product efficacy evaluation. Furthermore, qualitative research entails gathering and analyzing non-numerical data (such as text, video, or audio) in order to better understand thoughts, opinions, or experiences. It can be utilized to gain in-depth insights into a topic or to produce novel research ideas (Bhandari, 2023).

Methodology provides a defined framework for problem solving and information acquisition, allowing for a more systematic approach to issues. It acts as a set of guidelines that not only ensures the process's rigour, but also increases the reproducibility and generalizability of the outcomes, laying the groundwork for future improvements and discoveries. As a result, the purpose of this project is to undertake research on developing applications to assist with road maintenance work that involves the usage of premix. So, in this chapter, we will go over step-by-step instructions for developing such an application. The proposed technique for the designstudy is detailed to ensure that the research's purpose is met. One way for conducting design study is to gather and analyze data using the problem statement as a guideline. Conducting research utilizing quantitative and qualitative approaches that use measurable understanding frameworks, such as statistical tools, and creating questionnaires to measure and analyzethe relationship between problem statements and suggestions for problem solving.

In conclusion, a robust methodology serves as a guide for developers, outlining best practices and standards. The use of methodology in application development is essential to achieve success in today's dynamic and competitive environment. It also provides a clear road map for testing and quality assurance, ensuring the end product meets defined user needs and expectations. Not only streamlining the development process but also fostering collaboration, ensuring quality, and ultimately leading to the delivery of innovative and reliable applications. As technology continues to advance, adopting and adapting methodologies will remain fundamental to effective and efficient application development.

3.2 PROCESS DEVELOPMENT APPLICATION

Challenges and appropriate system choices at federal road maintenance project locations informed the research methods and approaches used in this project. Scope of the study, focusing on the periodic pavement project for road maintenance of federal road in Kubang Pasu, Kedah. For this study, the focus is on accurately recording the premix calculation data used as well as progress tracking the quality of the work that can be done on the project site The researcher's perspective on knowledge and reality related to the discipline will shape the research design. The flow chart in figure 3.1 below illustrates the research strategy and flow development that used in this project.

This application development study consists of three phases, as illustrated in figure 3.1. The flowchart in the figure clearly maps each key step and component of the application development process. The explanation of these phases will be provided in greater detail in this chapter. Several methods have been employed in this project, including interviews, site observations, literature review, designing questionnaires, and analyzing project progress. These methods are integrated into the three identified phases to successfully complete this project.

Phase 1 – Identify problem and literature review

Phase 2 – Data collection and development application (primary sources and secondary sources)

Phase 3 – Production of the system (Testing application, data analysis and interpretation of data) recommendation and conclusions.

3.2.1 Phase 1 – Identify problem and literature review.

The first phase in developing the On-Site Calculation Premix (OCPremix) application is the initial phase. In this phase, the design and analysis of the project are crucial components. Gathering information through industrial training is essential for identifying problems that occur on the project site. The investigation to identify these problems is conducted using several methods, including interview sessions and site observations with industry parties directly involved in the project.The design thinking process is applied during this phase. Based on table 3.1, the empathic process is employed by the researcher to understand and identify issues on-site. Concurrently, the researcher seeks information from previous studies to analyze and corroborate the information obtained, aiding the continuation of the defined process. As a result, alternative solutions to the identified problems are proposed. This stage involves observing the project site and conducting interview sessions with site supervisors, technical executives, and state managers.

Table 3.1 : Method and tools of Empathy process at THB Maintenance.

Observation site	THB Maintenance Alor Setar
Users	Site Supervisr, Technical Executives, State Manager, Routine Inspector, Engineer.
Issues to be solve	Identify problem at industry.

Figure 3.1 illustrates the flow chart for the development of the mobile application system design for OCPremix, detailing the implementation of the study flow as shown.

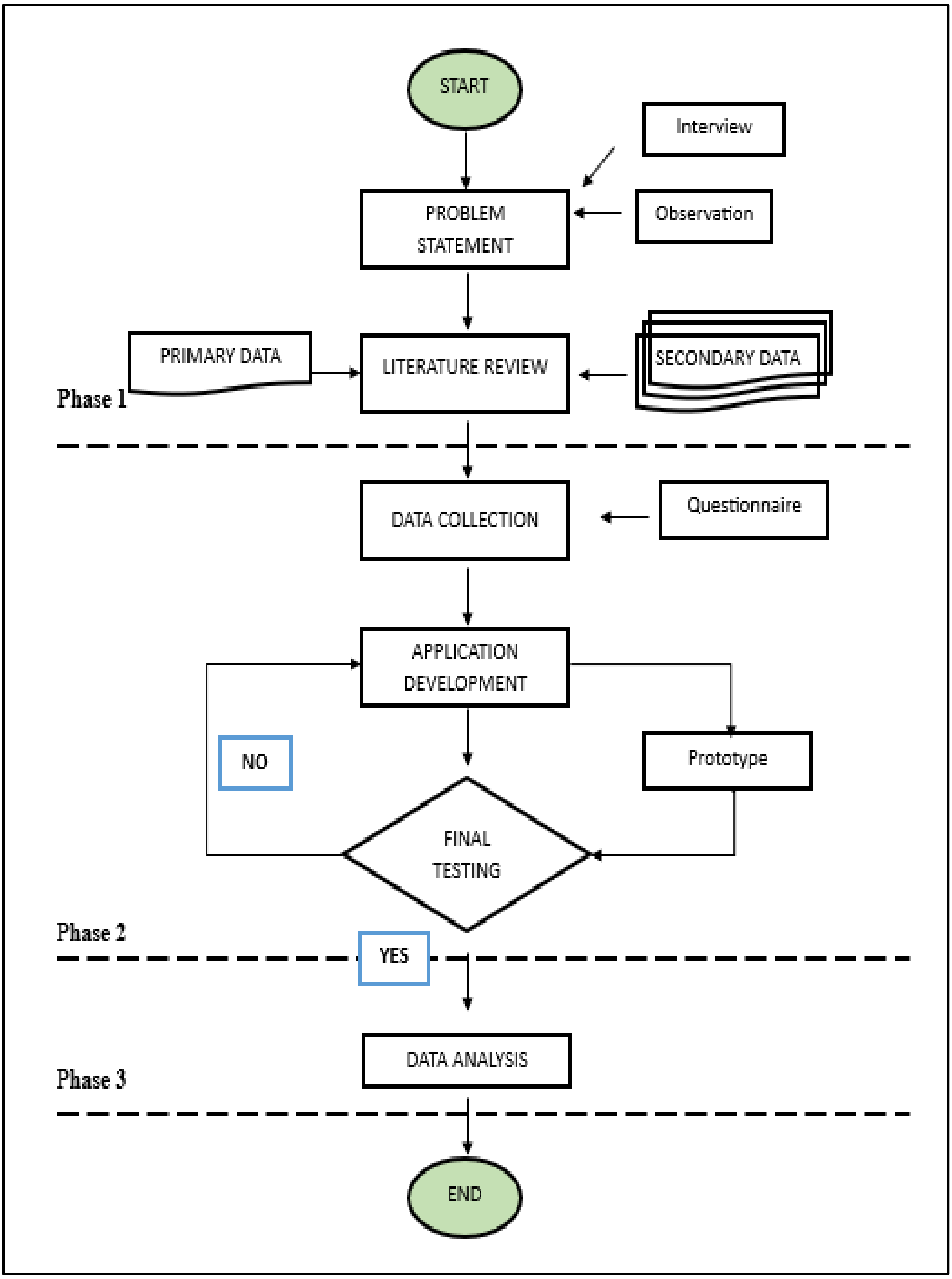


Figure 3.1 : Flowchart of Development application OCPremix.

3.2.2 Phase 2 – Data collection and development application (primary sources and secondary sources)

In the second phase, solutions were identified based on the methods mentioned above. For this study, the development of the OCPremix mobile application was chosen as the solution to the problem statement. Using the collected data, the application design process began by ensuring that the content and features could gather data to meet the study's objectives. Following this, a prototype of the application was developed. The final phase involves using the selected framework and database to fully develop the OCPremix application.

a) Primary Sources

Based on the flow chart depicted in Figure 3.1, primary sources are gathered in the first phase, where data collection is conducted through questionnaires, interview sessions, and site observations. The interview sessions were conducted to strengthen the problem statement and to obtain more detailed information on the issues discussed.

Referring to figure 3.2, the interview session was conducted by the researcher with one of the THBM staff in the operations department who is directly involved in the activities of the pavement periodic maintenance project using the WhatsApp application. The information obtained based on the interview session is the cause of premix damage at the project site, which causes a lack of material at the project site and delays in completing the project. Additionally, premix calculations that use different density values may result in insufficient material for road pavement. a formula often used by the industry to calculate the use of premixes that will be used for a project. The determination of material adequacy at the project site is based on the density value of the material used. For all types of premixed mixtures, the commonly used and calculated safe density value is 2.33 kg/m^3.

Formula to calculated premix mixtures :

$$\text{Tonnage (MT)} = \text{Length (m)} \times \text{width (m)} \times \text{Depth (m)} \times \text{Density (kg/m}^3\text{)}$$

In addition, the researcher conducted site observations to obtain more detailed information. Based on Figure 3.3, one of the projects faced a problem involving the use of premix. On the last day of the project's expected completion, road paving was delayed due to insufficient premix at the end of the section. As a result, the contractor needed to order additional premixes to cover the insufficient part. This caused a delay while we were waiting for the premix truck to arrive at the project site.

To further strengthen the issues identified by the researcher, a questionnaire conducted with nine employees at THB Maintenance Alor Setar revealed several factors contributing to project delays. As detailed in Appendix B, these issues include calculation errors in determining the amount of premix needed, inadequate monitoring of premix usage, and delays caused by shortages and non-functioning machines on site.

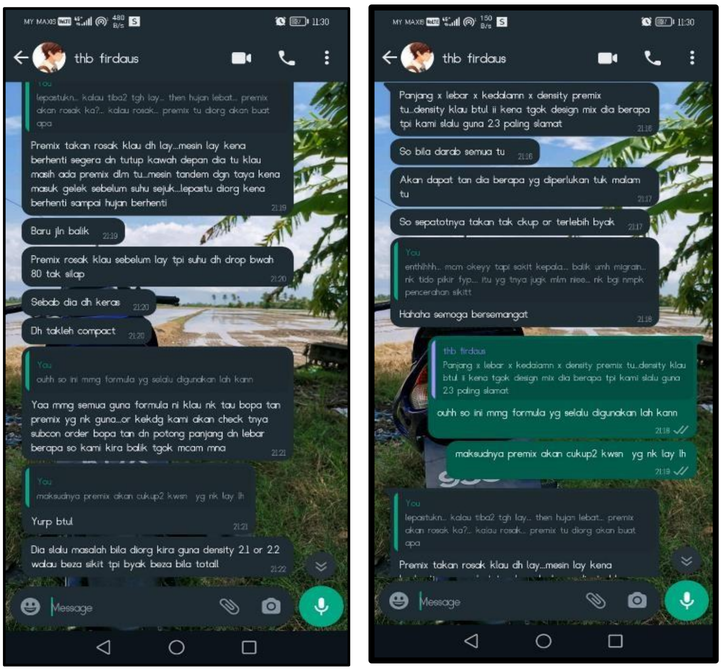


Figure 3.2 Interview session with industry people by using whatapps.

Figure 3.3 Site observation

.b) Secondary Sources

Secondary sources are documents or recordings that relate to or discuss information originally presented elsewhere. They analyze, interpret, or summarize primary sources and often provide a second layer of perspective. For on-site computational premix application development, refer to figure 3.4 secondary sources may include information searches from Google sources, i.e., journals and articles related to application development and road maintenance. In addition, among the research sources obtained from THBM company information, the problem that occurs is the lack of premixes at the project site on the last day of project implementation, as well as the lack and damage of machines at the project site, which caused the project to be prolonged and slow to be prepared.

Therefore, the project site supervisor needs to report to the superiors about the progress of the project being implemented and any problems that occur, especially to the client, the Public Works Department (JKR), to avoid any problems that may occur at the project site.According to the issues highlighted, the solution to the problem is to develop a more systematic application or platform to digitally track premix calculations and progress tracking reports. Therefore, by developing or creating On-Site Calculation Premix (OCPremix) as a solution that can be used for premix calculations at the project site, record the progress of the work carried out, and be able to store data more systematically and digitally by using a mobile application, which can be used anywhere and anytime.

Based on the proposed solution, the prototype design of the proposed application is made in advance to ensure that the features and content contained in the application can be used and meet the outlined objectives. The prototype design is shown to the state manager and site supervisor as a guide to ensure that the information to be entered is correct and accurate. Application construction or development involves using some programmers or software that have been identified among Flutterflow to build UI (user interface). Next is data collection, which is the main purpose of developing the On-Site Calculation Premix (OCPremix) mobile application, to test the effectiveness of the application.

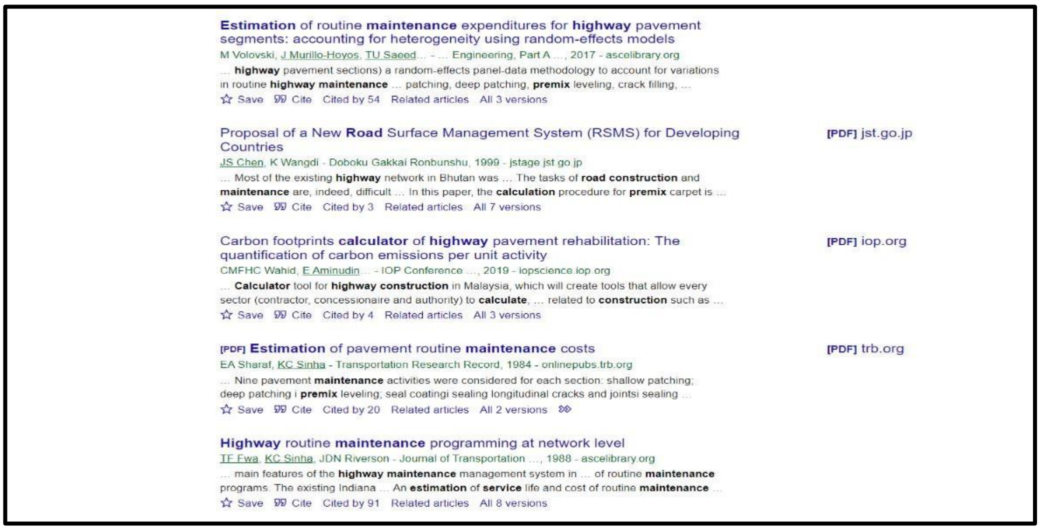


Figure 3.4 : Example of getting journal or article from google scholar

3.2.3 Phase 3 - Production of the system (Testing application, data analysis and interpretation of data) recommendation and conclusions.

In the third and final phase, after the application is developed, it undergoes final testing. The developed mobile application will be tested by entering the necessary data to ensure that the application is free to use and run. The effectiveness of the application is then evaluated through a questionnaire to achieve the third objective. The data collected was analyzed using the Statistical Package for the Social Sciences (SPSS) software to determine whether the product was effective in solving the problems encountered at the project site.

3.3 PROPOSED APPLICATION CONCEPTUALIZATION (PROTOTYPE DESIGN)

As seen in the figure 3.5 , the creation of a prototype for On-Site Calculation Premix (OCPremix) which helps document the actions taken at the project site to track premix usage, progress tracking and recording data on the site. This is the first development, so we expect that users will find it easier to use and they will use the application regularly in the end. The design of this prototype uses Canva software, which is open to all users and easy to use.

In this phase, the programmers who will be used in developing the application are also identified. The framework chosen for this development is React Native, which is an open-source framework established by Facebook and can be used for both Android and iOS. This application was developed specifically for Android users. Referring to figure 3.6, React Native is used to design the user interface. For data storage, the researcher chose the Supa base database to store information recorded by users of the OCPremix application. Finally, the recorded data can be entered into Google Drive as softcopy data storage.

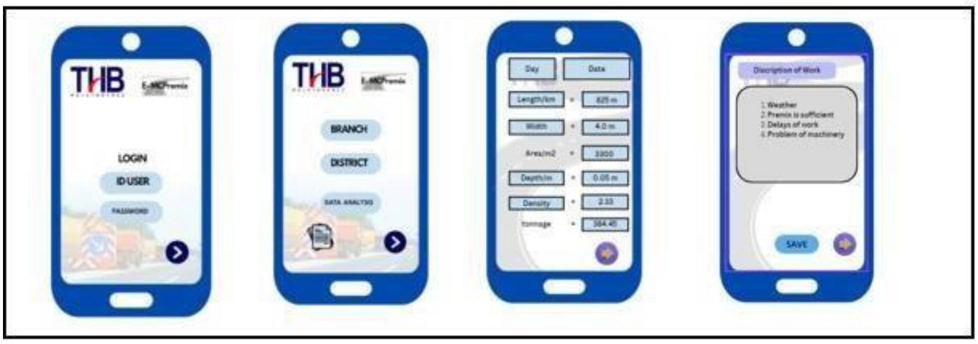


Figure 3.5 : Prototype Design to develop an application.

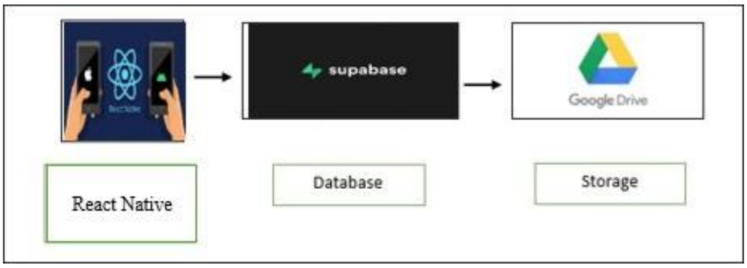


Figure 3.6 : Application Development

3.4 DEVELOPMENT OF THE PRODUCT

In developing this application, it starts with the need. The requirements are where user analysis has been identified in Table 3.1. Table 3.2 shows product development, where the researcher will design use case diagrams, activity diagrams, sequence diagrams, and interface diagrams. Then the application development phase begins with creating the database. The development of the OCPremix application uses Supabase as a data storage place, as can be seen in figure 3.11.

After that, the development of the interface, which is the product of the application design interface, Next to building interfaces is programming to build interfaces. This is a challenging phase where it is necessary to detect errors or problems during the coding system. Among the coding systems used to develop OC Premix applications, frameworks such as figures 3.7, 3.8, 3.9, and 3.10 are used.

Finally, after the coding system is finished, it will be exported using the Build artefact or Android Internal Distribution Build to test the application. Figure 3.12 shows the saved file or data used to develop the On-Site Calculation Premix (OC Premix) application. Table 3.3 shows the application of the product and can be used as a manual for users to conduct product effectiveness tests. The tests carried out are to ensure that each button works and follows the flow of the proposed application.

Table 3.2 : Developing the product

No..	Item	Type
1.	**Design of product** 1. Sign Up (Register User) 2. Login 3. Enter the button for "Add New Project" and "Project List" for data recording. 4. Enter the button for data recording for premix calculation 5. Enter the button for data recording to progress work onsite. 6. Enter the save button to manage the data 7. Enter the button to print premix calculation data and work progress "set print file pdf".	To design this application using Flutterflow and Canva software for interface construction. To develop and function the application using react native and javascript as a programming language. React Native is an open source framework for iOS and Android. However, to develop the product for this study using the framework and graphic design for the use of mobile applications for android users.
2	Software Used	Using the App Builder programme. Application Builder is a web-based software application that enables anyone to design and publish mobile apps using several programming and coding languages. This programme includes a visual layout editor (Visual Studio Code), a smart code editor, a real-time profiler, and apk.format. Andorid Builder Distribution exports built programmes to mobile phones via an install link.

3	Database	For data management for the product application in this study, the Supabase website was used. Supabase is a database that can be accessed by registered administrators. All information entered through the mobile phone application will be stored in Supabase.Data management by admin can be done in the database.

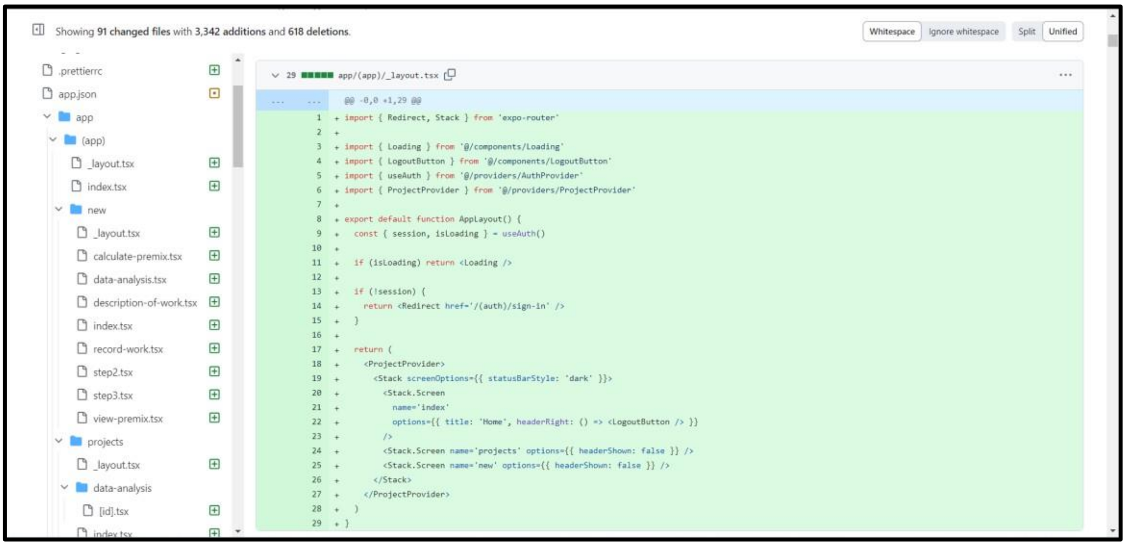


Figure 3.7 : Coding part for “Home” interface in On Site Calculation Premix (OCPremix) application.

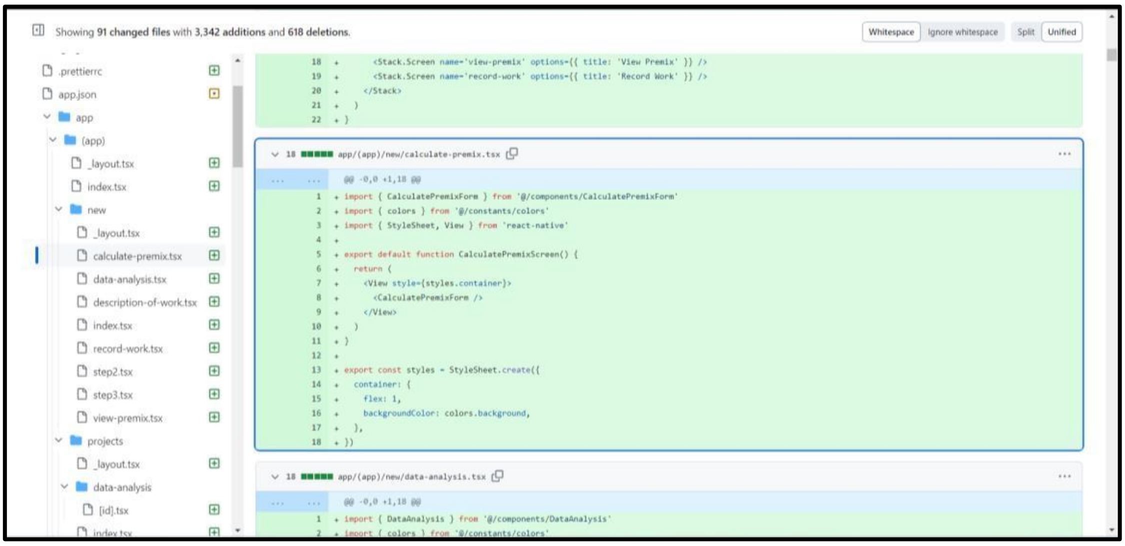


Figure 3.8 : Coding part for “ Calculate Premix” interface in On Site Calculation Premix (OCPremix) application.

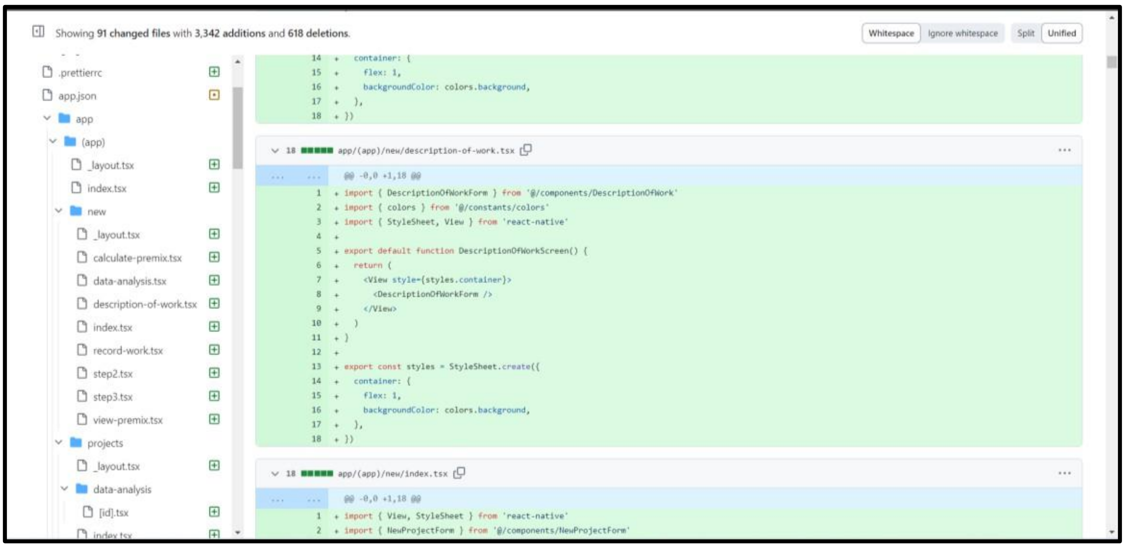


Figure 3.9 : Coding part for “ Description of Work” interface in On Site Calculation Premix (OCPremix) application.

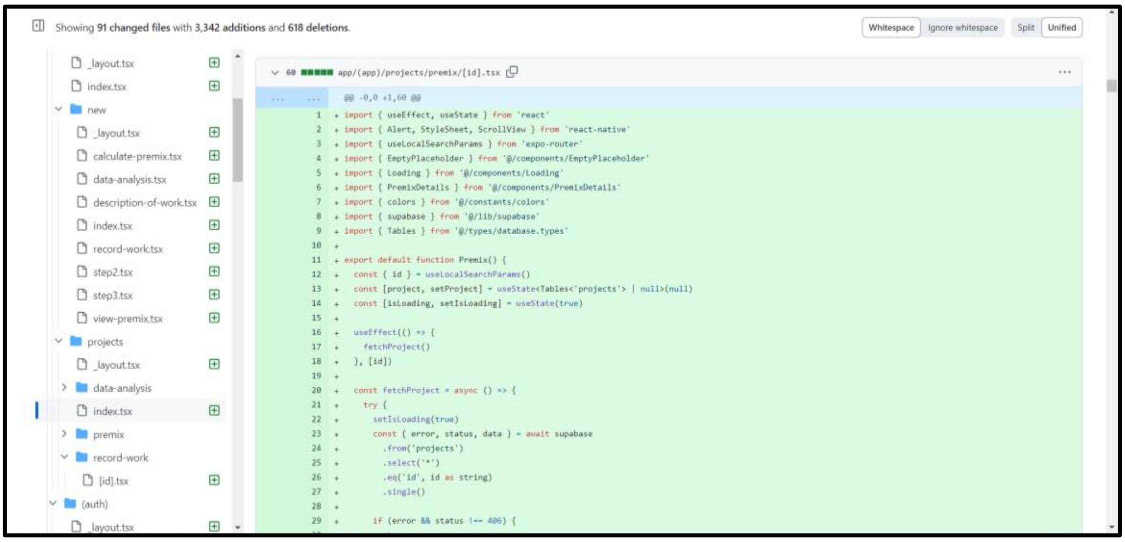


Figure 3.10 : Coding part for “ Project List” interface in On Site Calculation Premix (OCPremix) application.

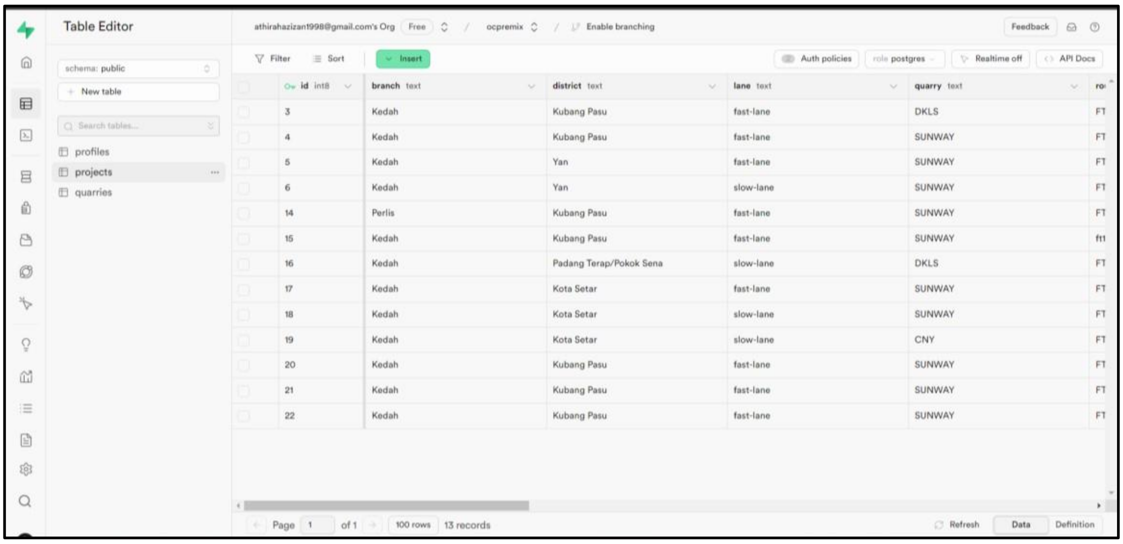


Figure 3.11 : Database of OnSite Calculation Premix (OC Premix) application using Supa base.

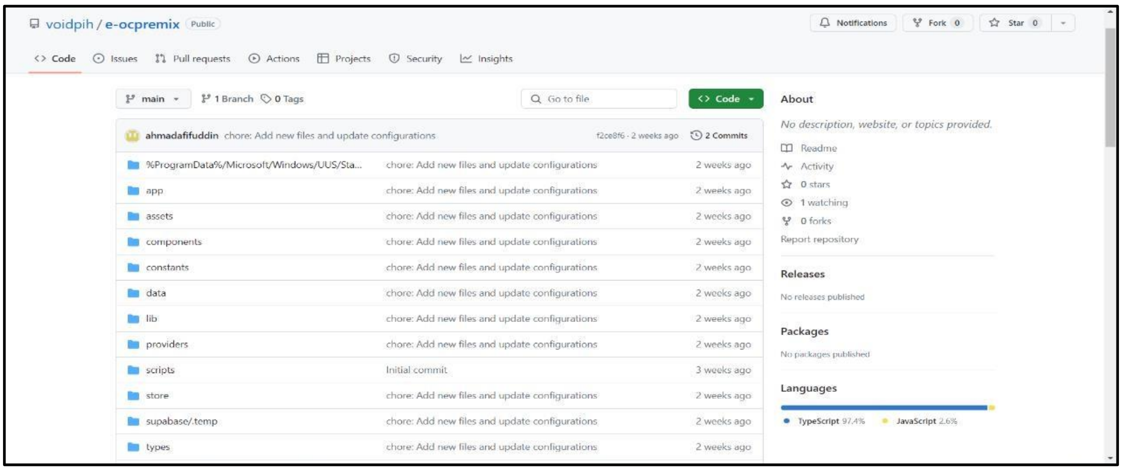
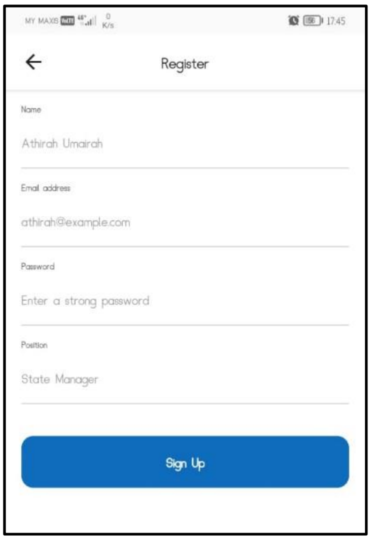
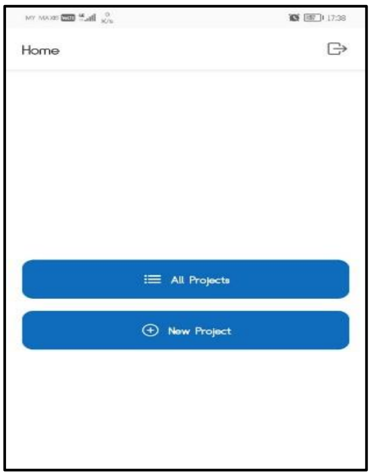
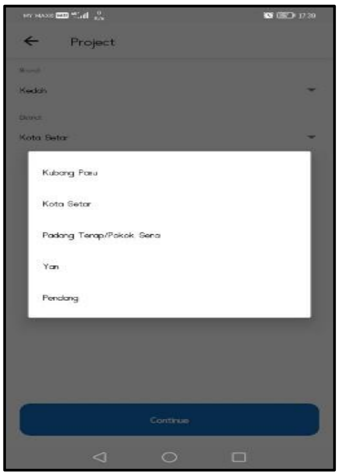


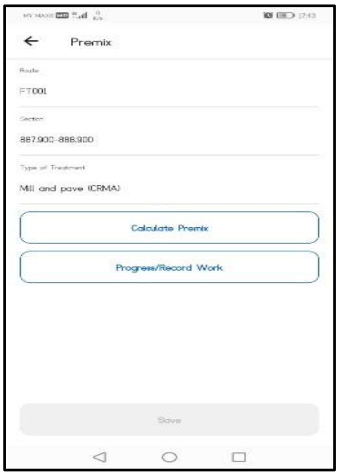
Figure 3.12 : File to develop On Site Calculation Premix (OCPremix) application.

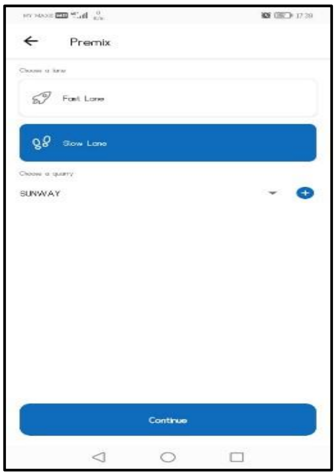
3.5 APPLICATION OF THE PRODUCT

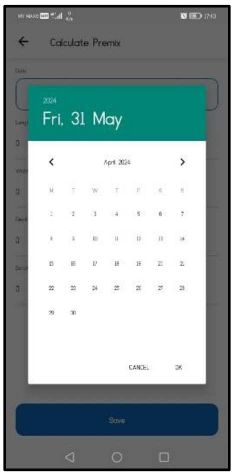
Table 3.3 : Application of product.

Design of Application	Description
	First, to log into the application, users can press the OCPremix application icon.
	For the first user, it is necessary to register as a user by creating an email and password to access as a user.

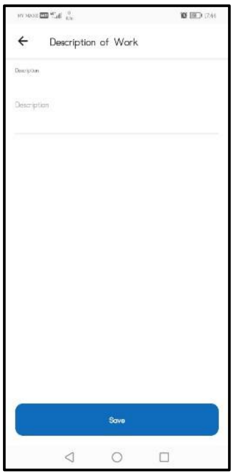
	After the admin authenticates and the user's data is entered into the database, the user can log in using the registered email and password.
	Next, to record new project data, you can press the "Add New Project" button to increase the newly started project. For the "All Projects" button will display to the user a record of previous projects and work.
	After that, the user needs to fill in the data to select the state and district that will carry out the work, then the user needs to press the save button.

<table>
<tr>
<td>


</td>
<td>Then, the next interface is where the user can choose whether to "Calculate Premix" is to ensure that the premix ordered by the subcontractor is sufficient for the distance of the route to be nilling that day or "Progress/Work Record" is to record all activities carried out or the situation at the project site. Where data is populated on the project site in real time.</td>
</tr>
<tr>
<td>


</td>
<td>If the user chooses to "Calculate Premix" on the previous interface, the user needs to fill in the project information such as the selection of the lane to be milled and the material supplier from the quarry company.</td>
</tr>
<tr>
<td>


</td>
<td>Next, the user needs to set the date, then enter the information for the premix calculation, namely the length, width, depth and density of the material we use on the project. Material density is not standardized due to material design mix. And the design mix will be determined on the first day of the project, which is when the trial lay procedure is carried out. Then the data is saved.</td>
</tr>
</table>

 	Then, the user can record the data for the progress/record of the work part. Then, the user can press the save button to save the recorded data. And the list of projects that have recorded data will appear and the user can choose to view the recorded projects. The project list is recorded according to the user id that has been recorded in the database.
 	Finally, after filling and updating. All data information will be recorded here such as the tonnage for premix part and progress/record of work for description of work.. Next time if the information needs to be shown to superiors or clients, namely the JKR officer in charge of the project, the responsible party can open the data that has been recorded and can also print it if necessary.

3.6 EFFECTIVENESS OF ON SITE CALCULATION PREMIX (OCPREMIX) APPLICATION.

Based on the three-phase methodology outlined to develop the On-Site Calculation Premix (OCPremix) application, its effectiveness can be evaluated through the application development stage. In this initial phase, comprehensive problem identification was conducted through industry training, interviews, and site observations at THB Maintenance Alor Setar. Issues identified include calculation errors in determining premix quantities, inadequate premix consumption monitoring, and delays caused by machine breakdowns. This insight is important in defining the problem statement and is supported by a literature review that supports the need for a more systematic approach to tracking and managing premix use on construction sites.

Next, data collection and application development using two data sources, namely primary and secondary, Primary data was collected using questionnaires based on Appendix C , interviews, and site observations, while secondary data was collected from journals and company reports. This phase focuses on designing a prototype of the OCPremix application to address the identified problems. The application was developed using Flutterflow for UI and Supabase for database management, ensuring that it can digitally track premix calculations, monitor progress, and store data systematically. Then, in the third phase, the OCPremix application undergoes testing to ensure functionality and ease of use. The data obtained through the questionnaire based on Appendix C involved a total of 30 respondents who made an assessment based on 10 variables and 20 questions related to existing methods and the development of the OCPremix application. The data was then analysed using SPSS software.

The OCPremix mobile application can improve project management efficiency by solving important difficulties with premix calculation and monitoring highlighted in Phase 1 of the study. After implementation, evaluations from users obtained higher mean scores for technology integration, system monitoring and final project output, indicating increased work productivity and time efficiency. Statistical investigation, including a paired sample t-test, revealed the significance of this improvement (eg, technology integration, $t = 2.443$, $p = 0.021$). Although the standard deviation values varied (0.610 to 1.050), the overall improvement was consistent. Furthermore, a strong reliability score (Cronbach's alpha = 0.913) indicates that the assessment procedure is reliable and trustworthy. These findings illustrate the application's ability to streamline operations and minimize construction delays.

3.7 CONCLUSION.

This chapter delves into the research methods utilized in this study, emphasizing techniques for data and information collection, which encompass study design, methodology, and the data collection process. The method for developing the application is thoroughly explained, addressing identified challenges and selecting the appropriate system for development at the project site. Effectiveness assessment is conducted using quantitative methods, such as questionnaires, to evaluate the application. Flow chart illustrations are employed to systematically develop the application, ensuring that the study's goals and objectives are met. The On-site Calculation Premix (OCPremix) application is designed to digitally calculate premixes and record project site progress in real time.

CHAPTER 4

DATA ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

The construction of the application shown in Chapter 3 is a result that aids in the computation of the premix on-site, progress monitoring, and the recording of activities performed or incidents that may occur on the project site. In this study, the questionnaire approach is utilised to achieve the two mentioned objectives, with the major component being a pre-questionnaire to identify difficulties at the project site. A total of 9 respondents were asked to identify the obstacles that arise when attempting to attain the first objective. The second section includes a pre-questionnaire before and after utilising the On-Site Computing Premix (OCPremix) programme. The analysis and research findings for the second part, which evaluates the effectiveness of the On-Site Calculation Premix (OCPremix) application, were obtained from a total of 30 respondents from various sites and projects who may have a civil-related background. engineering industry to evaluate the effectiveness of developed applications. This chapter will go into greater detail regarding the project's objectives and results. The objective's final result determines whether or not it was met.

4.2 DATA COLLECTION AND FINDING

Based on the results of the questionnaire that was distributed to 9 respondents involved in the project location, namely site supervisors, state managers, technical executives, and routine inspectors, namely operational department staff, The results obtained will be presented in a complete study, together with the results and data analysis in the form of tables, and diagrams, with a summary of the data analysis.

4.3 DATA COLLECTION OF QUESTIONNAIRES (IDENTIFY THE CURRENT ISSUES IN PREMIX USAGE TRACKING AND PROGRESS WORK AT ROAD CONSTRUCTION SITES).

This questionnaire is divided into 2 parts, namely part A and part B. Part A is about the demographics of the respondents. While part B is related to current issues in the use of premix, tracking and progress work at road construction sites. Finally, there are questions related to the development of On-Site Computing Premix applications as needed to design and set up the project.

4.3.1 Demographic data

Demographic data is about the background of the respondents, which involves four items. Among the items:

i. Gender
ii. Age
iii. Designation
iv. Working Experience

i. Gender

The table below shows the number of respondents who participated in this study. The total number of respondents involved in this study was nine. Figure 4.1 below shows the number of respondents by gender.

Table 4.1 : Gender of the respondent

No	Gender	No of respondent	Percentage (%)
1.	Male	9	100
2.	Female	0	0
Total		9	100

Table 4.1 shows the data for the gender of respondents. Based on the data above, 100% of the respondents are male.

ii. Age

Table 4.2 illustrates the age range of the respondents that participated in this study. Researchers divided age into four categories. As can be seen, table 4.2 includes the proportion of age.

Table 4.2 : Age of the respondents

No	Age	No of respondent	Percentage (%)
1.	20 - 25	2	22.2
2.	26 - 30	3	33.3
3.	31 - 35	2	22.2
4.	36 – 40	1	11.1
5.	40 and above	1	11.1
Total		9	100

Table 4.2 illustrates the age distribution of the respondents to the pre-project questionnaire. According to the data gathered, the greatest age of the respondents who answered the questionnaire was 26 to 30 years, 33.3% (3), while the respondents aged 36 to 40 and above 40 years old were 11.1 (1).

iii. Designation

The next item in the demographic data is the position or role at the construction site, which includes four positions directly involved in the project: state manager, technical executive, routine inspector, and site supervisor in the operations department. Table 4.3 below depicts the designation schedule.

Table 4.3 : Designation of the respondent

No	Designation	No of respondent	Percentage (%)
1.	Supervisor	4	44.4
2.	Technical Executive	1	11.1
3.	Routine Inspector	3	33.3
4.	State Manager	1	11.1
Total		9	100

Table 4.3 show the data about the designation of respondent from operation department at industry. From the data, 44.4% (4) of the respondent are supervisor, 11.1% (1) of the respondent is technical executive and state manager. Last but not least are routine inspector 33.3% (3) of the respondent.

iv. Work Experience

The last item in the demographic data is the work experience of the respondent at the operations department who was involved in this study for the pre-project questionnaire. From the data below, the respondent has experience working in industry, starting from 2–5 years, followed by 6–10 years, and above 10 years.

Table 4.4 : Work Experience of respondent.

No	Age	No of respondent	Percentage (%)
1.	< 2 years	0	0
2.	2 – 5 years	4	44.4
3.	6 – 10 years	3	33.3
4.	> 10 years	2	22.2
Total		9	100

Table 4.4 show the data about the working experience of respondent from operation department at industry. From the data, 44.4% (4) of the respondent are 2 - 5 years , 33.3% (3) of the respondent are 6 – 10 years . Last but not least 22.2 % (2) of the respondent have working experience more than 10 years.

4.3.2 To Identify the current issues in premix usage tracking and progress work at road construction sites.

In order to identify problems and issues that often occur at the project site regarding the use of premix at the project site and the progress of work at the project site, five questions have been prepared, including a questionnaire on application development as a platform that can be used at the project site. All the data will be analysed to complete this study.

Table 4.5 : Summary of questionnaire to identify the current issues.

No.	Question	Item		N = 9 Percentage (%)	
		Yes	No	Yes	No
1	Did you think calculating premix usage on site is important.	9	0	100	0
2	Is there a designated system or process for tracking premix usage at your construction site?	9	0	100	0
3	If there is a problem at the project site due to the use of premix will it cause the project to be delayed?	8	1	88.9	11.1
4	What is the problem due to delay on site? a) Documentation (calculate and monitor premix) b) Shortages or damaged of material	5 4	0	55.6 44.4	0
5	Did you think that utilizing a mobile-application could help in tracking premix usage and progress work on-site?	9	0	100	0

Based on table 4.5, the data obtained by the researcher from the questionnaire revealed a critical view of the issues related to the use of premix in construction sites. All respondents (100%) agreed that calculating the use of premix on site is important during road maintenance works. Despite this, all respondents (100%) also reported that no system or process was in place to track the use of premix, indicating a significant gap in project management. Furthermore, 88.9% of respondents believe that problems with premix can cause project delay. The projects carried out are in different locations, and the subcontractors carrying out the work are different. indicating that such issues are common and impactful. The data on the cause of this delay shows that 55.6% of respondents attributed the delay to insufficient documentation and monitoring of the use of premix, while 44.4% stated the lack or damage of materials as the cause. If this happens, the site supervisor needs to report to the superiors and the client, namely JKR, to avoid any accidents at the project site and to complete the project immediately. Additionally, there was unanimous support (100%) strongly agree for the implementation of a mobile application to track premix use and project progress, highlighting a strong consensus on the potential benefits of technology solutions to address this issue.

4.4 Evaluation the effectiveness of On-Site Calculation Premix (OC Premix) Survey.

In order to analyse the data to evaluate the effectiveness of application development, a total of 30 respondents gave an evaluation through a questionnaire that was implemented using Google Forms. The 30 respondents consist of different users, such as company staff, customers, and the private sector, who have a background in civil engineering work. This questionnaire evaluation form is divided into 3 parts, namely Part A, Part B, and Part C. Part A is the demographic part, where the background data of the respondents involved is collected. Part B is about the effectiveness of on-site calculations application Premix (OCPremix).

4.4.1 Demographic Data

Demographic data is about the background of the respondents, which involves four items. Among the items:

i. Gender
ii. Age
iii. Designation
iv. Working Experience

i. Gender

The table below shows the number of respondents who participated in this study. The total number of respondents involved in this study was 30 . Figure 4.6 shows the number of respondents by gender.

Table 4.6 : Gender of respondents

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Female	14	46.7	46.7	46.7
Male	16	53.3	53.3	100.0
total	**30**	**100.0**	**100.0**	

ii. Age

Table 4.7 illustrates the age range of the respondents that participated in this study. Researchers divided age into four categories. As can be seen, table 4.7 includes the proportion of age.

Table 4.7 Age of respondents

	Frequency	Percent (%)	Valid percent(%)	Cumulative Percent (%)
18-25	11	36.7	36.7	36.7
26-35	14	46.7	46.7	83.3
36-45	4	13.3	13.3	96.7
45 and above	1	3.3	3.3	100.0
total	**30**	**100.0**	**100.0**	

iii. Designation

The next item in the demographic data is the position or role at the construction site, which includes four positions directly involved in the project: state manager, technical executive, routine inspector, and site supervisor in the operations department. Table 4.8 depicts the designation schedule.

Table 4.8 Designation of respondent

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Supervisor	3	10.0	10.0	10.0
Engineer	8	26.7	26.7	36.7
Asst. Eng	6	20.0	20.0	56.7
Manager	4	13.3	13.3	70.0
Other	9	30.0	30.0	100.0
Total	**30**	**100.0**	**100.0**	

iv. Work Experience

The last item in the demographic data is the work experience of the respondent at the operations department who was involved in this study for the pre-project questionnaire. Based on table 4.9, the respondent has experience working in industry, starting from 2–5 years, followed by 6–10 years, and above 10 years.

Table 4.9 : Work Experience Respondent

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
< 2years	9	30	30	30
2-5 years	6	20.0	20.0	50.0
6-10 years	9	30.0	30.0	80.0
> 10 years	6	20.0	20.0	100.0
Total	**30**	**100.0**	**100.0**	

4.4.2 Section B : Evaluate the effectiveness of Using On site Calculation Premix (OCPremix).

In this section, there are 10 questions that use a Likert scale to evaluate the effectiveness of using the On-Site Calculation Premix (OCPremix) application. This section is divided into 2, which are evaluator questions about existing methods and the use of On-Site Calculation Premix (OCPremix) application development.

i. Work Productivity

Table 4.10 : Existing Method of Work Productivity.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Disagree	1	3.3	3.3	3.3
Neither agree or Disagree	4	13.3	13.3	16.7
Agree	19	63.3	63.3	80.0
Strongly Agree	6	20.0	20.0	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.11 : OC Premix application of Work Productivity

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Neither agree or Disagree	3	10.0	10.0	10.0
Agree	18	60.0	60.0	70.0
Strongly Agree	9	30.0	30.0	100.0
Total	**30**	**100.0**	**100.0**	

Based on the results presented in Tables 4.10 and 4.11, it is evident that the OCPremix application significantly improves user satisfaction compared to existing manual calculation methods. Table 4.10 shows that a majority of respondents (63.3%) agree and an additional 20% strongly agree that existing methods are prone to errors in determining material density, leading to inefficient material use. Conversely, Table 4.11 indicates that 60% of respondents agree and 30% strongly agree that the OCPremix application is easy to use and facilitates faster, more accurate calculations. The cumulative agreement (agree and strongly agree) for the OCPremix application (90%) is significantly higher than that for the existing methods (83.3%), highlighting the perceived benefits of the digital platform in enhancing work productivity and reducing errors.

ii. Work Progress

Table 4.12 : Existing methods of Work Progress

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Disagree	1	3.3	3.3	3.3
Neither agree or Disagree	1	3.3	3.3	10.0
Agree	16	53.3	53.3	53.3
Strongly Agree	12	40.0	40.0	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.13: OC Premix application of Work Progress

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Disagree	1	3.3	3.3	3.3
Neither agree or Disagree	2	6.7	6.7	10.0
Agree	13	43.3	43.3	53.3
Strongly Agree	14	46.7	46.7	100.0
Total	**30**	**100.0**	**100.0**	

The comparison of results in Tables 4.12 and 4.13 indicates a clear preference for the OCPremix application over existing methods for tracking project activities. Table 4.12 shows that while a majority (53.3%) agree and 40% strongly agree that existing methods are reliable, they also acknowledge issues such as machinery problems, unprofessionalism, and poor documentation that lead to project delays. In contrast, Table 4.13 reveals that the OCPremix application is perceived more favorably, with 43.3% agreeing and 46.7% strongly agreeing that it simplifies tracking project progress and enhances communication of ongoing activities. The cumulative agreement for

OCPremix (90%) is slightly higher than for existing methods (93.3%), suggesting that respondents find the digital platform more effective in mitigating delays and improving work progress management.

iii. Technology in construction

Table 4.14 : Existing methods of Technology in Construction

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Strongly Disagree	1	3.3	3.3	3.3
Disagree	2	6.7	6.7	10
Neither agree or Disagree	5	16.7	16.7	26.7
Agree	14	46.7	46.7	73.3
Strongly Agree	8	26.7	26.7	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.15 : OC Premix application of Technology in Construction

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Neither agree or Disagree	3	10.0	10.0	10.0
Agree	12	40.0	40.0	50.0
Strongly Agree	15	50.0	50.0	100.0
Total	**30**	**100.0**	**100.0**	

The results in Tables 4.14 and 4.15 highlight a strong endorsement for the OCPremix application as an innovative technological solution in the construction industry. Table 4.14 shows that while a majority of respondents (46.7% agree and 26.7% strongly agree, totaling 73.4%) find existing methods effective and suitable for modern construction projects, a significant portion remain neutral (16.7%) or disagree (10%). In contrast,

Table 4.15 reveals even stronger support for the OCPremix application, with 40% agreeing and 50% strongly agreeing that it represents a forward-thinking implementation of IoT in construction for Industry 4.0. The cumulative agreement for the OCPremix application (90%) is notably higher than that for existing methods (73.4%), indicating a clear preference for the advanced digital approach over traditional methods, underscoring the industry's readiness to embrace new technology to enhance efficiency and effectiveness.

iv. Ease of Use

Table 4.16 : Existing methods of Ese of Use.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Disagree	3	10	10	10
Neither agree or Disagree	2	6.7	6.7	16.7
Agree	15	50.0	50.0	66.7
Strongly Agree	10	33.3	33.3	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.17 : OCPremix application of Ease of Use.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Neither agree or Disagree	3	10.0	10.0	10.0
Agree	13	43.3	43.3	53.3
Strongly Agree	15	46.7	46.7	100.0
Total	**30**	**100.0**	**100.0**	

The analysis of Tables 4.16 and 4.17 demonstrates a clear preference for the OCPremix application over existing methods in terms of ease of use for premix calculations, data collection, and project progress tracking. Table 4.16 shows that 50% of respondents agree and 33.3% strongly agree that existing methods are simple to use, totaling an 83.3% cumulative agreement. However, Table 4.17 indicates an even higher satisfaction with the OCPremix application, with 43.3% agreeing and 46.7% strongly agreeing, resulting in a 90% cumulative agreement. This comparison reveals that while a majority find existing methods straightforward, there is a stronger consensus that the OCPremix application offers a more systematic and user-friendly approach, enhancing efficiency and user experience in managing construction tasks.

v. Time Efficiency

Table 4.18 : Existing methods of Time Efficiency.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Strongly Disagree	1	3.3	3.3	3.3
Disagree	2	6.7	6.7	10
Neither agree or Disagree	5	16.7	16.7	26.7
Agree	13	43.3	43.3	70.0
Strongly Agree	9	30.0	30.0	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.19 : OCPremix application of Time Efficiency

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Neither agree or Disagree	4	13.3	13.3	13.3
Agree	14	46.7	46.7	60.0
Strongly Agree	12	40.0	40.0	100.0
Total	**30**	**100.0**	**100.0**	

The results in Tables 4.18 and 4.19 show a preference for the OCPremix application over existing methods in terms of time efficiency. Table 4.22 indicates that 43.3% agree and 30% strongly agree that existing methods are time-efficient, totaling 73.3% agreement. However, Table 4.23 shows higher approval for the OCPremix application, with 46.7% agreeing and 40% strongly agreeing, totaling 86.7% agreement. This suggests that while existing methods are considered somewhat time-efficient, the OCPremix application is perceived as significantly more efficient, providing real-time updates and streamlining data collection.

vi. Integration system

Table 4.20 : The existing method of Integration system.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Disagree	1	3.3	3.3	3.3
Neither agree or Disagree	6	20.0	20.0	16.7
Agree	15	50.0	50.0	66.7
Strongly Agree	8	26.7	26.7	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.21 : OCPremix application of Integration system

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Disagree	1	3.3	3.3	3.3
Neither agree or Disagree	1	3.3	3.3	16.7
Agree	12	40.0	40.0	46.7
Strongly Agree	16	53.3	53.3	100.0
Total	**30**	**100.0**	**100.0**	

The comparison of Tables 4.20 and 4.21 reveals a clear preference for the OCPremix application over existing manual methods regarding integration systems. Table 4.20 shows that 50% agree and 26.7% strongly agree that manual management of calculation data makes compilation, analysis, and reporting challenging, totaling 76.7% agreement. In contrast, Table 4.21 demonstrates higher approval for the OCPremix application, with

40% agreeing and 53.3% strongly agreeing that it automates data management, analysis, and reporting, totaling 93.3% agreement. This indicates that while manual methods are somewhat effective, the automated OCPremix application is viewed as significantly more efficient and easier to use.

vii. Sustainability

Table 4.22 : Existing methods of Sustainability.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Strongly Disagree	1	3.3	3.3	3.3
Disagree	1	3.3	3.3	6.7
Neither agree or Disagree	5	16.7	16.7	23.3
Agree	12	40.0	40.0	63.3
Strongly Agree	11	36.7	36.7	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.23 : OCPremix applications of Sustainability.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Neither agree or Disagree	4	13.3	13.3	13.3
Agree	17	56.7	56.7	70.0
Strongly Agree	9	30.0	30.0	100.0
Total	**30**	**100.0**	**100.0**	

The comparison of Tables 4.22 and 4.23 highlights a preference for the OCPremix application over existing methods in terms of sustainability. Table 4.22 shows that 40% agree and 36.7% strongly agree that existing methods lead to inefficient resource use, negatively impacting sustainability, totaling 76.7% agreement. In contrast, Table 4.23

reveals that 56.7% agree and 30% strongly agree that the OCPremix application promotes environmentally responsible practices, totaling 86.7% agreement. This indicates that while existing methods are recognized for their inefficiencies, the OCPremix application is seen as significantly improving the sustainability of construction projects.

x. Monitoring

Table 4.24 : Existing method of Monitoring

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Strongly Disagree	1	3.3	3.3	3.3
Disagree	1	3.3	3.3	6.7
Neither agree or Disagree	3	10.0	10.0	16.7
Agree	17	56.7	56.7	73.3
Strongly Agree	8	26.7	26.7	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.25 : OCPremix application of Monitoring

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Neither agree or Disagree	2	6.7	6.7	6.7
Agree	13	43.3	43.3	50.0
Strongly Agree	15	50.0	50.0	100.0
Total	**30**	**100.0**	**100.0**	

The comparison of Tables 4.24 and 4.25 shows a clear preference for the OCPremix application over existing manual methods in terms of monitoring. Table 4.24 indicates that 56.7% agree and 26.7% strongly agree that manual methods make it difficult to track real-time progress, totaling 83.4% agreement. In contrast, Table 4.25 reveals that

43.3% agree and 50% strongly agree that the OCPremix application allows for real-time progress tracking on-site, totaling 93.3% agreement. This indicates that while manual methods are somewhat effective, the OCPremix application is seen as significantly better for real-time monitoring and addressing project site issues promptly.

xi. System style

Table 4.26 : Existing method of System style.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Strongly Disagree	1	3.3	3.3	3.3
Disagree	1	3.3	3.3	6.7
Neither agree or Disagree	7	23.3	23.3	30.0
Agree	9	30.0	30.0	60.0
Strongly Agree	12	40.0	40.0	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.27 : OCPremix application of System style.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Disagree	1	3.3	3.3	3.3
Neither agree or Disagree	1	3.3	3.3	6.7
Agree	16	53.3	53.3	60.0
Strongly Agree	12	40.0	40.0	100.0
Total	**30**	**100.0**	**100.0**	

The comparison of Tables 4.26 and 4.27 shows a preference for the OCPremix application over existing manual methods regarding system style. Table 4.26 indicates that 30% agree and 40% strongly agree that manual methods are effective for on-site tasks, totaling 70% agreement. In contrast, Table 4.27 reveals that 53.3% agree and 40% strongly agree that the OCPremix application is more systematic and easier for data calculation and tracking, totaling 93.3% agreement. This indicates that while manual methods are considered effective, the OCPremix application is viewed as a significantly more organized and user-friendly approach for managing on-site tasks.

xii. Final outcome

Table 4.28 : Existing methods of Final Outcome.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Strongly Disagree	1	3.3	3.3	3.3
Disagree	2	6.7	6.7	10
Neither agree or Disagree	5	16.7	16.7	26.7
Agree	17	56.7	56.7	83.3
Strongly Agree	5	16.7	16.7	100.0
Total	**30**	**100.0**	**100.0**	

Table 4.29 : OCPremic application of Final Outcome.

	Frequency	Percent (%)	Valid percent (%)	Cumulative Percent (%)
Neither agree or Disagree	3	10.0	10.0	10.0
Agree	16	53.3	53.3	63.3
Strongly Agree	11	36.7	36.7	100.0
Total	**30**	**100.0**	**100.0**	

The comparison of Tables 4.28 and 4.29 indicates a preference for the OCPremix application over existing methods for tracking progress and calculating premixes. Table 4.28 shows that 56.7% agree and 16.7% strongly agree that existing methods are effective on-site, totaling 73.4% agreement. In contrast, Table 4.29 reveals that 53.3% agree and 36.7% strongly agree that the OCPremix application makes tracking and calculations easier digitally, totaling 90% agreement. This suggests that while existing methods are considered effective, the OCPremix application is perceived as a more efficient and user-friendly digital solution.

4.5 RESULT ANALYSIS

4.5.1 Districution of Mean Score (Agreement Level)

In mathematics and statistics, the term "mean" refers to a measure of central tendency that determines the average value of a group of integers. Mean is a key term in mathematics and statistics. The mean is the average or most common value among a set of numbers. In statistics, it is a measure of a probability distribution's central tendency between the median and mode. It is also known as the expected value. These methods are utilised in a variety of settings, depending on the nature of the data and the unique requirements of the analysis.

a) 5 points Likert scale

A Likert scale is a psychometric scale commonly used in questionnaires to measure attitudes, opinions, or perceptions. Based on table 4.30, the Likert scale typically consists of a series of statements, with respondents asked to indicate their level of agreement or disagreement with each statement using a fixed set of options that are : (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree.

Table 4.30 : Mean score interpretation scale.

Mean Score	Interpretation
4.30 - 5.00	Very High
3.50 - 4.29	High
2.70 - 3.49	Moderate
1.90 - 2.69	Low
1.00 - 1.89	Very Low

(Source : Zaki, 2017)

4.5.2 Overall mean and standard deviation interpretation

The questionnaire conducted has a section that is analyzed using SPSS software, which is section b. Part b is where to evaluate the effectiveness of Using On-site Computational Premix (OCPremix). In part b there are 10 questions in total.

Table 4.31 presents data that compares the effectiveness of the existing method with the OCPremix application across ten variable categories, as evaluated by 30 respondents. Mean scores and standard deviations (SD) reveal that the application consistently outperforms existing methods in terms of efficiency, ease of use, integration, and monitoring. The mean score for "work productivity" using OCPremix is 4.20 (SD = 0.610), indicating a high level of satisfaction compared to the Mean of existing methods of 4.00 (SD = 0.695). This trend continued across other categories, such as "work progress" (OCPremix: mean = 4.33, SD = 0.758 vs. Existing: Mean = 4.30, SD = 0.702) and "Ease of Use" (OCPremix: Mean = 4.37, SD = 0.669 vs. Existing: Mean = 4.07, SD = 0.907), indicating superior application performance and consistent user satisfaction.

Lower standard deviations in categories such as "work productivity" (0.610), "ease of use" (0.669), and "monitoring" (0.626) for the OCPremix application suggest a higher level of agreement among respondents regarding its benefits. The implementation of IoT applications for Industry 4.0 significantly improves "Technology in Construction" (mean = 4.40, SD = 0.675) compared to existing methods (mean = 3.87, SD = 1.008). These results show that the OCPremix application improves real-time tracking, systematic data management, and sustainability practices, leading to more efficient and accurate project management. Overall, the application is considered a valuable tool to increase productivity, reduce errors, and facilitate better resource management in construction projects.

Table 4.31 : Mean and Standard Deviation Interpretation.

No.	Effectiveness Category	Issued Related Regarding On Site Calculation Premix (OCPremix)	Respondent = N = 30		
			Mean	SD	Interpretation mean score
1	Work Productivity	Existing methods rely on manual calculations that are prone to errors in determining material density resulting in insufficient material consumption and inaccurate use of resources.	4.00	0.695	HIGH
		The application is a digital calculation platform where the material density has been standardized, easy to use for faster calculations.	4.20	0.610	
2	Work Progress	Existing methods are reliable methods of tracking project activities, but machinery issues, unprofessionalism, and poor documentation and premix calculations cause project delays.	4.30	0.702	VERY HIGH
		Using the Application it is easier to track the progress of the project with a simple set of platforms or tasks to communicate the ongoing activities in detail.	4.33	0.758	
3	Technology in construction	Existing methods are effective and suitable for modern construction projects.	3.87	1.008	HIGH
		This application is an idea to implement IOT in construction for industry 4.0	4.40	0.675	
4	Ease of Use	Existing methods are simple for premix calculation, data collection and project progress tracking using paper and whatapps	4.07	0.907	VERY HIGH
		The app is easier for premix calculations, data collection and project progress tracking more systematically.	4.37	0.669	
5	Time Efficiency	Existing methods are time-efficient for premix calculation, progress tracking, and on-site data collection.	3.90	1.029	HIGH
		Using the app rapidly increases efficiency in project calculations, progress tracking by providing real-time updates and streamlining data collection.	4.27	0.691	
6	Integration systems	The existing method is the manual management of calculation data on site making the compilation, analysis and reporting of work progress challenging.	4.00	0.788	VERY HIGH
		The application is automated in data management, analysis and reporting of calculation results on site.	4.43	0.728	
7	Sustainability	Existing methods can lead to inefficient use of resources, negatively impacting the sustainability of construction practices.	4.03	0.999	HIGH
		Using applications on site promotes environmentally responsible practices and improves the sustainability of construction projects.	4.17	0.648	
8	Monitoring	Existing manual calculation methods make it difficult to track real-time progress, causing potential delays in identifying and addressing project site issues.	4.00	0.910	HIGH
		Application Usage can monitor the Progress of premix calculations and be tracked in real time on site.	4.43	0.626	

9	**System style**	Existing methods that rely on manual calculations and data collection are effective for on-site tasks.	4.00	1.050	HIGH
		This application is more systematic for data calculation and easier to track information	4.30	0.702	
10	**Final Outcome**	Existing methods are effective on site for tracking progress and calculating premixes.	3.77	0.935	HIGH
		This app makes it easier to track work progress and calculations digitally.	4.27	0.64	

Table 4.32 : Summary of Descriptive Statistics of Pre and Post Development OCPremix

Variables	**Pre - Development**		**Post - Development**	
	Mean	**Interpretation of Mean Score**	**Mean**	**Interpretation of Mean score**
Work Productivity	4.00	High	4.20	High
Work Progress	4.30	High	4.33	High
Technology in construction	3.87	High	4.40	Very High
Ease of Use	4.07	High	4.37	Very High
Time Efficiency	3.90	High	4.27	High
Integration System	4.00	High	4.43	Very High
Sustainability	4.03	High	4.17	High
Monitoring	4.00	High	4.43	Very High
System style	4.00	High	4.30	Very High
Final outcome	3.77	High	4.27	High
Average	**3.99**	**High**	**4.32**	**Very High**

The evaluation of the effectiveness of on-site calculation Premix (OCPremix) was analysed using SPSS, forming the mean shown in Table 4.32 with 10 variables that were tested by respondents to help the researcher with the project. The mean value for pre-development variables such as work productivity (Mean = 4.00), Work Progress (Mean = 4.30), Technology under construction (Mean = 3.87), Ease of use (Mean = 4.07), Time Efficiency (Mean = 3.90), System Integration (Mean = 4.00), Sustainability (Mean = 4.03), Monitoring (Mean = 4.00), System Style (Mean = 4.00) and Final

Results (Mean = 3.77) has a litte bit lower mean compared to the new implementation method which is OCPremix with the variable being work productivity (Mean = 4.20), Work Progress (Mean = 4.33), Technology in construction (Mean = 4.40), Ease of use (Mean = 4.37), Time Efficiency (Mean = 4.27), System Integration (Mean = 4.43), Sustainability (Mean = 4.17), Monitoring (Mean = 4.43), System Style (Mean = 4.30) and Final outcome (Mean = 4.27). Referring to table 4.30, the data obtained below shows that the average mean for post-development is 4.32, which has a very high interpretation on the mean scale, while for pre-development the value is 3.99, which is on a high scale, and it shows that the perspective on this project is very agreeable, but the existing methods are still relevant and agree to be used.

4.5.3 T-Test

The part t-test was performed to compare the means. A paired t-test is appropriate for this inquiry. This is because it contains two survey questions from two different events: a pre-questionnaire before using the app product, and a post-questionnaire after testing and using the app product.

a) T – Test (Paired Sample Statisitc)

Paired sample t-test data examining the effectiveness of the OCPremix application compared to existing methods across various categories of construction project management was based on responses from 30 participants. Table 4.33 is an analysis showing that the mean score for the OCPremix application was consistently higher across all pairs, indicating that respondents perceived the application as an improvement over existing methods. For example, "work productivity" improved from a mean of 4.00 (SD = 0.695, SEM = 0.111) to 4.20 (SD = 0.610, SEM = 0.127), and "technology in construction" increased from 3.87 (SD = 1.008, SEM = 0.12) to 4.40 (SD = 0.675, SEM = 0.184). Standard deviations are generally lower for applications, suggesting more consistent responses. The standard error of the mean (SEM) for the application is generally low, indicating an accurate estimate of the mean. Additionally, the relatively small standard deviations indicate that responses consistently favour the use of

OCPremix. These results collectively suggest that digital platforms improve productivity, accuracy, ease of use, time efficiency, integration, sustainability, and real-time monitoring, making them a more effective tool for managing on-site calculations and overall project progress than traditional methods.

Table 4.34 shows paired sample t-test results for the efficacy of the OCP remix application across ten variables. The analysis, based on the variable average mean of 0.3232, implies that the OCPremix application has an overall beneficial effect. However, the average significance value of 0.1848 is bigger than 0.05, indicating that when all categories are taken together, the change is not statistically significant at the 5% level. This may be due to the variation in importance of individual categories that partially show a significant improvement, for example, technology in construction (Mean = 0.533), (p-value = 0.021), system integration (Mean = 0.433), (p-value = 0.005), monitoring (Mean = 0.433), (p-value = 0.013), final results (Mean = 0.500), (p-value = 0.014), while others do not, for example, work productivity (Mean = 0.200), (p-value = 0.246), work progress (Mean = 0.033), (p-value = 0.839), sustainability (Mean = 0.133), (p-value = 0.442). The study found that using OCPremix had a statistically significant favourable influence in certain variables , including construction technology, system integration, monitoring, and final outcome. However, total effectiveness, when averaged across all categories, did not reach statistical significance, owing primarily to mixed results in other variables (Field. A, 2013).

Table 4.33 : Overall Paired Sample T-Test.

No.	Issued Related Regarding On Site Calculation Premix (OCPremix)	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Existing methods rely on manual calculations that are prone to errors in determining material density resulting in insufficient material consumption and inaccurate use of resources.	4.00	30	0.695	0.111
	The application is a digital calculation platform where the material density has been standardized, easy to use for faster calculations.	4.20	30	0.610	0.127
Pair 2	Existing methods are reliable methods of tracking project activities, but machinery issues, unprofessionalism, and poor documentation and premix calculations cause project delays.	4.30	30	0.702	0.138
	Using the Application it is easier to track the progress of the project with a simple set of platforms or tasks to communicate the ongoing activities in detail.	4.33	30	0.758	0.128
Pair 3	Existing methods are effective and suitable for modern construction projects.	3.87	30	1.008	0.123
	This application is an idea to implement IOT in construction for industry 4.0	4.40	30	0.675	0.184
Pair 4	Existing methods are simple for premix calculation, data collection and project progress tracking using paper and whatapps	4.07	30	0.907	0.122
	The app is easier for premix calculations, data collection and project progress tracking more systematically.	4.37	30	0.669	0.166
Pair 5	Existing methods are time-efficient for premix calculation, progress tracking, and on-site data collection.	3.90	30	1.029	0.126
	Using the app rapidly increases efficiency in project calculations, progress tracking by providing real-time updates and streamlining data collection.	4.27	30	0.691	0.188
Pair 6	The existing method is the manual management of calculation data on site making the compilation, analysis and reporting of work progress challenging.	4.00	30	0.788	0.133
	The application is automated in data management, analysis and reporting of calculation results on site.	4.43	30	0.728	0.144
Pair 7	Existing methods can lead to inefficient use of resources, negatively impacting the sustainability of construction practices.	4.03	30	0.999	0.118
	Using applications on site promotes environmentally responsible practices and improves the sustainability of construction projects.	4.17	30	0.648	0.182
Pair 8	Existing manual calculation methods make it difficult to track real-time progress, causing potential delays in identifying and addressing project site issues.	4.00	30	0.910	0.114
	Application Usage can monitor the Progress of premix calculations and be tracked in real time on site.	4.43	30	0.626	0.166
Pair 9	Existing methods that rely on manual calculations and data collection are effective for on-site tasks.	4.00	30	1.050	0.128
	This application is more systematic for data calculation and easier to track information	4.30	30	0.702	0.192
Pair 10	Existing methods are effective on site for tracking progress and calculating premixes.	3.77	30	0.935	0.117
	This app makes it easier to track work progress and calculations digitally.	4.27	30	0.640	0.171

Table 4.34 : Paired Sample T – Test with variables

Variables	Mean	Std. Deviation	t	Significance
Work Productivity	0.200	0.695	1.185	0.246
Work Progress	0.033	0.702	0.205	0.839
Technology in construction	0.533	1.008	2.443	0.021
Ease of Use	0.300	0.907	1.874	0.071
Time Efficiency	0.367	1.029	1.69	0.102
Integration System	0.433	0.788	3.067	0.005
Sustainability	0.133	0.999	0.779	0.442
Monitoring	0.433	0.91	2.644	0.013
System style	0.300	1.05	1.725	0.095
Final outcome	0.500	0.935	2.628	0.014
Average	**0.3232**	**0.9023**	**1.824**	**0.1848**

4.5.4 Reliability Test

Reliability tests determine the consistency and stability of a test or measurement device throughout time. It measures the instrument's ability to deliver stable and consistent results when repeated under identical settings. In SPSS software (Statistical Package for the Social Sciences), reliability analysis is used to determine the consistency of a group of scales or test items. This is typically accomplished using Cronbach's Alpha, a measure of internal consistency. A high Cronbach's alpha (usually more than 0.70) suggests that the items assess the same underlying notion. In this study, the researcher uses table 4.35 to determine the Cronbach's alpha level for the reliability test for this application.

Table 4.35 : Coefficient of Cronbach's Alpha.

No	Coefficient of Cronbach's Alpha	Reliability Level
1	More than 0.90	Excellent
2	0.80 - 0.89	Good
3	0.70 - 0.79	Acceptable
4	0.60 - 0.69	Questionable
5	0.50 - 0.59	Poor
6	Less than 0.59	Unacceptable

(Source : George, et al, 2003)

Table 4.36 : Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.909	0.913	10

As seen in Table 4.36, Cronbach's Alpha is an internal consistency coefficient used to assess the reliability of a scale or test. The values range from 0 to 1, with higher values indicating greater reliability. Specifically, Cronbach's Alpha measures the extent to which a set of items or variables measure a unidimensional latent construct.Table 4.36 shows that Cronbach's Alpha Based on Standardized Items is 0.913, confirming that OCPremix is at an excellent level of reliability. These values indicate that the set of items used to evaluate the OCPremix application demonstrates excellent internal consistency. This high level of reliability suggests that the scale is very reliable and OCPremix mobile application can give positively impact on real situation in road maintenance projects.

4.6 CONCLUSION

In conclusion, the results obtained from the survey form involved a total of 30 respondents from construction industry companies, government departments and private companies with a background in road construction. According to the results of the questionnaire, all respondents agreed that calculating premix consumption on site is important for road maintenance projects, but none reported using a method to detect premix consumption. The majority of respondents (88.9%) agreed that premix application problems can cause project delays, which are often caused by documentation issues and material shortages. Surprisingly, a total of 9 respondents selected to identify issues occurring in the industry agreed that the use of mobile applications will improve premix tracking and progress monitoring on site. These findings highlight the need for digital solutions to improve the efficiency of road construction and project management, with the goal of achieving smoother operations and timely project completion. Future initiatives should focus on incorporating such technologies to improve workflow and results in the construction industry.

Several key findings emerged from the SPSS analysis used to evaluate the performance of the On-Site Calculation Premix (OCPremix) application. The mean score before 3.99 and after implementation 4.32 showed a significant improvement in metrics such as work productivity, work progress, construction technology, ease of use, time efficiency, system integration, sustainability, monitoring, system style and final results, indicating positive user acceptance of OCPremix. Paired sample t-tests revealed statistically significant improvements in technology integration, system monitoring and final results using OCPremix which is less than 0.05. However, the aggregate mean across all factors failed to reach statistical significance at the 5% level, indicating mixed results in other areas. Cronbach's Alpha reliability analysis showed a high coefficient of 0.913, indicating great internal consistency when monitoring user impressions. Therefore, while OCPremix shows promising improvements in the management and efficiency of construction projects, especially in specific domains, further targeted improvements can optimize its overall impact in construction practice.

Standard deviation values ranging from 0.610 to 1.050, obtained from paired sample t-tests evaluating On-Site Computing Premix (OCPremix) application projects, illustrate the spread of differences between pre-development and post-development means across various variables. The On-Site Computing Premix (OCPremix) application project showed varying effects across various variables, with a higher standard deviation of 1.050 indicating greater variability. Conversely, a lower standard deviation approaching 0.610 indicates more consistency, suggesting a more uniform effect. These findings help assess the reliability and uniformity of the effectiveness of OCPremix in improving construction project management, in line with standard statistical practice. Analysis and interpretation were consistent with standard statistical practice in evaluating paired sample t-tests, as commonly used in research evaluating the effects of interventions on multiple variables (Field, 2013; Zaki, 2017).

CHAPTER 5

DISCUSSION, RECOMMENDATION AND CONCLUSION

5.1 INTRODUCTION

The development of the On-Site Calculation Premix (OCPremix) application represents a significant advance in road maintenance practice, addressing critical challenges such as calculation errors, inadequate monitoring and project delays. This chapter delves into a comprehensive discussion of findings from the implementation and testing phases of the OCPremix application, assessing their impact on project management efficiency and user satisfaction. Nevertheless, users of existing methods that are used now are still relevant based on the research findings stated in Chapter 4, but the development of On Site Calculation Premix also provides a positive impact from the point of view of certain variables and shows the development of this mobile application, it is able to move the implementation of the construction industry to the direction of sustainable development in line with the government's intention to make the industry in this country towards Industry 4.0. Following the discussion, we provide targeted recommendations to optimize the application and suggest strategies for wider implementation and adoption in the industry. Finally, the chapter concludes by summarizing the main results of the project, reflecting on the objectives achieved, and suggesting potential future research directions to further improve the utility and effectiveness of OCPremix in road maintenance.

5.2 DISCUSSION

Interest in industry 4.0 has emphasised transformative digital technologies such as IoT, artificial intelligence, and machine learning for efficiency, productivity, and sustainability. Accordingly, the development of the construction industry is very important in this country, and infrastructure projects can also provide many benefits in the advancement of Industry 4.0 to move the country towards the use of technology in the industry. Maintenance is also a high-risk industrial activity but important for the country's socio-economic growth; however, growth is hindered and slow due to several influencing factors, such as delays in completing projects due to a lack of resources, errors in inaccurate material calculations, and machine breakdowns at the project site. This is identified as inefficiency in premix calculations and project monitoring, which leads to frequent delays and material waste. The proposed solution, the On-Site Calculation Premix (OCPremix) mobile application, aims to address this issue by improving the accuracy of premix calculations, tracking project progress, and recording data efficiently. The application's expected benefits are improving workflow efficiency, optimising resource allocation, and minimising waste, thus contributing to more sustainable construction practices.

A literature review is a secondary source found by the researcher in completing this study. Based on previous studies conducted, it is important to determine and give ideas to researchers as a reference for the development of the On-Site Calculation Premix (OCPremix) application. The design thinking process is a technique that is used initially to identify problems or issues that often occur in the industry. This is where interview sessions are conducted with industry people, observations are made at the project site, and questionnaires are issued to further strengthen the issue, which has been highlighted. Next, develop the OCPremix application using a few selected software builders. After that, the prototype design is designed to facilitate the researcher's development of a system that can meet the needs of the users and achieve the outlined objectives.

The systematic approach used to develop and evaluate the effectiveness of the OCPremix mobile application was a research design that included a mixed-methods approach to collecting qualitative and quantitative data. The primary data collection method involved the distribution of detailed questionnaires to supervisors, inspectors, and technical executives at THB Maintenance Sdn. Bhd. The questionnaire was carefully designed to get a comprehensive picture of the current challenges faced in premix calculations and project monitoring. The feedback obtained from these key stakeholders provides a solid basis for identifying the specific needs and requirements that the OCPremix application needs to address. The application is designed to improve accuracy in premix calculations, facilitate efficient progress tracking, and enable seamless data recording and reporting.

This process involves several iterative stages, including requirements analysis, design, development, and testing. Each stage incorporates a feedback loop to ensure the application remains aligned with user expectations and practical usability. From a technical aspect, application development includes the choice of programming language, software framework, and the integration of IoT technologies to enable real-time data collection and processing. The application was developed to be intuitive and user-friendly, ensuring that site supervisors and other stakeholders can easily adopt and use it without extensive training. OCPremix application effectiveness assessors are conducted comprehensively, and application performance is closely monitored with specific performance metrics such as technology in construction, system integration, work productivity, and others. These tests can provide valuable insight into practical benefits and any potential areas for improvement.

By using SPSS software, data analysis can be carried out by taking into account the results of the paired sample T-test, reliability, mean score, standard deviation, and significance value. Based on the items mentioned, the test results obtained from the SPSS analysis can prove that the application developed, OnSite Calculation Premix (OCPremix), can benefit users or not. The analysis shows how the application significantly improves calculation accuracy and reduces material waste. The enhanced monitoring capabilities provided by the application enable real-time tracking and more efficient project management. Findings show that the application not only streamlines workflow but also supports better decision-making by providing accurate and timely data. The analysis revealed that 88.9% of respondents agreed that issues with premix applications can cause project delays, often due to documentation errors and material shortages. The mean score before and after implementation showed a significant increase from 3.99 to 4.32, indicating an increase in work productivity, progress tracking, and overall project efficiency.

5.3 RECOMMENDATION

In this study, the researcher would like to propose some suggestions obtained from user feedback collected through the product effectiveness evaluation questionnaire, in section C. and the results during the test phase were very positive. Site supervisors and project managers report that the application significantly reduces time spent on manual calculations and paperwork, allowing them to focus more on actual site supervision. The real-time data tracking and reporting features of the OCPremix application are highly praised, as they facilitate better decision-making and faster response to emerging issues.

Also , the suggested improvement for the use of this application in the future is for the further improvement of this application, the respondent suggested to clarify the exact premix temperature based on the current weather at the site. This is because temperature plays an important role because the use of premix materials in road maintenance is very sensitive to temperature and weather factors can affect it.

In addition, OCPremix can do some improvements for a better experience for premix on site such as by providing JKR Standard premix temperature whether it is acceptable or not to put on the road. Ensure all premixes are in accordance with the required temperature based on JKR Standards by estimating the distance between the quarry and the new road. And it would be even better if the application could help users identify their collection site with a google map that works together, the current turnaround time, giving an immediate percentage of work progress. It's also a great way to see and calculate the correct tonnage for the area they need to cover.

To enhance "On Site Calculation Premix" (OCPremix) to calculate premix and track work progress, it is recommended to have a user-friendly interface, ensure accurate calculations, provide real-time updates, implement reliable data storage and backup, make OCPremix is compatible. . with mobile devices, and includes reporting capabilities for better analysis and decision making. These recommendations will improve tool functionality, usability and reliability for on-site premix calculations and job progress tracking.

For continuous improvement, it is good to make a comparison between the calculation of DO premix on the actual site and OCPremix. This can lead to the reliability of the introduced system. In addition, a successful calculation will introduce more cost efficiency, effective site monitoring, and construction sustainability in terms of product quality, premix waste management, etc. In summary, all of the recommendations can help the researcher to improve OCPremix application become more accurate and efficient in future.

5.4 CONCLUSION

In conclusion, based on the analysis and discussion above, it shows that OCPremix effectively addresses the main challenges in road maintenance projects by improving the accuracy of premix calculations, streamlining progress monitoring, improving overall project management efficiency, and achieving the research objectives outlined

in this study. achieved a paired sample t, which showed a significant improvement in technology integration, system monitoring, and final project results ($t = 2.443$, $p = 0.021$). The reliability of the OCPremix application was assessed using Cronbach's alpha, which produced a high coefficient of 0.913. This high level of internal consistency confirms the app's reliability in real-world settings, supporting its effectiveness in reducing human error and material waste.
The standard deviation values, ranging from 0.610 to 1.050, indicate variability in application effects across different variables.

Although the overall improvement was consistent, certain areas showed more significant benefits than others, suggesting the need for targeted improvements to maximise the effectiveness of the application across all aspects of project management. Positive user feedback and statistically significant improvements in key performance indicators underline the app's potential to revolutionise road maintenance practices. The results of the discovery test show that the further integration of digital tools such as OCPremix can lead to great progress in the construction industry, promoting more efficient and sustainable project management practices. The evolution of technology in the construction sector, noting how progress has significantly improved the maintenance process and reduced delays. This mobile application innovation is presented as part of a wider move towards more resilient and environmentally friendly construction practices.

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APPENDIX A

Gantt Chart of Development Application

Month	Week	Dates
SEPTEMBER	W1	(11/09/2023 - 16/09/2023)
	W2	(17/09/2023 - 23/09/2023)
	W3	(24/09/2023 - 30/09/2023)
OCTOBER	W4	(01/10/2023 - 07/10/2023)
	W5	(08/09/2023 - 14/10/2023)
	W6	(15/10/2023 - 21/10/2023)
	W7	(22/10/2023 - 28/10/2023)
NOVEMBER	W8	(29/10/2023 - 04/11/2023)
	W9	(05/11/2023 - 11/11/2023)
	W10	(12/11/2023 - 18/11/2023)
	W11	(19/11/2023 - 25/11/2023)
	W12	(26/11/2023 - 02/12/2023)
DECEMBER	W13	(03/12/2023 - 09/12/2023)
	W14	(10/12/2023 - 16/12/2023)
	W15	(17/12/2023 - 23/12/2023)
	W16	(24/12/2023 - 30/12/2023)
JANUARY	W17	(31/12/2023 - 06/01/2024)
	W18	(07/01/2024 - 13/01/2024)
	W19	(14/01/2024 - 20/01/2023)
	W20	(21/01/2024 - 27/01/2024)
FEBRUARY	W21	(28/01/2024 - 03/02/2024)
	W22	(04/02/2024 - 10/02/2024)
	W23	(11/02/2024 - 17/02/2024)
	W24	(18/02/2024 - 24/02/2024)
MARCH	W25	(25/02/2024 - 02/03/2024)
	W26	(03/03/2024 - 09/03/2024)
	W27	(10/03/2024 - 16/03/2024)
	W28	(17/03/2024 - 23/03/2024)
APRIL	W29	(24/03/2024 - 30/03/2024)
	W30	(31/03/2024 - 06/04/2024)
	W31	(07/04/2024 - 13/04/2024)
	W32	(14/04/2024 - 20/04/2024)
MAY	W33	(21/04/2024 - 27/04/2024)
	W34	(28/04/2024 - 04/05/2024)
	W35	(05/05/2024 - 11/05/2024)
	W36	(12/05/2024 - 18/05/2024)
JUNE	W37	(19/05/2024 - 25/05/2024)
	W38	(26/05/2024 - 01/06/2024)
	W39	(02/06/2024 - 08/06/2024)
	W40	(09/06/2024 - 15/06/2024)

NO.	ITEM	TOTAL DAYS
1	REGISTRATION AT WORKPLACE	
	Find problem on site	
2	RESEARCH INTRODUCTION	
	Definition of Research	
	Epistomology from various perspective	
3	RESEARCH TOPIC	
	Topic related to Civil Engineering	
	Observation 1	
4	RESEARCH TOPIC	
	Topic Related to Civil Engineering	
5	RESEARCH FRAMEWORK	
	Objective	
	Problem statement	
	Scope of Study	
6	RESEARCH FRAMEWORK	
	Objective	
	identify software related to the topic	
7	RESEARCH FRAMEWORK	
	Reseach Literature Review	
8	RESEARCH FRAMEWORK	
	Research Methodology	
	Research Design	
9	RESEARCH PROPOSAL	
	Draft Chapter 1 (Introduction)	
	Draft Chapter 2 (Literature Review)	
	Draft Chapter 3 (Methodology)	
10	RESEARCH PROPOSAL	
	Completing Of Proposal	
11	PROPOSAL PRESENTATION AT PUO	
	PROPOSAL	
	Editing of proposal	
12	PROPOSAL	
	Finalediting of proposal	
13	OBSERVATION	
	2nd Observation & Evaluation	
	Log Book, Appraisal 2	
14	SUBMISSION OF FINAL PROPOSAL	
15	REGISTRATION FOR SEMESTER 8	
	Research about development of application	
	Draft for chapter 3	
	Editing of proposal FYP	
	Chapter 1	
	Chapter 2	
16	DEVELOPMENT OF PRODUCT	
	Programmming of software	
17	FIRST OBSERVATION SEM 8	
	Logbook, Appraisal 1	
	Editing of proposal FYP	
18	DATA COLLECTION	
	Draft questionnaire objective 3	
19	SECOND OBSERVATION SEM 8	
	Logbook, Appraisal 2	
20	DATA COLLECTION	
	Finaltesting	
	Data Analysis	
21	EDITING PROPOSAL FYP	
	Chapter 4	
	Chapter 5	
22	FYP PRESENTATION	
	Preparation FYP seminar presentation	
	FYP Presentation	

APPENDIX B

Questionnaire (Pre-Project)

Feedback of E-OCPremix

Hi everyone, I'm Ummi Athirah Binti Azizan, a final year student in Bachelor of Civil Engineering Technology with Honours , from Ungku Omar Polytechnic. Currently, I am undergoing Work Based Learning (WBL) at THB Maintenance Sdn.Bhd , and at the same time to settle down my Final Year Project (FYP). This Questionnaire aims to identify problems that occur during projects involving the use of premix by focusing on the use of applications to monitor and calculate premix throughout the road maintenance process.

Thank you for participating in this survey. I really appreciate your precious time. Feel free to answer questions.

Section A : Demographic

1. Gender

   Mark only one oval.

   - Male
   - Female

2. Age

   Mark only one oval.

   - 20 - 25
   - 26 - 30
   - 31 - 35
   - 36 -40
   - 40 and above

3. Designation

Mark only one oval.

- Supervisor
- Technical Executive
- Routine Inspector
- State Manager

4. Experience of work.

Mark only one oval.

- < 2 years
- 2 - 5 years
- 6 - 10 years
- > 10 years

Section B : Identify issues in premix usage tracking and monitoring at road construction sites.

5. Did you think calculating premix usage on site is important?

Mark only one oval.

- Yes
- No

6. Is there a designated system or process for tracking premix usage at your construction site?

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ if answer is yes please state.
- ◯ Other: ______________________

7. If there is a problem at the project site due to the use of premix will it cause the project to be delayed?

Mark only one oval.

- ◯ Yes
- ◯ No

8. What is the problems due to delay onsite?

Mark only one oval.

- ◯ Documentation (calculate and monitor premix)
- ◯ Shortages or damaged of material
- ◯ Communication
- ◯ Workers Attitude
- ◯ Shortages or broken machinery

9. Did you think that utilizing a mobile-application could help in tracking premix usage and progress work on-site?

Mark only one oval.

- ◯ Yes
- ◯ No

APPENDIX C

Questionnaire (Post – Project)

Evaluate the effectiveness of Development Application of On-Site Calculation Premix (OCPremix)

"Hello everyone, I'm
Ummi Athirah Binti Azizan, a final year student pursuing a Bachelor of Civil Engineering Technology with Honours at Ungku Omar Polytechnic. Currently, I am undergoing Work Based Learning (WBL) at THB Maintenance Sdn.Bhd, while simultaneously working on my Final Year Project (FYP). This project aims to develop a mobile-based application for onsite premix calculation, progress tracking and data recording. This questionnaire aims to evaluate the effectiveness of the On-Site Calculation Premix (OCPremix) application, which is designed to calculate premix quantities and track progress activities onsite. Your valuable input will help in evaluating the efficiency and practicality of this application in real-world construction scenarios. Here I have included a qr code and a link to a video of the OCPremix application. https://drive.google.com/file/d/10R_TBx-oV1k65E84T2LLYZT5w5gM3nWC/view?usp=sharing. Thank you for participating in this survey. I really appreciate your precious time. Feel free to answer questions.

* Indicates required question

1. Email *

Video of OCPremix mobile-apps.

Section A : **Demorgraphic section**

2. 1. Gender

Mark only one oval.

- Female
- Male

3. 2. Age

Mark only one oval.

- 18-25
- 26-35
- 36-45
- 45 and above

4. 3. Designation

Mark only one oval.

- Supervisor
- Technical Executive
- Engineer
- Asst.Engineer
- Manager
- Other: ____________________

5. 4. Work Experience

Mark only one oval.

- < 2 years
- 2 - 5 years
- 6 - 10 years
- > 10 years

Section B : Evaluate the effectiveness of Using On site Calculation Premix (OCPremix).

Pre Test

7. 1. Existing methods rely on manual calculations that are prone to errors in determining material density resulting in insufficient material consumption and inaccurate use of resources.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

8. 2. Existing methods are reliable methods of tracking project activities, but machinery issues, unprofessionalism, and poor documentation and premix calculations cause project delays.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

9. 3. Existing methods are effective and suitable for modern construction projects.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

10. 4. Existing methods are simply for premix calculation, data collection and project progress tracking using paper and whatsapps.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

11. 5. Existing methods are time-efficient for premix calculation, progress tracking, and on-site data collection.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

12. 6. The existing method is the manual management of calculation data on site making the compilation, analysis and reporting of work progress challenging.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

13. 7. Existing methods can lead to inefficient use of resources, negatively impacting the sustainability of construction practices.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

14. 8. Existing manual calculation methods make it difficult to track real-time progress, causing potential delays in identifying and addressing project site issues.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

15. 9. Existing methods that rely on manual calculations and data collection are ineffective for on-site tasks.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

16. 10. Existing methods are effective on site for tracking progress and calculating premixes.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

Section B : Perspectives on Development of On Site Calculation Premix (OCPremix) application.

Question in below is to determine the effectiveness of development mobile-apps of On Site Calculation Premix (OCPremix).

17. 1. OCPremix application is a digital calculation platform where the material density has been standardized based on design mix, easy to use for faster calculations.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

18. 2. OCPremix application it is easier to track the progress of the project with a simple set of platforms or tasks to communicate the ongoing activities in detail.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

19. 3. OCPremix application is an idea to implement IoT (Internet of Things) in construction for industry 4.0.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

20. 4. OCPremix application is easier for premix calculations, data collection and project progress tracking more systematically.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

21. 5. OCPremix application rapidly increases efficiency in project calculations, progress tracking by providing real-time updates and streamlining data collection.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

22. 6. OCPremix application is automated in data management, analysis and reporting of calculation results on site.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

23. 7. Using OCPremix apps on site promotes environmentally responsible practices and improves the sustainability of construction projects.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

24. 8. OCPremix application usage can monitor the Progress of premix calculations and be tracked in real time on site.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

25. 9. OCPremix application is more systematic for data calculation and easier to track information

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

26. 10. OCPremix app makes it easier to track work progress and calculations digitally.

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

Section C : Recommendation

Please write your answer.

27. Please give some recommendation for improvement regarding "On Site Calculation Premix" (OCPremix) to calculate premix and tracking progress work on site. *

APPENDIX D

Coding Development Application

```
{
  "expo": {
    "name": "e-ocpremix",
    "slug": "e-ocpremix",
    "version": "1.0.0",
    "orientation": "portrait",
    "icon": "./assets/images/icon.png",
    "scheme": "myapp",
    "userInterfaceStyle": "automatic",
    "splash": {
      "image": "./assets/images/splash.png",
      "resizeMode": "contain",
      "backgroundColor": "#ffffff"
    },
    "ios": {
      "supportsTablet": true
    },
    "android": {
      "adaptiveIcon": {
        "foregroundImage": "./assets/images/adaptive-icon.png",
        "backgroundColor": "#ffffff"
      },
      "package": "com.voidpih.ocpremix"
    },
    "web": {
      "bundler": "metro",
      "output": "static",
      "favicon": "./assets/images/favicon.png"
    },
    "plugins": [
```

```
      "expo-router",
      "expo-secure-store"
    ],
    "experiments": {
      "typedRoutes": true
    },
    "extra": {
      "router": {
        "origin": false
      },
      "eas": {
        "projectId": "229dea36-51c6-4e5b-8d7d-cf2254287c1e"
      }
    }
  }
}
```

……………………………………………………………………..

```
import { Redirect, Stack } from 'expo-router'

import { Loading } from '@/components/Loading'
import { LogoutButton } from '@/components/LogoutButton'
import { useAuth } from '@/providers/AuthProvider'
import { ProjectProvider } from '@/providers/ProjectProvider'

export default function AppLayout() {
  const { session, isLoading } = useAuth()

  if (isLoading) return <Loading />

  if (!session) {
```

```
    return <Redirect href='/(auth)/sign-in' />
  }

  return (
    <ProjectProvider>
      <Stack screenOptions={{ statusBarStyle: 'dark' }}>
        <Stack.Screen
          name='index'
          options={{ title: 'Home', headerRight: () => <LogoutButton /> }}
        />
        <Stack.Screen name='projects' options={{ headerShown: false }} />
        <Stack.Screen name='new' options={{ headerShown: false }} />
      </Stack>
    </ProjectProvider>
  )
}
```

……………………………………………………………………

```
import { Stack } from 'expo-router'

export default function ProjectLayout() {
  return (
    <Stack>
      <Stack.Screen name='index' options={{ title: 'Project' }} />
      <Stack.Screen name='step2' options={{ title: 'Premix' }} />
      <Stack.Screen name='step3' options={{ title: 'Premix' }} />
      <Stack.Screen
        name='calculate-premix'
        options={{ title: 'Calculate Premix' }}
      />
      <Stack.Screen
```

```
        name='description-of-work'
        options={{ title: 'Description of Work' }}
      />
      <Stack.Screen name='data-analysis' options={{ title: 'Data Analysis' }} />
      <Stack.Screen name='view-premix' options={{ title: 'View Premix' }} />
      <Stack.Screen name='record-work' options={{ title: 'Record Work' }} />
    </Stack>
  )
}
```

……………………………………………………………..

```
import { CalculatePremixForm } from '@/components/CalculatePremixForm'
import { colors } from '@/constants/colors'
import { StyleSheet, View } from 'react-native'

export default function CalculatePremixScreen() {
  return (
    <View style={styles.container}>
      <CalculatePremixForm />
    </View>
  )
}

export const styles = StyleSheet.create({
  container: {
    flex: 1,
    backgroundColor: colors.background,
  },
})
import { CalculatePremixForm } from '@/components/CalculatePremixForm'
import { colors } from '@/constants/colors'
```

```
import { StyleSheet, View } from 'react-native'

export default function CalculatePremixScreen() {
  return (
    <View style={styles.container}>
      <CalculatePremixForm />
    </View>
  )
}

export const styles = StyleSheet.create({
  container: {
    flex: 1,
    backgroundColor: colors.background,
  },
})
```
…………………………………………………….

```
import { DescriptionOfWorkForm } from '@/components/DescriptionOfWork'
import { colors } from '@/constants/colors'
import { StyleSheet, View } from 'react-native'

export default function DescriptionOfWorkScreen() {
  return (
    <View style={styles.container}>
      <DescriptionOfWorkForm />
    </View>
  )
}

export const styles = StyleSheet.create({
```

```
  container: {
    flex: 1,
    backgroundColor: colors.background,
  },
})
```

…………………………………………..

```
import { View, StyleSheet } from 'react-native'
import { NewProjectForm } from '@/components/NewProjectForm'
import { colors } from '@/constants/colors'

export default function NewProjectScreen() {
  return (
    <View style={styles.container}>
      <NewProjectForm />
    </View>
  )
}

const styles = StyleSheet.create({
  container: {
    flex: 1,
    backgroundColor: colors.background,
  },
})
```

………………………………………………….

```
// import { RecordWork } from '@/components/RecordWork'
import { colors } from '@/constants/colors'
import { StyleSheet, ScrollView } from 'react-native'

export default function RecordWorkScreen() {
```

```
  return (
    <ScrollView style={styles.container}>{/* <RecordWork /> */}</ScrollView>
  )
}

export const styles = StyleSheet.create({
  container: {
    flex: 1,
    backgroundColor: colors.background,
  },
})
```