POLITEKNIK UNGKU OMAR

DEFECT MONITORING MOBILE APPLICATION (e-DM)

FATIN AMEELIA BINTI MOHAMAD A'ZEMI

(01BCT21F3004)

CIVIL ENGINEERING DEPARTMENT

SESSION II 2023/2024

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

CIVIL ENGINEERING DEPARTMENT

SESSION II 2023/2024

DECLARATION OF ORIGINAL AND OWNERSHIP

DEFECT MONITORING MOBILE APPLICATION (e-DM)

1. **FATIN AMEELIA BINTI MOHAMAD A'ZEMI (NO.KP: 980520-08-5850)** am a student of **Bachelor of Civil Engineering Technology, in Politeknik Ungku Omar,** at the address **Jalan Raja Musa Mahadi, 31400 Ipoh, Perak**

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

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

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APPRECIATION

In the name of Allah SWT, the Most Gracious and Merciful, peace and blessings be upon Prophet Muhammad SAW, his family, and his chosen friends. First and foremost, I want to express my heartfelt gratitude to Allah for His kindness and guidance, which has enabled me to complete my report "Defect Monitoring Mobile Application (e-DM)".

Thank you to my family for never failing to support me. They were always encouraging and praying for me during my studies. This thesis is wholeheartedly dedicated to my mother, Puan Fadilah and my fiancé, Muhamad Shadzmie who took lead in everything. Next, I'd like to express my heartfelt gratitude to my academic supervisor, Ts. Dr. Sunitha V. Doraisamy, without her kind direction and proper guidance, this project would have been a little less successful. Her oversight and assistance throughout the process ensured that this report was completed successfully.

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Thank you.

ABSTRAK

Industri pembinaan di Malaysia menghadapi cabaran dalam mengenal pasti dan mengurus kecacatan, yang boleh memberi kesan kepada kejayaan projek, kos dan kepuasan pelanggan. Kajian mengenai Sunway Flora, Bukit Jalil mendedahkan isu pembinaan yang lazim di kawasan itu, yang memerlukan pemantauan kecacatan untuk pengenalpastian dan penyelesaian. Penyepaduan teknologi maklumat dalam industri pembinaan global telah mempercepatkan isu ini. Pemantauan kecacatan ialah proses sistematik untuk mengenal pasti, mendokumenkan dan mengurus kecacatan, dan penting untuk kualiti dan keselamatan projek. Sebuah projek bertujuan untuk membangunkan aplikasi mudah alih pemantauan kecacatan (e-DM) menggunakan React Native dan Supabase, boleh diakses oleh pelbagai pihak berkepentingan. Kajian menggunakan Model Penerimaan Teknologi (TAM) untuk menganalisis tingkah laku dan keutamaan pengguna untuk kerja pemantauan kecacatan. E-DM memudahkan tugas manusia dengan menyediakan kemas kini masa nyata pada peranti mudah alih, menggantikan kaedah tradisional dan menangani data yang terlepas atau hilang. Kajian mendapati bahawa e-DM adalah jauh lebih mudah daripada kaedah semasa, mengatasi kaedah semasa dari segi keberkesanan.

KATA KUNCI: Pembinaan, Kecacatan, Pemantauan, Aplikasi, Keberkesanan

ABSTRACT

The construction industry in Malaysia faces challenges in identifying and managing defects, which can impact project success, costs, and customer satisfaction. The study on Sunway Flora reveals prevalent construction issues in the area, necessitating defect monitoring for identification and resolution. The integration of information technology in the global construction industry has accelerated this issue. Defect monitoring is a systematic process for identifying, documenting, and managing defects, and is crucial for project quality and safety. A project aims to develop a defect monitoring mobile application (e-DM) using React Native and Supabase, accessible to various stakeholders. The study uses the Technology Acceptance Model (TAM) to analyze user behavior and preferences for defect monitoring work. The e-DM simplifies human tasks by providing real-time updates on mobile devices, replacing traditional methods and addressing data overlooking or loss. The study found that e-DM was significantly easier than the current method, outperforming the current method in terms of effectiveness.

KEYWORDS: Construction, Defect, Monitoring, Application, Effectiveness

LIST OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

QA	Quality Assurance
QAS	Quality Assessment System
QLASSIC	Quality Assessment System in Construction
CIDB	Construction Industry Development Board
CIS	Construction Industry Standard
CASC	Construction Assessment Centre
CREAM	Construction Research Institute of Malaysia
DLP	Defect Liability Period
TAM	Technology Acceptance Model
PU	Perceived Usefulness
PEOU	Perceived Ease of Use
IU	Intention to Use

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The acknowledgement of the construction industry's significance on economic growth in Malaysia dates back to the early years of independence, when the industry was characterized by limited technological advancements and a predominant reliance on handicrafts (Kamal et al., 2012). In contemporary times, the building industry has emerged as a prominent sector within the Malaysian economy. Nonetheless, in relation to other sectors such as services, industry, and agriculture, it remains a relatively minor component. In accordance with the national strategic plan outlined in 1990, Malaysia aspired to transition from a developing nation to a vibrant, prosperous, resilient, competitive, and dynamic country by the year 2020. The construction sector plays a significant and vital role in enhancing the economy due to its dynamic nature and its interconnectedness with several other sectors (Chia et al., 2014; Khan et al., 2014;Berawi et al., 2019). In contemporary times, the construction sector in Malaysia has witnessed significant advancements in terms of progress, modernization, efficiency, and equipment. This has enabled Malaysian construction firms to explore the potential advantages of undertaking complex and extensive infrastructure projects through the utilization of modern and advanced methodologies (Khan et al., 2014).

Construction defects are consistently a primary concern within the construction sector. Various designed facilities produce distinct sorts of flaws and necessitate varying levels and forms of quality, contingent upon factors such as its role, system, type, and materials employed. Numerous solutions have been devised with the aim of mitigating flaws during the process of construction operations. The global construction industries are seeing continuous growth and advancement due to the integration of information

technology in recent years. Construction defects have emerged as a significant global concern for practitioners and researchers worldwide. The presence of defects can have a substantial impact on the overall success of a construction project. More precisely, it exerts a significant influence on the expenses incurred during construction, the duration of the construction process, as well as the productivity and sustainability aspects, all of which ultimately affect customer satisfaction. The circumstances surrounding construction are subject to continual fluctuations.

In order to achieve success, it is imperative for companies to engage in a process of ongoing development and improvement. The implementation of modifications should be grounded in a comprehensive understanding of the surrounding environment as well as one's own professional endeavors. In this particular scenario, it is vital to possess a comprehensive understanding of the characteristics and properties of the errors that have transpired. By possessing such knowledge, it becomes possible to implement effective measures aimed at enhancing the process.

1.2 PROBLEM STATEMENT

According to Yacob et al. (2019), construction defects are a common issue encountered by the majority of buildings, irrespective of their construction techniques or age. However, the occurrence of these defects in contingent upon the underlying causes and contributing variables. The significance of several construction defects has been proven, and their relevance to building maintenance is acknowledged (Tayeh et al., 2020). architectural design errors, manufacturing defects, the use of substandard materials, inappropriate material usage, non-compliance with the design by contractors, or a combination of these problems can lead to construction defects (Ahzahar et al., 2011). In addition, Waziri (2016) found that certain building issues might be attributed entirely or substantially to readily identifiable construction defects that could have been anticipated and hence prevented. Multiple causal factors have been identified in various research. Therefore, the present study aimed to gather these rationales and categorise them into several groups based on their origins.

The study has centered on Sunway Flora and has revealed construction problems as a prevalent issue in this area. Through defect monitoring, multiple issues have been identified based on observations. The precise location or position of the building with

problems is not disclosed. This issue prevents the subcontractors and workers from receiving information with accuracy and efficiency. Furthermore, the main contractor fails to adequately specify the specific deficiencies and there is a lack of clarity regarding the scoring criteria for defects that require monitoring. The sub-contractors lack clarity regarding the specific scoring details for defect assessment. Furthermore, the person in charge does not receive timely information about the problems, while the subsequent person in charge lacks adequate details about the defects.

1.3 OBJECTIVE

The objectives of this project are:

a. To identify the defects issues in construction site at Sunway Flora.
b. To develop the apps for defects monitoring.
c. To validate the efficiency of the developed apps with industrial experts.

1.4 SCOPE OF STUDY

The study's scope is at the Sunway Flora project's construction site, as indicated in Figure 1.0. This project focuses on construction site inspection and defect monitoring. This project is not particular to Quality Assurance (QA), it can also be accessed by project manager, project engineer, sub-contractor, documents controller, consultant, and others. The material that will be used in the application development are React Native and Supabase. These materials are the system that will produce an application.

Figure 1.0 Sunway Flora Bukit Jalil (Source: Autodesk Construction Cloud Sunway Flora)

This study focuses on making it easier for engineers and workers to handle defects inspections on site. Defects inspection is performed during the construction process to identify and assess defects and issues, assuring the reliability and safety of the building or structure. For the users that will use the application are the experts from Sunway Flora itself including the Project Manager, Quality Assurance Engineer, Site Engineer and Site Supervisor.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The literature review is a crucial component of a study, as it serves to clarify the fundamental procedures or conduct a component analysis of a research issue. In this study, the subsequent literature review will make a logical connection between the research to be conducted and prior findings and analyses.

In the last two decades, there has been a notable transition in the construction industry from manual methods to computer aided approaches for knowledge processing. The forthcoming chapter will center its attention on the concepts and theories pertaining to continuous learning. Furthermore, this chapter will encompass a comprehensive overview of project monitoring technology, providing essential background knowledge. The acquisition of relevant data is essential for the creation of writing of superior quality. Both print and electronic media are accessible for obtaining information. Print media sources encompass a wide range of materials such as books, journals, articles, reports, and news publications that provide information on current events. On the other hand, electronic media sources mostly consist of websites accessible through the internet.

2.2 CONSTRUCTION INDUSTRY

In the construction industry, it is customary to adhere to a project-based structure, wherein projects are begun, thoroughly organized, implemented, and finally completed within scheduled time and financial constraints. A variety of stakeholders, encompassing architects, engineers, contractors, subcontractors, and laborers, engage in collaborative efforts to effectively execute a construction project (Abbasnejad et al., 2021). The construction industry acknowledges the importance of enhancing the integration,

planning, and management of its massive manufacturing operations to align with the global market. This includes adopting an open construction system, embracing new economic trends, and implementing standardized goods. The government recognizes the significance of fostering a proficient construction industry propelled by technical advancements in the manufacturing and service sectors, which can make substantial contributions to the sector's economy. According to Ngowi et al., (2005) , the expansion of multinational operations in the construction industry has played a significant role in the globalization of the sector.

The industry has a high degree of growth, which is determined by several factors such as economic instances, technology developments, regulatory constraints, and societal needs. Construction projects encompass a sequence of distinct stages, commencing with the conceptualization and design phase, followed by procurement, construction, and concluding with post-construction evaluation. During the various stages of a project, it is essential to provide good project management, implement appropriate safety measures, and comply to building rules and laws (Dang & Sui Pheng, 2015). Because of its diversity, the construction industry contributes significantly to economic growth, employment creation, and community development. Nevertheless, the industry is confronted with various obstacles related to issues such as project schedule disruptions, budgetary excesses, concerns over safety, and adverse effects on the environment. Consequently, this industry undergoes constant evolution, integrating new technologies and methodologies to improve the effectiveness, environmental friendliness, and safety of construction procedures (Tafesse et al., 2022).

2.3 DEFECTS OF BUILDING CONSTRUCTION

Webster's Dictionary says that a defect is a lack of something that is needed to make something whole, a shortcoming. A defect, mistake, or blotch is another way to describe it. A deficiency is another word for a defect. The word "deficiency" in Webster's Dictionary implies "a state or quality of being deficient" or "a shortage; deficit." Deficient means wanting or missing something that is needed to make something whole; faulty and one that is deficient. A defect is "the failure of a component to meet a standard of a certain characteristic" (Ahzahar et al., 2011). Any problem that lowers the value of a house,

condo, or building can be called a building defect. Building defects can be caused by an architect's oversight in the design, a flaw in the making process, poor materials, incorrect methods of using or installing the materials, the contractor not following the design, or a mix of these things. The occurrence of the defect would not only result in aesthetic issues but also compromise the safety of the consumers (Che-Ani et al., 2011).

In addition, faults might be defined as being imperfect, faulty, or blemished. Defect, in another sense, refers to a deficit that falls short of fulfilling its anticipated performance criteria. The Webster Dictionary defines inadequacy as a factor that will negatively impact the quality. A construction fault can be described as any condition that diminishes the value of residential structures or homes and poses a threat to residents if left unaddressed (Ahzahar et al., 2011). Structure defects that cause cracks or collapse, undesirable electrical wiring and/or lighting, bad plumbing, inadequate or fractured drainage systems, inadequate or fractured ventilation, cooling, or heating systems, inadequate insulation or soundproofing, and inadequate fire protection or suppression systems are some of the most common types of building defects. A building defect could also cause dry rot, wood rot, mold, fungus, or an infestation of termites or other pests. Earth settlement or land movement-related damage to a building are also problems (Shah Ali, 2011). Most of the time, hiring and testifying of a highly skilled and experienced expert is needed to prove a building defect. An expert, like an engineer or architect, will be able to tell if a problem in a building is caused by bad design, materials, or work.

2.4 TYPES OF CONSTRUCTION DEFECTS

The construction industry is primarily concerned with construction faults. Buildings with varying construction methods, systems, and materials can result in different sorts of flaws and requirements at different stages of a construction project. The quality of the building is also influenced by its function. Several solutions have been developed to mitigate building problems. The cost of defects refers to the amount of resources spent on rectifying errors. Several variables, such as time, materials, and equipment, are assessed during the construction process in order to rectify any flaws. Valuable time is wasted throughout the process of redoing tasks. A faulty construction

job not only adds to the overall expenses of the project, but also entails the cost of maintenance, which must be considered. The faulty construction, which could potentially result in total structural failure. The construction business worldwide is rapidly modernising, advancing, and expanding due to technological advancements (Sellakutty, 2017).

2.4.1 Structural Defects

Structural defects refer to any imperfections found in the structural components of a structure, which can be attributed to defective design, poor workmanship, faulty materials, or a combination thereof. The construction of a building encompasses various components, such as earth retaining walls, columns, beams, and flat slabs. Structural flaws encompass several types of fissures, including those seen in foundations, floors or slabs, and walls. The majority of structural issues can be mitigated through the explicit and comprehensive incorporation of design and planning elements (Ahzahar et al., 2011). The occurrence of structural faults in a structure can be attributed to various factors such as the gradual process of degradation, the effects of wear and tear, excessive loading, and inadequate maintenance practices. In order to preserve the structural integrity of the building and mitigate the risk of future malfunctions, it is imperative that necessary repairs be undertaken. The regular examination of a building's structure is essential for safeguarding its overall integrity. Common structural defects include steel corrosion, the formation of cracks, and deflection (Tayeh et al., 2020).

Structural defects are abnormalities that arise within the framework of a building because of flawed design, poor workmanship, the utilization of poor materials, or occasionally a combination thereof. The architectural composition comprises many elements, including a retaining wall, beams, columns, and flat slabs. Many types of structural defects can be classified into various classifications, including cracks detected in the foundation, cracks observed in walls, and cracks present in floors and slabs. These defects may arise due to inadequate soil conditions, poor design, and the utilization of poor materials. The majority of structural issues can be mitigated through effective design and

thorough planning (Lee et al., 2018). Structural deficiencies in buildings may arise because of factors such as normal usage, progressive deterioration, excessive loads, and inadequate maintenance practices. In order to mitigate the risk of future building failure, it is essential to conduct frequent inspections and perform necessary repair work. One common issue that consistently arises in building structures is the occurrence of steel corrosion, cracks, and deflection (Ilozor et al., 2004).

2.4.2 Non-Structural Defects

According to Alomari (2022), when non-structural parts of a building are built inadequately, it can cause problems with the structural parts of the building. Non-structural flaws are the name for these kinds of problems. Non-structural defects refer to the occurrence of flaws in the non-structural elements of a building, such as issues in brickwork, relative humidity in older constructions, and issues with plasterwork.

2.5 SCORING

Quality in the construction industry is crucial for ensuring the personal satisfaction of the customers. Consequently, quality in construction industries should be consistently enhanced, contributing to the industry's and Malaysia's rapid growth and development. As an outcome, it is essential to continuously enhance the quality of work within the building and construction industry by developing a quality management system or a quality evaluation system. The Quality Assessment System (QAS) in the construction industry in Malaysia is known as (QLASSIC), and it was established by the Construction Industry Development Board (CIDB) (CIDB,2020).

The CIDB defines QLASSIC as a system or method for measuring and assessing the quality of construction work based on the Construction Industry Standard (CIS 7:2014), which is similar to standards used for construction projects in achieving quality results. The primary motivation for QLASSIC is to improve the quality of Malaysia's construction industry. QLASSIC was originally introduced in Malaysia in 2006 in order

to objectively compare the quality of workmanship amongst building projects using a score system. Buildings that can be accessed with QLASSIC include landed homes, stratified housing, public buildings such as offices and schools, as well as noteworthy buildings such as hospitals and airports, among others (Azir et al., 2018).

QLASSIC defines the standard for the quality of workmanship for various building construction components. Marks are assigned depending on the amount of compliance with the standard (CIS 7:2014) to which the workmanship adheres, and these marks are added together to compute the QLASSIC Score (%) for the building job. Because assessing all components in a building project is impossible, the assessment via QLASSIC employs a sample method for this task (Azir et al., 2018). A delegate from the Construction Assessment Centre (CASC), a unit under the Construction Research Institute of Malaysia (CREAM) that manages the QLASSIC assessment activities, will decide on the nature and size of the components or areas (i.e. samples) to be assessed prior to conducting the assessment. The samples must reflect the activities and work completed throughout the project and must be drawn from the designs and plans of the applicable construction project. For the assessment, all parts of the construction project must be accessible (Ashraf & Fateh, 2022).

2.6 APPLICATION

The growing interest in modern construction methods and new technologies has led the construction industry to explore ways to embrace innovative ideas and actively participate in new methods to enhance their practices. Extensive research has been conducted to explore the application of various technologies within the construction industry. Nevertheless, an extensive knowledge of new and developing technologies that have demonstrated advantageous outcomes for construction undertakings is still lacking. This research seeks to fix the existing knowledge gap by presenting an overview of the technologies that have been implemented within the construction industry, along with an analysis of the advantages that are linked to their adoption (Chen et al., 2022).

The construction industry is witnessing an increasing inclination towards the integration of new technologies in the domains of design and construction. This shift is

primarily driven by the need to address cost reduction, enhance efficiency, productivity, safety, and achieve sustainability objectives (Loosemore, 2014). Sepasgozar & Davis (2018) define construction technology as a collection of innovative tools, machinery, and adaptations that facilitate accomplishing of objectives, execution of specific tasks, or resolution of challenges. According to Duncan et al (2018), the use of technologies can offer effective approaches in meeting present and future demands, as well as improving performance and productivity within the construction industry.

2.6.1 Supabase

An open-source backend-as-a-service (BaaS) platform called Supabase gives programmers a set of tools for creating and scaling applications. Developers can create, administer, and interact with relational databases with ease thanks to Supabase's PostgreSQL database. It offers database-integrated functionality including authorization, authentication, and real-time changes. With support for many login options like email and password, OAuth providers (like Google and GitHub), and third-party authentication systems, it comes with integrated user management and authentication services. Because of Supabase's real-time features, apps may be updated as soon as data in the database changes. This is especially helpful for apps that need real-time data updates, like chat programmes or dashboards. Developers can store, manage, and serve files like documents, movies, and photographs with its scalable file storage options. Without requiring significant backend programming, Supabase automatically creates RESTful APIs for the database, making it simple to integrate with frontend apps (Rosich, 2022). Like AWS Lambda, Supabase enables serverless functions, which let developers run code on demand in response to different triggers. Supabase is a developer-friendly design that makes development easier by integrating nicely with common frontend frameworks and tools. Supabase is well-known for offering a feature-rich backend solution that is simple to set up and expand, especially for developers who want to manage and deploy their apps fast without having to worry about the complicated details of backend infrastructure (Hoang, 2024).

2.6.2 React Native

Facebook created the open source React Native framework to let developers create mobile applications with React and JavaScript. It enables developers to use a single codebase to create cross-platform apps for both iOS and Android. React Native cuts down on development time and effort by allowing developers to create code only once and have it run on both the iOS and Android platforms. Native components are used in React Native applications, guaranteeing excellent performance and a user experience that is almost identical to that of native development tool applications. Because of React Native's component-based architecture, developers may create encapsulated components that independently maintain state. Because these parts can be utilized repeatedly throughout the application, the code is more scalable and manageable. With the help of this functionality, developers may examine the effects of their most recent code changes right away without having to completely rebuild the application (Dekkati et al., 2019). This gives quick feedback, which speeds up the development process. Developers using React Native are part of a sizable and vibrant community. Several libraries and tools in this ecosystem can be integrated into React Native projects, which simplifies the addition of complicated functionality by avoiding the need to create them from the ground up. React Native supports native code integration even though its goal is to address most JavaScript use cases. This gives developers the freedom to use native libraries and APIs by enabling them to create bespoke native modules as needed (Kaushik et al., 2018.).

2.7 DEFECT LIABILITY PERIOD (DLP)

The term "defect liability period" refers to a specific timeframe within which clients have the right to seek compensation or require the owner or developer to rectify any faulty construction discovered in the finished building after the handover of the completed dwelling units. The duration of the defect liability period spans a period of 24 months commencing from the date of the conveyance of vacant possession. If any faulty

construction is observed during this timeframe, the client has the right to seek reparation and compensation, or alternatively, demand that the vendor developer rectifies the problematic construction (Hilal et al., 2015).

The Defect Liability Period (DLP), which is also known as the warranty period or the rectification period, is a set amount of time after the end of a construction project during which the contractor is responsible for fixing any problems or grievances that may come up. The contractual agreement between the client (either the owner or developer) and the contractor frequently specifies the inclusion of this particular timeframe. During the Defect Liability Period, it is the contractor's responsibility to address any defects, faults, or issues that arise in the construction process. This entails returning to the site and undertaking the required repairs or corrections without imposing any additional charges on the client (Hilal et. al, 2015).

The primary objective of the Defect Liability Period (DLP) is to make sure that the deliverables adhere to the predetermined standards and requirements. The duration of the defect liability period is subject to variation and is typically stipulated within the construction contract. The duration of this phase typically spans one year, although its length may vary based on the specific project and the negotiated agreements between the concerned parties. Upon the expiration of the defect liability period, it is customary for the contractor to be relieved of the responsibility to rectify flaws without incurring any additional expenses. Any subsequent difficulties that arise may be subject to distinct contractual agreements or warranties (Hasim & Tabassi, 2015).

2.8 SUMMARY

The literature review is crucial in directing research and connecting it to existing knowledge. Construction projects involve multiple stakeholders, including architects, engineers, contractors, subcontractors, and laborers. Building defects can be caused by oversights, construction process deficiencies, substandard materials, improper procedures, or contractor failures. The construction sector is increasingly adopting contemporary methodologies and technology, but there is a lack of understanding about emerging technologies that have shown positive results in construction. This study aims

to fill this gap by examining the technologies used in the construction sector and evaluating their advantages.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter will provide an explanation of the methodology employed in this study. The chapter will thoroughly discuss each stage of the study process, involving the population, population frame, and methodologies employed for selecting the interview sample. The chapter concludes by providing a thorough review of the selected analytical approach and the methodology applied to collect the data.

This chapter will comprehensively discuss the various stages involved in the study process, encompassing the identification of the population, determination of the population frame, and selection of the interview sample methodologies. The chapter concludes with an elaborate examination of the selected method of analysis and the approach utilised to gather the data. The implementation of the observation would be carried out during the course of employment in order to evaluate the feasibility of the application. This chapter also includes a demonstration of the idea of simulation. The utilisation of primary and secondary sources will enhance the project's overall efficiency. This initial source has been subjected to surveys and observations. The information is derived from the process of gathering and analysing data for the secondary source.

The paper will provide a comprehensive explanation of the ways to be employed, taking into consideration the challenges involved. Additionally, it will discuss the selection of suitable systems within the chosen platform. The main objective of this study is the current study, which includes relevant work, references, interviews, interpersonal exchanges, and other significant variables.

3.2 RESEARCH METHODOLOGY

The research methodology conventionally refers to a structured flowchart that provides a guiding framework for the research process. The research process commences with identifying the research problem or question under investigation and thereafter undertaking a detailed review of the current literature related to the subject matter. In the meantime, the researcher proceeds to establish the research objectives and constructs precise research questions or hypotheses in order to effectively tackle the identified problem. The selection of a suitable research design is thereafter made, with careful consideration given to issues such as the fundamental features of the study problem and the resources that are currently accessible. The process of determining the appropriate sample size and selecting a proper sampling technique is crucial in order to obtain data from a representative sample.

Various data gathering approaches, including surveys, interviews, observations, experiments, and document analysis, are utilised to get accurate data. After the collection of data, it is subjected to analysis employing suitable statistical or qualitative methodologies. The results are subsequently analysed in connection with the research inquiries or hypotheses. Conclusions are derived from the available evidence, serving to briefly summarise the primary findings of the research. Ultimately, the findings are made available via a research report, academic article, or a speech. It is important to acknowledge that the flowchart utilised in a research endeavour might differ depending on factors such as the field of study, the chosen methodology, and the specific objectives of the project (Roopa & Rani, 2012). Consequently, certain elements within the flowchart may overlap or necessitate repeated iterations throughout the course of the research process. The illustration of a Flow Chart in the context of Research Methodology is depicted in Figure 3.1 (Abbasian-Hosseini et al., 2014).

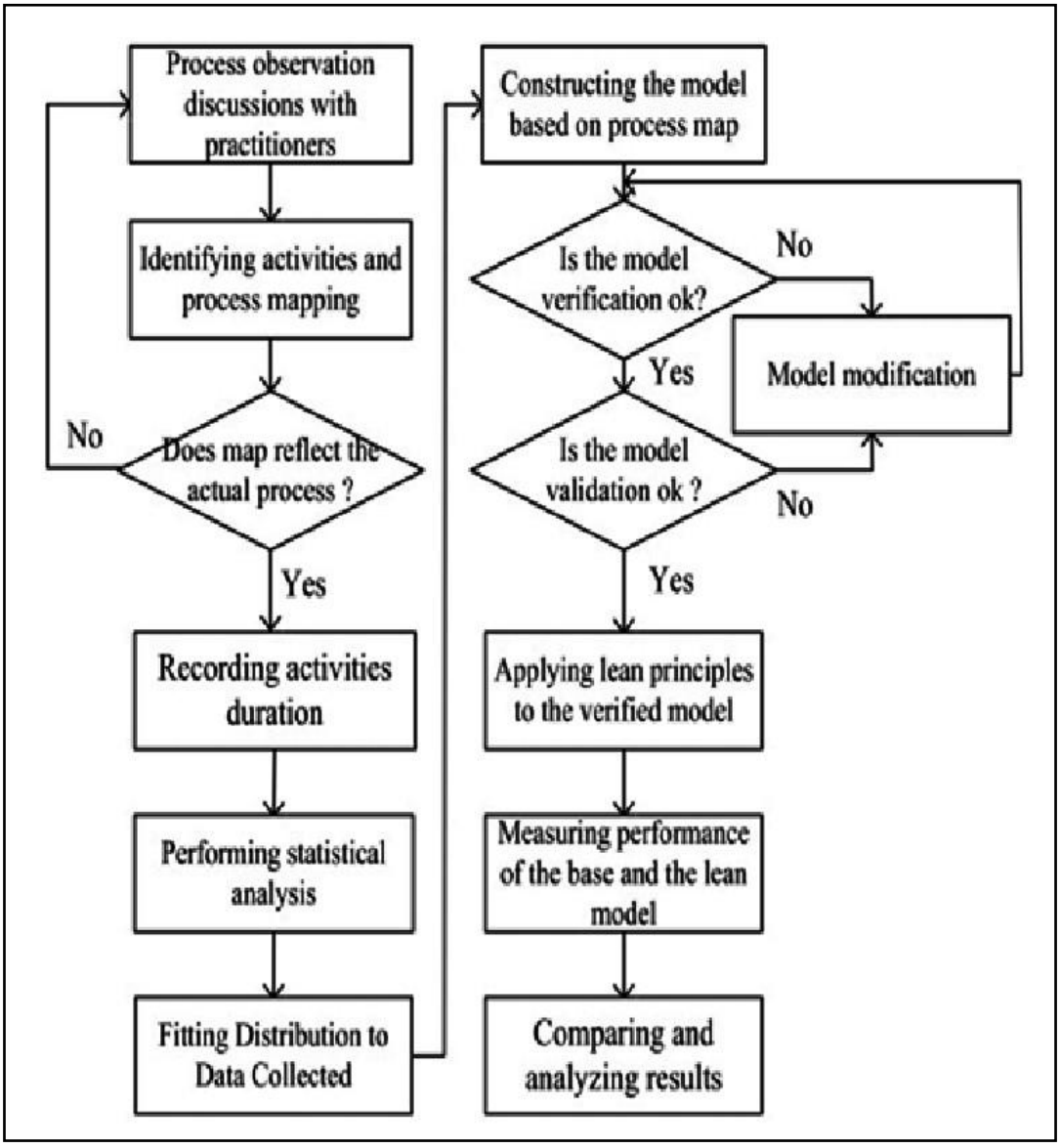


Figure 3.1 Flow Chart in Research Methodology

The methodology of e-DM is shown in Figure 3.2 using a flow chart. The purpose of this strategy is to effectively achieve the goals of the projects and produce the most favorable results. This study will provide a detailed description of the exact research methodology utilized. This chapter will address the various components associated with the execution of the research, encompassing the target population, population frame, and the sampling methodologies employed for the interviews. Furthermore, this study will present a thorough elucidation of the selected analytical approach and the employed data

gathering methodology, so providing in-depth understanding of the research procedures (Goundar, 2019).

Throughout the process of executing the mission, several observations will be conducted in order to evaluate the practicality and viability of the application. The forthcoming chapter will incorporate the utilization of concept simulation as a means to provide more clarification and exemplification of the topics presented. In order to improve the project's value, a blend of primary and secondary sources will be employed. The utilization of questionnaires and observations constitutes the primary sources in this study. On the other hand, secondary sources involve the acquisition and examination of pre-existing data. The integration of primary and secondary sources is intended to offer a thorough and balanced viewpoint for the project (Patel, 2019).

In addition, this study will comprehensively outline the methods that need to be utilized, which will be determined in accordance with the discovered issues. The process of selecting appropriate systems for implementation within the platform will also be explained. The primary objective of this study is to expand upon the existing body of research and sources, including records, interviews, interactions, and other relevant information (Goundar, 2019). These sources will facilitate the development of a comprehensive knowledge of the subject matter and assist in making well-informed decisions according to the selected methods and systems for implementation.

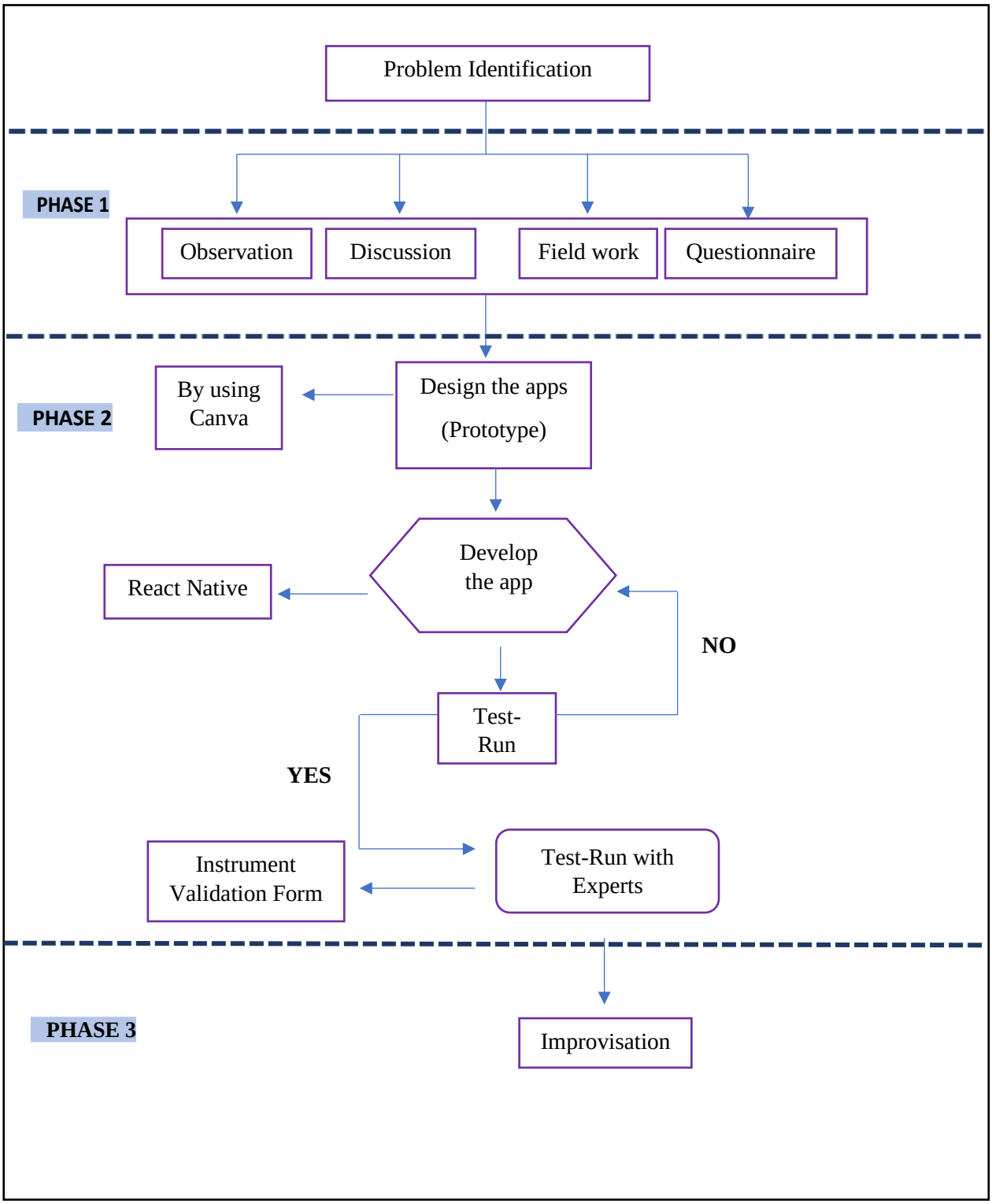


Figure 3.2 Flow Chart Methodology of e-DM

3.3 IDENTIFICATION OF DEFECT MONITORING

The approach of defect monitoring is of utmost importance as it involves the systematic identification, documentation, and management of defects or difficulties. It is essential to establish a widely recognised and consistent structure for defect reports, including essential elements such as full instructions for reproducing the issue, accurate assessment of its severity, and appropriate determination of its priority. Defects are categorised based on their status and scoring in order to enhance efficiency and facilitate the resolution of issues.

A well-defined workflow is established for the resolution of defects, covering the entire process from identification to verification. Notification systems were developed with the purpose of informing the team members in the case of a new reported defect or a change in status. Through the implementation of a thorough defect monitoring procedure, teams are able to immediately detect and resolve errors, thereby guaranteeing the delivery of software of superior quality. Effective defect monitoring strategies require regular communication, teamwork, and a steadfast dedication to ongoing development.

3.3.1 Observation

The observation and monitoring of flaws on a building site are of paramount importance in ensuring the overall quality and safety of the project. Site inspections are often scheduled to view and monitor the progress of construction activities. While conducting observations at Sunway Flora, several concerns arose during the construction phase. The primary goal of observation is to comprehend a situation by the process of directly observing it. This strategy is the initial stage in acquiring information regarding the problems that have occurred. Upon completion of the observation, it has been determined that the primary concerns at the site pertain to defects. Defect monitoring necessitates extensive labour and paperwork. The need is in ensuring the effectiveness of communication tools in the efficient reporting and resolution of defects. Construction work is verified to ensure they are in compliance with the authorized plans and specifications. The task at hand involves the monitoring and assessment

of the quality of materials being utilized, with the objective of ensuring their compliance with predetermined standards. The task of conducting defect monitoring on a construction site requires careful consideration to detail and an optimistic outlook towards resolving issues. Regular and comprehensive observations play an essential part in enhancing the overall effectiveness of construction projects. By shortly identifying and addressing problems, these observations assist to the development of a final product that is both of high quality and safe for use.

3.3.2 Discussion

Some discussion with an industrial mentor was conducted to identify and address the primary concerns at the site. There has been some opinion regarding the defect issues, primarily targeting the QA team, operation team, sub-contractors, and workers. The monitoring of defects at a construction site is a key part in providing the overall quality, safety, and accomplishment of a construction project. The process involves the thorough identification, monitoring, and resolution of defects or concerns that may develop throughout the construction process. The practice of defect monitoring plays an essential part in upholding the quality standards of construction projects. By rapidly identifying and resolving any problems, the construction team may effectively ensure that the outcome not merely fulfilled but also surpasses the required criteria. The query evaluation of defects acts an important function in the mitigation of risks that are built into construction projects. Furthermore, the timely resolution of issues serves to mitigate their potential development into more significant challenges that may have adverse effects on the project's scheduling and budgetary constraints. The process of monitoring defects at a building site is a complex and ever-changing effort that requires the cooperation, effective communication, and an unwavering commitment to ensuring high standards of workmanship. Through the use of efficient defect monitoring techniques, construction projects are able to effectively navigate various obstacles ensuring the delivery of outcomes of superior quality that align with the expectations of both clients and regulatory authorities.

3.3.3 Field Work

Field work is the process of observing and collecting data about the defect problems. The field work is conducted at Sunway Flora and in a wide range of area. For this field work involves conducting surveys, taking photos, and more. Field work for defect monitoring at a construction site refers to a range of on-site activities that are undertaken with the objective of finding, documenting, and solving defects or issues that may develop throughout the construction process. The implementation of an efficient approach must be maintained in preserving the overall quality, safety, and compliance to regulations within the construction project. The primary objective of field work is to methodically evaluate the advancement of construction projects and detect any observable defects or deviations from the authorized design. It is fundamental to conduct periodic inspections at various stages of the construction project in order to document observations, identify defects, and monitor on-site progress for future reference and evaluation. Fieldwork for defect monitoring is a crucial and ever-changing component of construction project management. In order to achieve optimal outcomes in construction projects, it is imperative to adopt a proactive strategy, employ efficient communication strategies, and incorporate technological advancements to swiftly detect and rectify any problems that may arise. This comprehensive approach plays a pivotal role in enhancing the overall success of the construction endeavour (Delyser & Starrs, 2010).

3.3.4 Questionnaire and Survey

The questionnaire method is a commonly acknowledged tool used to gather information about participants' social features, current and past behaviour, typical behaviour or attitudes, as well as their views and motivations related to the issue being studied. The training programme is assessed across multiple domains to determine its effectiveness, impact and potential for enhancement in future iterations. The questionnaire approach offers a cost-effective, practical, and

effective method of gathering significant quantities of information from a sizable sample of individuals inside the organisation. This method is advantageous for broad populations when conducting interviews would be impractical. Questionnaires are valuable tools for gathering information, expanding organisational knowledge, developing specific skills, reducing uncertainty, enhancing awareness of complex subjects, and problem-solving. A questionnaire is a highly efficient method for data collection (Nigel et al., 2009). For the target respondents for this survey are from QA team, operation team, and subcontractors. The questionnaire is distributed to the mentioned team because they are the one who actively involves in the defect works. Appendix A shows the questionnaire before the application development.

3.4 APPLICATION DESIGN (PROTOTYPE)

The e-DM model includes three crucial components, mainly computers, networks, and mobile applications. Templates are designed refer to pre-existing compilations of visual and written elements that can be customized and altered as per individual requirements. Templates are commonly developed in order to ensure consistency among users and media platforms by adhering to pre-established rules or criteria. The development of the template design prototype involved a series of five distinct design phases. The proposed application will be developed utilizing the NoSQL database management system, Supabase integrated development environment, and the React Native framework for data programming.

Developing a prototype is required for evaluating the problem-solving concepts created in the earlier phase. Prototypes may be exchanged and evaluated by the design team, other departments, or a select group of individuals who are not affiliated with the design team. The primary goal of this experimental phase is to determine the ideal solution for each of the problems identified in the initial three phases. The responses are sequentially integrated into the prototypes, and subsequent to user feedback, they endure a process of acceptance, improvement, reevaluation, or rejection. By the end of this phase, the design team will possess a more comprehensive awareness of the limitations and problems associated with the product. In addition, they will have gained enhanced insight

into the behavior-related, cognitive, and emotional aspects of actual users when engaging with the finalized product. Table 3.1 shows the prototype and explanation of design of e-DM.

Table 3.1 Prototype and explanation of e-DM

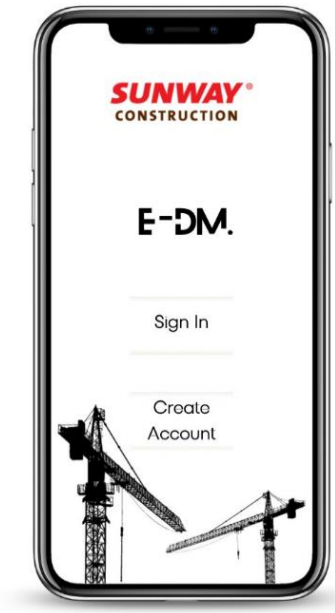
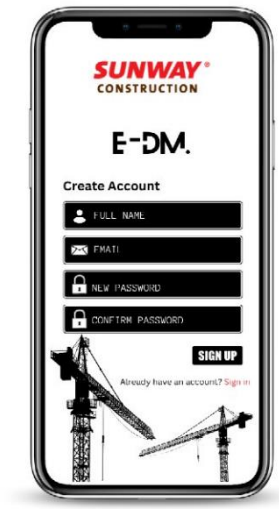
Prototype	Explanation
	1. Interface of e-DM main page consists of sign in and create account button.
	2. The first thing users do is open the app and go to the area where they can sign up or register. Here, they are asked to give important details like their name, email address, and a strong password.

Table 3.1 Prototype and explanation of e-DM (Continued)

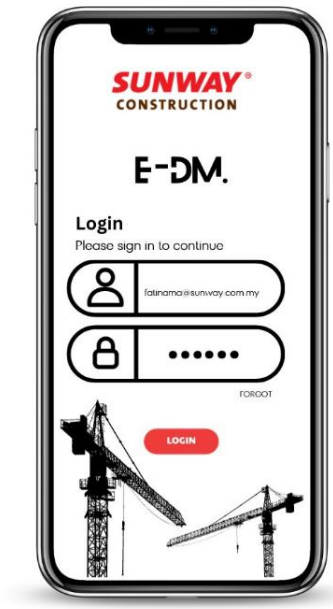
Prototype	Explanation
	3. Most of the time, users press a "Login" or similar button after entering the necessary information. After a successful login, users can use the app's features and see their own personalized material.
	4. Users can choose to select item that they need to access to do the assessment or the defect monitoring.

Table 3.1 Prototype and explanation of e-DM (Continued)

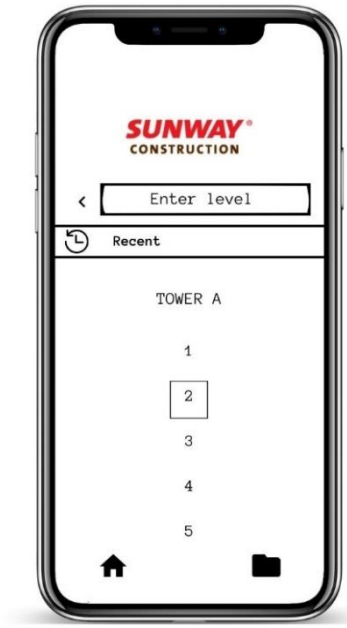
Prototype	Explanation
	5. Users need to enter which level that they need to access.
	6. At Sunway Flora, every level was divided into six zones so users must choose which zone that they need to access.

Table 3.1 Prototype and explanation of e-DM (Continued)

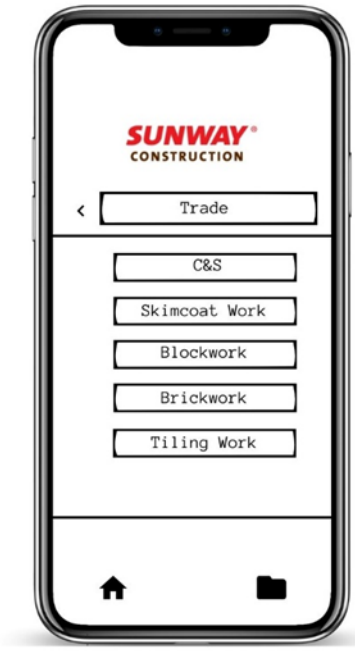
Prototype	Explanation
	7. Users need to choose which trade to do the assessment and to monitor.
	8. In every trade, some assessment has its own criteria, and all the assessment must be done. Scoring for each assessment is based on QLASSIC. The assessment of C&S works

Table 3.1 Prototype and explanation of e-DM (Continued)

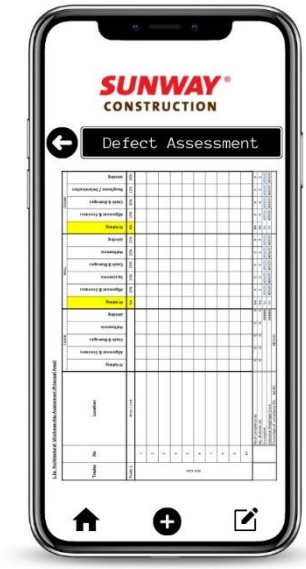
Prototype	Explanation
	9. The assessment of the skim coat works.
	10. The interface of the defect assessment of tiling work

Table 3.1 Prototype and explanation of e-DM (Continued)

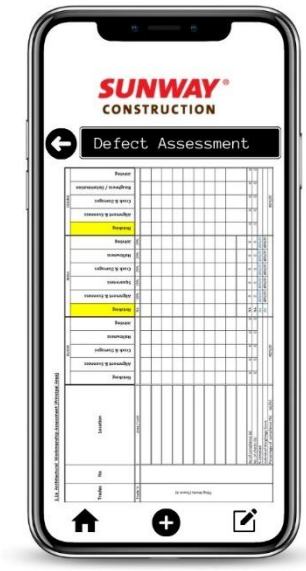
Prototype	Explanation
	11. The assessment of brickwork.
	12. Defect monitoring interface

Table 3.1 Prototype and explanation of e-DM (Continued)

Prototype	Explanation
	13. Users need to insert/snap photos of the defect and insert defect description.

3.5 DEVELOPMENT OF THE APPLICATION

Developing an application involves several steps, and the process can vary depending on the type of application you want to create (e.g., web app, mobile app, desktop app) and the technologies you plan to use. Before the actual development process, some decisions need to be taken about the mobile app. The first one usually is the platform to be used to develop the application. After that, need to choose from any of the different approaches to building mobile apps.

Facebook created the open source React Native framework to let developers create mobile applications with React and JavaScript. It enables developers to use a single codebase to create cross-platform apps for both iOS and Android. React Native cuts down on development time and effort by allowing developers to create code only once and have it run on both the iOS and Android platforms. Native components are used in React Native applications, guaranteeing excellent performance and a user experience that is almost identical to that of native development tool applications. Because of React Native's component-based architecture, developers may create encapsulated components that independently maintain state. Because these parts can be utilized repeatedly throughout the application, the code is more scalable and manageable. With the help of this functionality, developers may examine the effects of their most recent code changes right away without having to completely rebuild the application (Dekkati et al., 2019).

3.6 TEST-RUN/ TEST-RUN WITH EXPERTS

The process of testing a mobile application contains a series of procedures aimed at verifying its proper functionality, user-friendliness, and compliance to the set specifications. In the context of functional testing, it is important to thoroughly evaluate the fundamental functionalities of the application. This encompasses the processes of user authentication and authorization. The ability to effectively move throughout the application is of utmost importance to facilitate data input and validation. Engagement with external services, if deemed relevant. The process of testing is influenced by the functions of data retrieval and display.

If no issues arise during the trial phase of the application, it will be implemented within the industry. The application will undergo testing conducted by industry

specialists. In the event of encountering any issues during the testing phase, the programme will undergo necessary modifications until it achieves successful control, thereby rendering it suitable for implementation within the construction industry.

3.7 IMPROVISATION

The development of a mobile application includes various important stages, with improvisation regularly serving an essential part within this undertaking. It is imperative to establish a sequence of vital features for the initial release. The primary emphasis should be placed on the functionality that offers significant value and effectively addresses the fundamental issue at hand. It is imperative to perform comprehensive testing in order to identify and rectify any software defects. Conducting unit testing, integration testing, and user acceptability testing is crucial in software development. Collect comments from beta testers and prospective users. The software is consistently enhanced through the addition of user feedback, technology improvements, and industry trends. The attributes of flexibility and adaptability are crucial inside the dynamic domain of mobile application development. It is fundamental to consistently evaluate the strategy and be updated on emerging technologies and user preferences in order to maintain the relevance and success of the application.

3.8 SUMMARY

This chapter clarified the research methodology that was used for the study, covering several aspects such as the research design, procedures for data gathering, techniques for analysis, and the selected technology for the development of the application. The approach taken in this study adheres to a systematic flowchart, commencing with the identification of the problem and progressing through data analysis to the formulation of conclusions. React Native framework was implemented for the creation of the mobile application framework. A survey instrument was distributed to collect user input, and the process of data analysis played an essential part in understanding and analyzing the obtained results. In general, the selected research

approach facilitated a thorough comprehension of the study problem and intends to improve the project's effectiveness.

CHAPTER 4

RESULT: DATA ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

The findings of this study encompass two main components. The first component involves an assessment of the issues associated with the current method being used, which was conducted prior to the implementation of the Defect Monitoring Mobile Application (e-DM). The second component involves evaluating the satisfaction of users after the development of e-DM.

Before the development of e-DM, interviews by using questionnaire were conducted with specific users including project manager, quality assurance department, operation department, and sub-contractors. These interviews focused on gathering insights regarding work experience and documentation reports. The viewpoint expressed by the respondents concerning the existing issues were collected and used as the foundation for the problem statement in this project.

The data and conclusion derived from the questionnaire and site-based interviews are presented and discussed in this chapter. Additionally, the results of the project's objectives are mentioned. The project's objectives will be justified based on the results, and an assessment will be made whether the goals have been achieved.

4.2 Outcome of Identification

In the context of construction project, defect monitoring contributes an essential part by ensuring the identification and resolution of issues prior to their development into more significant problems. Defect monitoring is a systematic approach that involves the identification, categorization, and analysis of probable defects. This approach allows project managers and stakeholders to acquire a deeper understanding of the underlying

factors contributing to defects or other causes. Project teams can effectively prioritise the resolution of defects by actively monitoring them, taking into consideration their severity and the potential influence on the project schedule and budget.

Defect monitoring leads to the discovery of issues that have the potential to hinder the progress of the project or compromise its overall quality. In addition, defect monitoring plays a vital part in identifying reoccurring issues, enabling project teams to proactively pertain preventive measures and improve their development processes.

The primary objective of defect monitoring is to not only detect issues but also assist with their efficient resolution. By promptly resolving discovered defects, teams could reduce delays, enhance the allocation of supplies, and guarantee the overall achievement of the project. Furthermore, the knowledge acquired from defect monitoring can be very useful for upcoming projects, as it enhances the understanding of effective techniques and plans for ongoing improvement. Hence, defect monitoring plays a significant part in ensuring quality assurance and project management, enabling the provision of goods and services that comply to or beyond expected requirements.

4.2.1 Outcome of Observation

Interviews, questionnaires, and observational studies are used to learn about user behaviours and preferences by the design team. The major goal is defining the scope, objectives, and user requirements. This observation stage is done at Sunway Flora for defect monitoring work. Before the creation of this application, Sunway Flora used the existing method which is the method of filling out the physical form on the site. Upon observing the conventional method employed at construction sites, it was recognized that there is room for improvement, particularly in the areas of post concreting inspection and documentation. As a result, a proposal was made to develop a mobile application to address these shortcomings. This improved method, known as the Defect Monitoring Mobile Application (e-DM), is intended to enhance the efficiency and effectiveness of defect monitoring and documentation in construction projects. The development of this standalone application is an effort to streamline and optimize the monitoring and documentation processes related to post-concreting activities.

4.2.2 Outcome of Discussion

Discussions are conducted with mentor in the industry to find issues that exist on the construction site. The main issue that always occurs at this construction site is the construction defect issue. Defect monitoring is a key aspect to ensure the quality of work at this construction site. Defect monitoring improves communication and collaboration within the teams. Clear and detailed defect reports promote a common knowledge of issues, resulting in improved teamwork and coordination. This is especially crucial in distant teams, where members may not have frequent face-to-face interactions. Effective defect communication ensures that all team members are informed of current concerns and the steps being taken to rectify them, reducing misunderstandings and redundancies (Cockburn, 2000)

4.2.3 Outcome of Questionnaire

The questionnaire is completed during the first stage to ensure the issues at the construction site. These questions must be answered by the Project Manager, Quality Assurance Engineer, Site Engineer, and Site Supervisor. The questions for the first phase are included in Appendix 1. Table 4.2 shows the summary of survey to identify the existing problems in industrial especially for project design phase.

Table 4.1 Marking Scale Questionnaire

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

Table 4.2 Survey to Identify the Existing Problems

No.	Survey to identify the existing problem in industrial especially for project design phase	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
1	Issues on defect monitoring on site	70%	30%	0%	0%	0%
2	Issues regarding the delay in documentation	50%	40%	10%	0%	0%
3	Issues on reporting to rectify defect works	70%	30%	0%	0%	0%
4	Issues with business partner that not complying the date to complete the work that has been issued	66.7%	0%	33.3%	0%	0%

The purpose of the survey was to find important problems in the industrial sector, especially when planning a project. The results show that most of the people who answered agreed on several significant issue areas. To begin, most people agree that defect monitoring on site is a major issue. 70% of those who answered strongly agreed and the other 30% agreed. This unanimous agreement shows how important it is to keep an eye on defects on-site, highlighting it as an area that needs instant attention and improvement.

Second, delays in paperwork are an additional major issue. 50% of those who answered strongly agreed that this is a problem, 40% agreed, and 10% were neutral. Based on this spread, it looks like most of the people who answered think that delays in paperwork are a problem, but some may not think it's as bad or may not be as affected by it. But the fact that no one disagrees shows that everyone is aware of the problem.

The third question, about reporting problems to fix them, follows the same pattern as the first one. 70% of people who answered strongly agreed and 30% agreed. This unanimous agreement shows how important it is to have good ways to report bugs. The fact that there were no neutral, disagree, or highly disagree answers makes it even more clear that we need better reporting systems to find and fix problems quickly.

Lastly, problems with business partners not meeting the due dates for completed work offer a slightly different view. In this case, 66.7% of those who answered strongly agreed that this is a problem, while 33.3% were not sure. Most of the people who answered were neutral, which means that while most people think not meeting deadlines is a major issue, some of them either fail to recognize it that often or use different factors to decide how bad the problem is. No one disagreed or strongly disagreed, which suggests that most people are aware of the problem, even if their reactions to it are different.

Overall, the results of the survey show that most people agree that there are significant issues in the industrial sector's project design phase with defect monitoring, documentation delays, defect reporting, and business partner compliance. These new ideas make it clear that specific actions are needed to fix these issues. These actions should focus on making monitoring, documentation, reporting, and partnership deals better so that projects are finished on time.

4.3 Designing Defect Monitoring Mobile Application (e-DM)

The Defect Monitoring Mobile Application (e-DM) is designed to ease human tasks by switching from traditional methods to real-time updates on mobile devices. Previously, engineers and supervisors tracked the progress of defect monitoring activities using physical forms. Furthermore, data may be overlooked or lost at times. It would require more time to complete the repair work. This action was inefficient and time-consuming. Given these circumstances, the old traditional approach was neither methodical nor suited for sustained use. Defect Monitoring Mobile Application (e-DM) was created to address this issue.

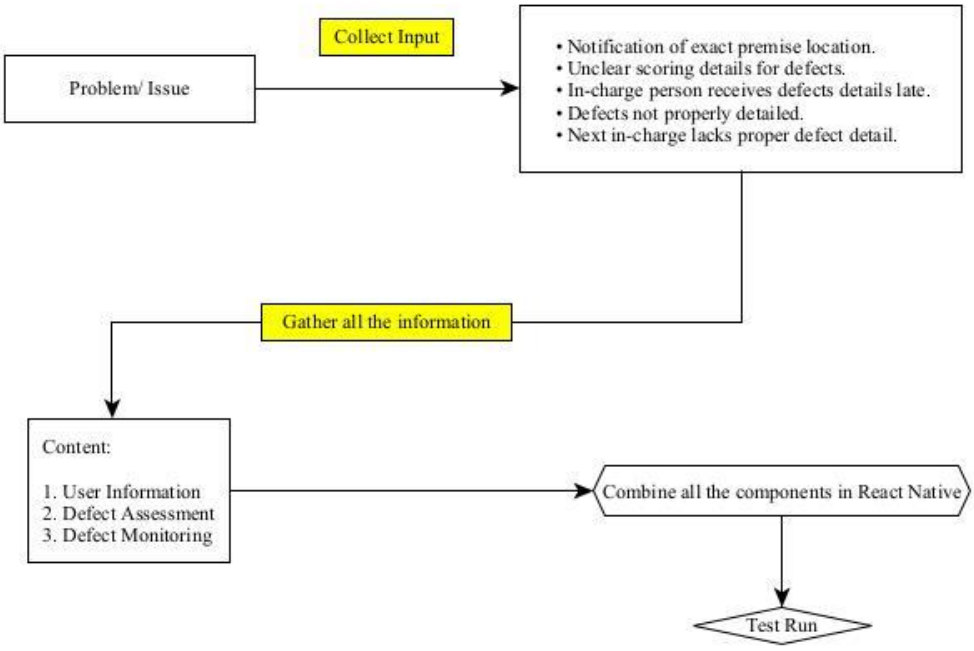


Figure 4.1 Flowchart of Design the Defect Monitoring Mobile Application (e-DM) using React Native

The mobile application allows project managers, quality assurance engineers, site engineers, and site supervisors to use it without having to discuss daily updates. This tool saves time, reduce the usage of papers and reduces project delays by allowing any defect rectification information to be easily sent. Furthermore, the tool allows users to confirm the accuracy of the defects. This is made possible by the continuous access to real-time results while working on the construction site, allowing users to effectively track and monitor progress.

4.4 Developing Defect Monitoring Mobile Application (e-DM) Using React Native

JavaScript and React can be used by developers to create mobile applications with Facebook's open source React Native framework. Code reusability and quicker development cycles are encouraged by the ability to create natively rendered mobile apps for both the iOS and Android platforms from a single codebase. High efficiency and a genuinely native user experience are guaranteed by React Native's usage of native

components and APIs. React Native simplifies the development process and offers a reliable solution for creating intricate, feature-rich mobile applications by utilizing React's core concepts, such as component-based design and state management. Added to that, the development for developing e-DM is shown in Table 4.3.

Table 4.3 Defect Monitoring Mobile Application (e-DM)

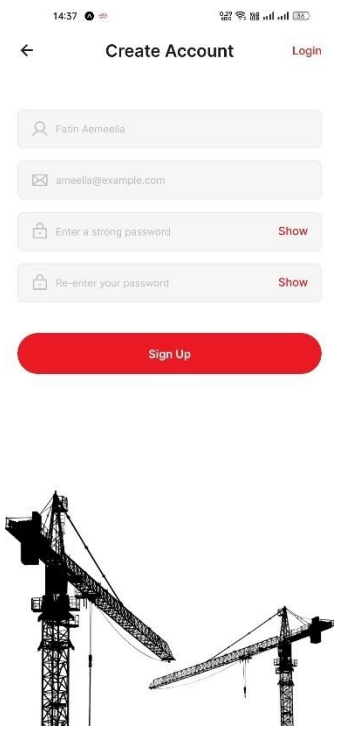
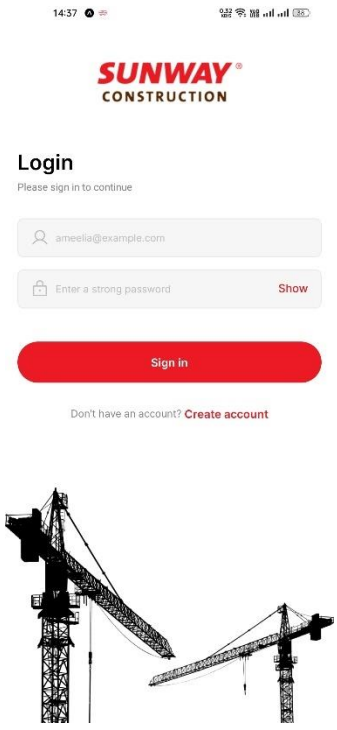
Development	Description
	1. The first step is user need to create account with providing necessary information to sign up.
	2. Users can login to the mobile application after signing up into the application.

Table 4.3 Defect Monitoring Mobile Application (e-DM) (Continued)

Development	Description
	1. On the home page, users need to select item that they need to access to do the assessment or the defect monitoring.
	2. Users need to select which tower that they need to access to do the defect monitoring.

Table 4.3 Defect Monitoring Mobile Application (e-DM) (Continued)

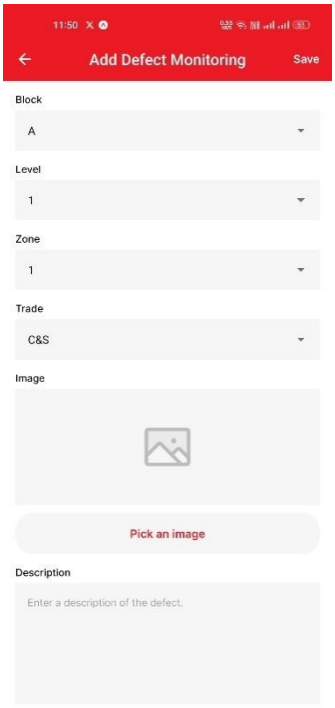
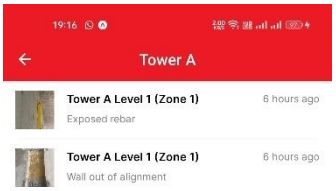
Development	Description
	3. On the defect monitoring interface, the user needs to insert which block, level, zone and trade of the defects. Insert an image or instantly capture the photo of the defects and enter defect description.
	4. The defect's monitoring list was saved by tower. All the defects' details will show up in the tower folder.

Table 4.3 Defect Monitoring Mobile Application (e-DM) (Continued)

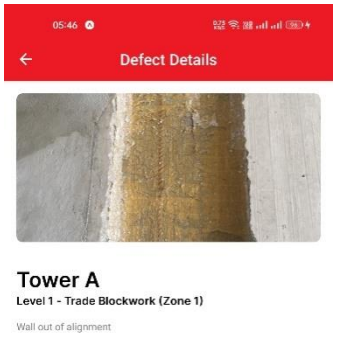
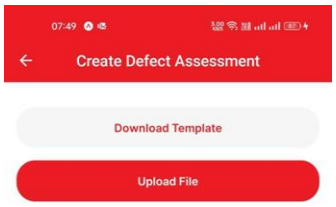
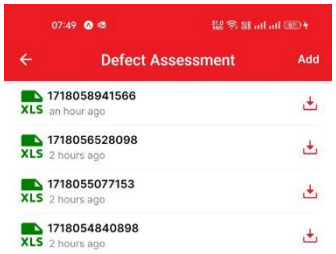
Development	Description
	5. Users can view the defect details after they gather all the defects information.
	6. To do the defect assessment, users need to upload the excel file into the mobile application. Users can also download the defect assessment template.

Table 4.3 Defect Monitoring Mobile Application (e-DM) (Continued)

Development	Description
	7. Each excel contains different trades. Users need to select which excel that they need to assess. This excel includes all defects criteria and scoring.

4.5 Evaluating the Usability of Defect Monitoring Mobile Application (e-DM)

The final product was tested with an online questionnaire. This product was developed with Flutter and tested by the experts from Sunway Construction Sdn. Bhd. employees included a project manager, a quality assurance engineer, a site engineer, and a site supervisor. e-DM was developed to help teams identify areas for improvement. These surveys were distributed to 10 respondents. The findings will give a comprehensive summary of the study's findings and analyses in the form of tables, graphs, and figures, emphasizing the important details.

This questionnaire contains four components. Section 1, 2, and Section 3C. Section 1 highlights the demographic profile. Section 2 is related to the questions in the Effectiveness Categories section, Perceived Ease of Use and Intention to Use of existing method. Section 3 discusses the Effectiveness Categories section, Perceived Ease of Us and Intention to Use of Defect Monitoring Mobile Application (e-DM). This study's questionnaire was based on Technology Acceptance Model (TAM), which was proposed in by Davis (1989). The Technology Acceptance Model (TAM) is a theoretical framework that aims to explain how individuals come to embrace and use technology. There are two key elements that influence technology adoption: perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness is the degree to which a person believes that utilizing a specific system would improve their job performance, whereas perceived ease of use is the degree to which a person believes that using the system will be effortless. These factors influence users' attitudes about using technology, which in turn influences their intention to use and actual use of the technology.

The number of samples used in this study was determined using the Krejcie and Morgan Table. Since the population consisted of 10 responders, a sample size of 10 was considered adequate (Abdul et al., 2021). As a result, the study included the entire population. Furthermore, simulation research conducted by De Winter (2013) indicated that even with small sample sizes, such as 2, there were no significant concerns when employing a standard t-test.

The demographic data for the respondents is discussed in the following section, which includes four components:

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

i. Gender

The table displays the gender of those who responded to this survey. The total number of respondents was approximately 10. The table 4.4 and figure 4.2 below display the number of respondents by gender.

Table 4.4 The number of respondents by gender

No.	Gender	No Respondent	Percentage (%)
1	Male	8	80%
2	Female	2	20%
Total		10	100%

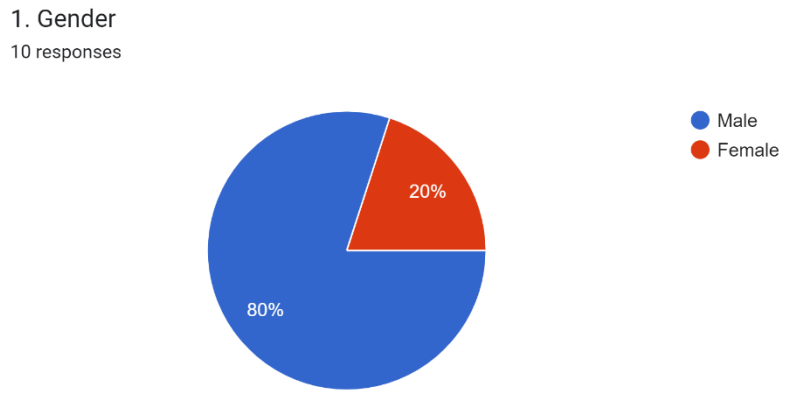


Figure 4.2 The number of respondents by gender

There was a total of 8 male respondents and only 2 female respondents. The percentage rate for male respondents is 80%, compared to only 20% for female respondents. The percentage observed shows there are more male respondents than female respondents at the construction site.

ii. Age

The table below illustrates the respondent age categories for this survey. The study separated respondents into four age groups. This division was created to ensure that data analysis is carried out efficiently and that respondents are recognized on construction sites. Therefore, the percentage based on age is shown in Table 4.5 and Figure 4.3.

Table 4.5 The number of respondents by age

No.	Age	No Respondent	Percentage (%)
1	20-30	3	30%
2	31-40	7	70%
3	41-50	0	0%
4	>50	0	0%
Total		10	100%

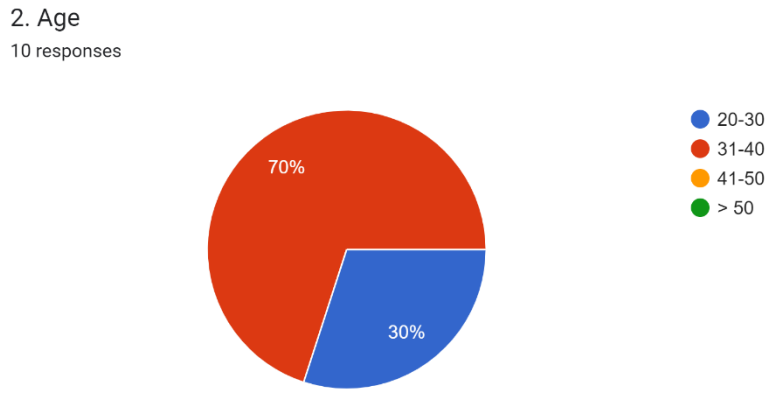


Figure 4.3 The number of respondents by age

According to the statistics, the highest percentage is between the ages of 31 and 40, accounting for 70%. The percentage of people aged 20 to 30 has been reduced by three individuals.

iii. Designation

The third variable in the demographic data is the position on the construction site, which includes several positions such as Project Manager, Quality Assurance Engineer, Site Engineer, and Site Supervisor that are involved in defect monitoring. The percentage of the designation is shown in figure 4.4 and table 4.6 below.

Table 4.6 The number of respondents by designation

No.	Designation	No Respondent	Percentage (%)
1	Project Manager	1	10%
2	Quality Assurance Engineer	2	20%
3	Site Engineer	4	40%
4	Site Supervisor	3	30%
Total		10	100%

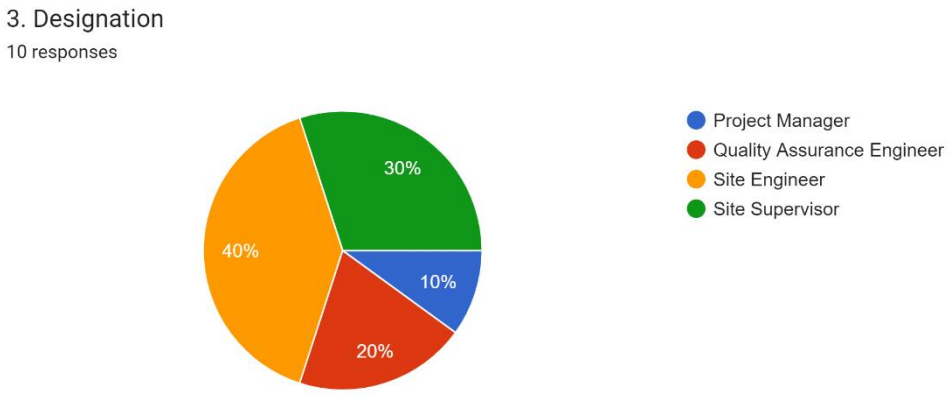


Figure 4.4 The number of respondents by designation

In the table above, the percentage of respondents for project manager is 10%. Quality assurance engineers include 20%, followed by site engineers at 40% and site supervisors at 30%.

iv. Work Experience

The final item in section 1 of the demographic data is the respondents' work experience, with current positions lasting less than a year, one to two years, three to five years, six to ten years, or more than ten years. The percentages of job experience are shown in table 4.7 and figure 4.5.

Table 4.7 The number of respondents by work experience

No.	Work Experience	No Respondent	Percentage (%)
1	Less than 1 year	1	10%
2	1-2 years	0	0%
3	3-5 years	4	40%
4	6-10 years	4	40%
5	More than 10 years	1	10%
Total		10	100%

The second section of this survey emphasizes research on conventional or existing systems. Respondents were required to select adequate scores in a range of 5 to 1. The suggested scoring scale is as follows:

Table 4.8 Marking Scale Questionnaire

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

Table 4.9 Survey to identify perceived usefulness of existing method

No.	Survey to identify perceived usefulness of existing method	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
1(a)	Using the existing method enhances my effectiveness in work. (P.U 1)	0%	0%	20%	60%	20%
1(b)	Using existing method would improve my performance in work (P.U 2)	0%	0%	10%	50%	40%
1(c)	Using existing method would increase my productivity. (P.U 3)	0%	0%	0%	50%	50%
1(d)	I found existing method useful. (P.U 4)	0%	0%	40%	30%	30%

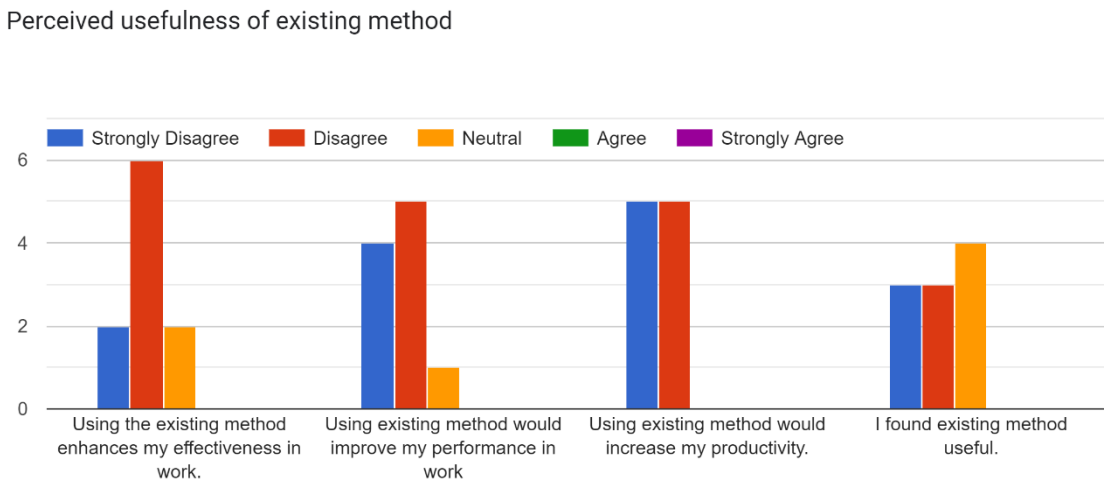


Figure 4.5 Survey to identify perceived usefulness of existing method

Section 2 of the post-FYP questionnaire included questions about the respondent's acceptance of the existing method and after the Defect Monitoring Mobile Application (e-DM) was developed. A survey to determine perceived usefulness of existing methods is conducted, and the data for Section 2 of the Pre-FYP questionnaire can be obtained from Table 4.9 and Figure 4.5 above. The data for question 1 (P.U 1) shows that 60% of respondents disagreed, with 20% strongly disagreed. 20% of respondents opted neutral, while none decided to agree or strongly disagree with the statement. For question 1 (P.U 2), 50% of respondents disagreed, with 40% strongly disagreeing. Another 10% are neutral, while none of the respondents agree or strongly agree with existing method. In response to question 1 (P.U 3), 50% of respondents disagreed or

strongly disagreed. Finally, for question 1 (P.U 4), 40% of respondents were neutral about the existing method, 30% disagreed, and 30% strongly disagreed.

Table 4.10 Survey to identify perceived ease of use of existing method

No.	Survey to identify perceived ease of use of existing method	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
2(a)	I found existing method easy to use. (P.E 1)	0%	10%	20%	70%	0%
2(b)	Learning to use existing method would be easy for me. (P.E 2)	0%	10%	20%	60%	10%
2(c)	My interaction existing method was clear and understandable. (P.E 3)	0%	0%	30%	70%	0%
2(d)	It would be easy for me to manage my project using existing method. (P.E 4)	0%	0%	20%	40%	40%

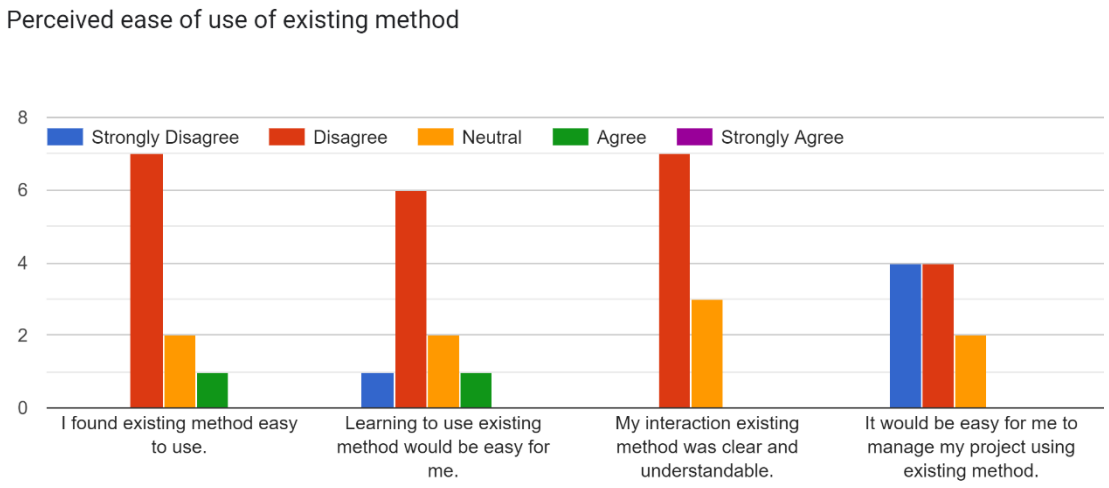


Figure 4.6 Survey to identify perceived ease of use of existing method

Question 2 (P.E.U. 1) to (P.E.U 4) gathered data on the perceived ease of use of the existing method. According to the findings, most respondents think the current system is ineffective. For question 2 (P.E.U 1), 70% of respondents disagree with the existing system, 20% are neutral, and 10% believe the existing method is simple to use. For question 2 (P.E.U 2), 60% of respondents disagreed that learning to use the existing

approach would be simple for them. 20% of respondents remained neutral, 10% agreed, and 10% strongly disagreed. For question 2 (P.U.E. 3), 70% of respondents disagreed and 30% were neutral on whether their interaction with the existing approach was clear and intelligible. Finally, on question 2 (P.U.E 4), 40% of the respondents disagreed, 40% strongly disagreed, and 20% were neutral that it would be easy for them to handle the project using the existing method.

Table 4.11 Survey to identify intention to use of existing method

No.	Survey to identify intention to use existing method	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
3(a)	I intend to use existing method during my work (I.U 1)	0%	0%	30%	50%	20%
3(b)	I will use the existing method often. (I.U 2)	0%	0%	0%	60%	40%
3(c)	I intend to use existing method frequently. (I.U 3)	0%	0%	0%	30%	70%

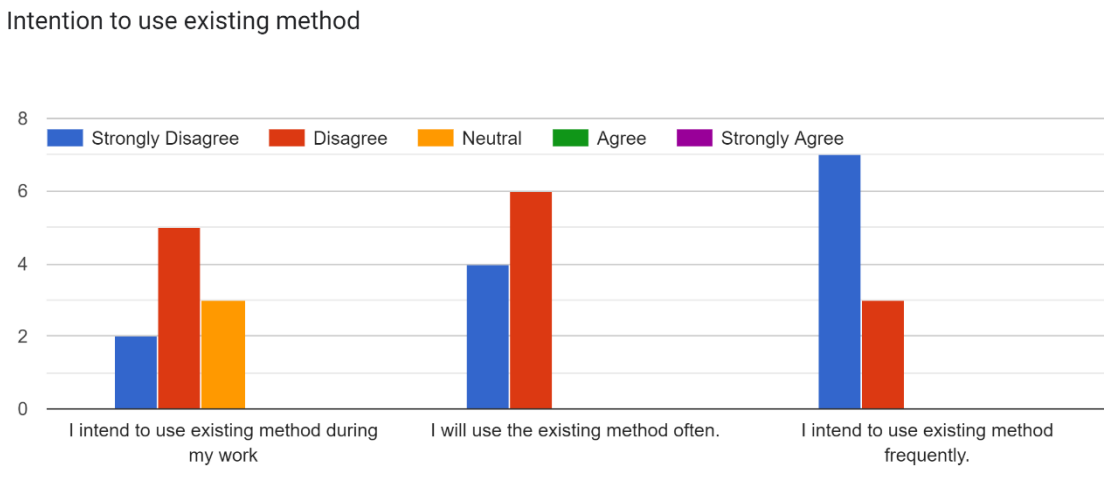


Figure 4.7 Survey to identify intention to use existing method

Question 3 (I.U.I 1) through (I.U.I 3) gathered information about the intention to use the current method. The findings indicate that the majority of respondents are dissatisfied with the current method. In response to question 3 (I.U.I 1), 50% of respondents disagreed, 20% strongly disagreed with the current method, and 30% were neutral. For question 3 (I.U.I 2), 60% disagreed, with 40% strongly disagreeing with using the existing approach frequently. Finally, 70% of respondents strongly disagreed with question 3 (I.U.I 3), whereas 30% disagreed. This shows that people have little intention of using the current method.

Table 4.12 Survey to identify perceived usefulness of e-DM

No.	Survey to identify perceived usefulness of e-DM	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
1(a)	e-DM was simple for me to use. (P.U 1)	90%	0%	10%	0%	0%
1(b)	e-DM was straight forward. (P.U 2)	90%	0%	10%	0%	0%
1(c)	Implementing e-DM is easy for me. (P.U 3)	90%	0%	10%	0%	0%
1(d)	e-DM was convenient to me. (P.U 4)	90%	0%	10%	0%	0%
1(e)	The design of e-DM is simple to understanding (P.U.5)	90%	0%	10%	0%	0%

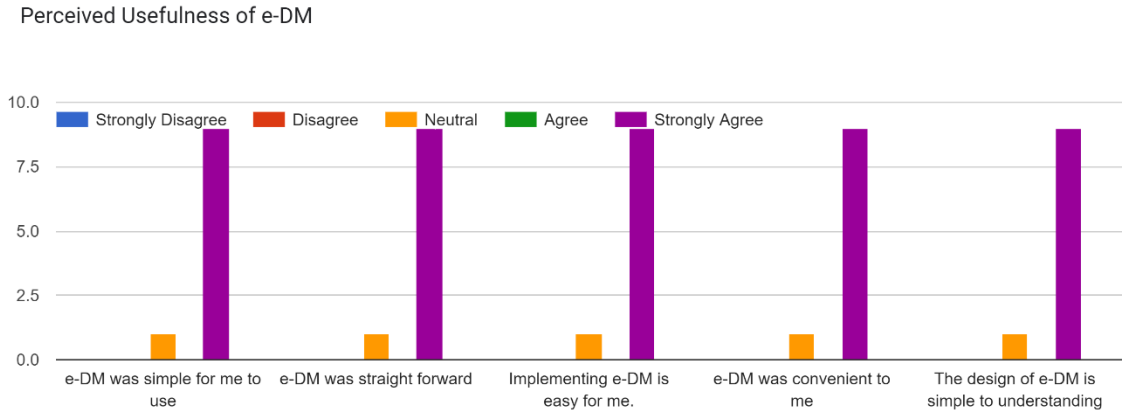


Figure 4.8 Survey to identify perceived usefulness of e-DM

Section 3 of the post-FYP questionnaire queried respondents on their satisfaction with utilizing the Defect Monitoring Mobile Application (e-DM) to monitor defects at construction sites. The table and figure above illustrate the data for Section 3 of the Post-FYP questionnaire. Question 1 (P.U 1) through 1 (P.U 4) collected data on the perceived use of using the Defect Monitoring Mobile Application (e-DM) to obtain detailed information on defect work. According to the data, most respondents encountered that the Defect Monitoring Mobile Application is useful for project management on construction sites. For question 1 (P.U 1), 90% of respondents strongly believe that the Defect Monitoring Mobile Application (e-DM) method will improve their work effectiveness, while 10% are neutral about the development of the mobile app. Next, for question 1 (P.U 2), which questions whether using Defect Monitoring would improve users' work performance, 90% strongly agree, while 10% are neutral about the mobile application. For question 1 (P.U 3), 90% of respondents strongly agree, with 10% neutral, that adopting the Defect Monitoring Mobile Application (e-DM) is simple for them. For question 1 (P.U.4), 90% of respondents strongly agree, with the remaining 10% ambivalent. Finally, 90% of respondents strongly agree on question 1 (P.U. 5), with 10% neutral. This displays the Defect Monitoring Mobile Application (e-DM) for defects work on a construction site.

Table 4.13 Survey to identify perceived ease of use of e-DM

No.	Survey to identify perceived ease of use of e-DM	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
		(5)	(4)	(3)	(2)	(1)
2(a)	e-DM would increase the effectiveness in work. (P.U 1)	70%	20%	10%	0%	0%
2(b)	e-DM would make easy finishing the task. (P.U 2)	80%	10%	10%	0%	0%
2(c)	Using e-DM can reduce from using too much paper. (P.U 3)	80%	10%	10%	0%	0%

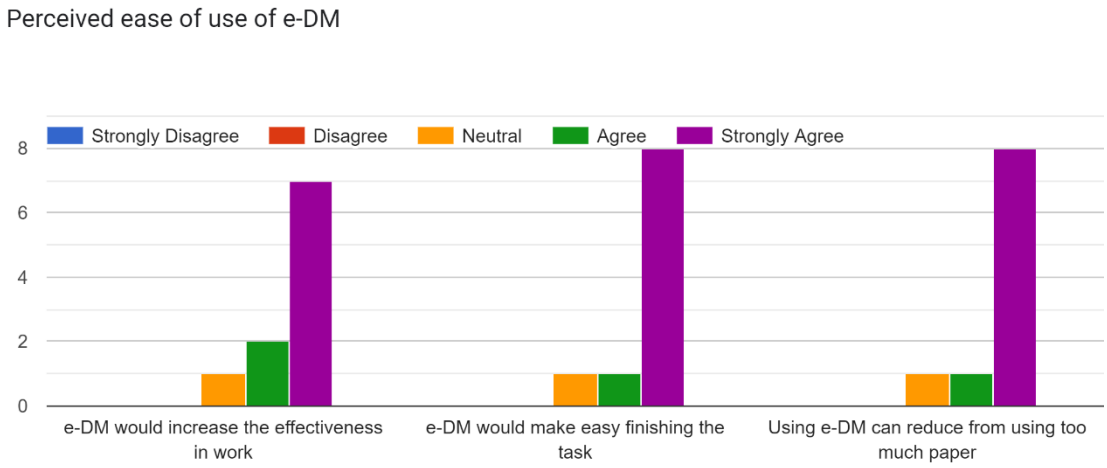


Figure 4.9 Survey to identify perceived ease of use of e-DM

Question 2 (P.E.U. 1) to (P.U.E 4) will provide statistics on the perceived ease of use of the Defect Monitoring Mobile Application (e-DM). According to the study findings, most respondents think e-DM is effective. For question 2 (P.E.U 1), 70% of respondents strongly agree, 20% agreed, and 10% are neutral about the mobile application. Question 2 (P.E.U 2) states that e-DM would make it easier to complete the given task. 80% of respondents strongly agreed, 10% agreed, and another 10% remained neutral. Finally, for question 2 (P.U.E. 3), 80% strongly agreed, 10% agreed, and 10% were neutral about adopting e-DM to reduce too much paper.

Table 4.14 Survey to identify intention to use of e-DM

No.	Survey to identify intention to use of e-DM	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
3(a)	I intend to use e-DM to complete my work. (P.U 1)	70%	20%	10%	0%	0%
3(b)	I will use e-DM often. (P.U 2)	70%	20%	10%	0%	0%
3(c)	I do not intend to find another method. (P.U 3)	40%	50%	10%	0%	0%

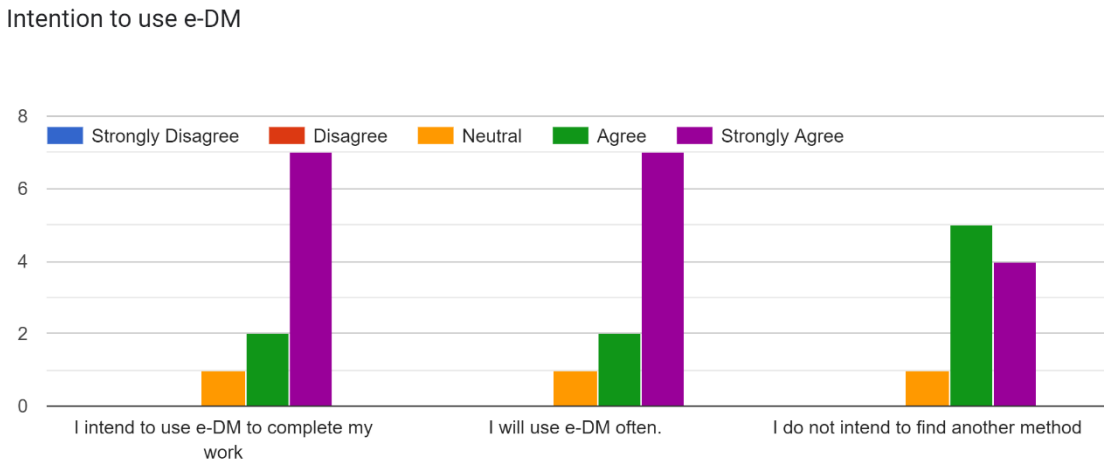


Figure 4.10 Survey to identify intention to use of e-DM

Question 3 (I.U 1) to (I.U 3) described the goal of using the Defect Monitoring Mobile (e-DM) to provide users with easy access to get information on defect rectification. According to the data, the majority of respondents believe that this mobile application may significantly improve work efficiency. In response to question 3 (I.U 1), 70% strongly agree, 20% agree with e-DM, and 10% are neutral. Then, in response to question 3 (I.U 2), 70% of respondents strongly agreed, 20% agreed, and 10% were ambivalent about using e-DM often. Finally, for question 3 (I.U 3), 50% of them agreed, 40% strongly agreed, and 10% of the respondents were neutral or did not intend to find another method.

Table 4.15 Usability Level of existing method among respondents

Variables	Mean	Interpretation
Perceived Usefulness	1.83	Low
Perceived Ease of Use	2.20	Low
Behavioural Intention to Use	1.67	Low

The table displays the respondents' levels of usability towards the application of existing methods, with analysis revealing that for all variables tested, the mean score was less than 3.50, indicating that the usability level of existing was low (Cohen, 1988).

Table 4.16 Usability Level of e-DM among respondents

Variables	Mean	Interpretation
Perceived Usefulness	4.80	High
Perceived Ease of Use	4.67	High
Behavioural Intention to Use	4.50	High

The following table displays the respondents' level of usability towards using the Defect Monitoring Mobile Application (e-DM), with analysis showing that for all variables evaluated, the mean score was greater than 4.00, indicating that the use of Defect Monitoring (e-DM) is considerably easier than the current method.

Table 4.17 Paired sample t-test

Pair	Paired Different	t	Significant (two tailed)
	Mean		
Perceived Usefulness	2.98	8.91	.000
Perceived Ease of Use	2.45	6.50	.000
Behavioral Intention to Use	2.83	8.79	.000

A paired sample t test was used to evaluate the Defect Monitoring Mobile Application's (e-DM) efficacy in the project. The findings indicate that respondents preferred using e-DM; in comparison to the current method, which measures perceived usefulness (mean = 1.83), perceived ease of use (mean = 2.20), and behavioral intention to use (mean = 1.67), all three variables measured—Perceived Usefulness (mean = 4.80), Perceived Ease of Use (mean = 4.67), and Behavioral Intention to Use (mean = 4.50)—were higher. This difference was shown to be significant for all measured variables using a paired sample t-test; the perceived usefulness t-value is 8.91 and the p-value is < .00001. At $p < .05$., the finding is significant. For perceived ease of use, the value of t is 6.50, and the value of p is < .00001. At $p < .05$., the outcome is significant. For behavioral intention to use, the value of t is 8.79 and the value of p is < .00001. At $p < .05$., the finding is significant. This implies that utilizing e-DM was far more straightforward and effective

than using the current method. This indicates that e-DM outperformed the current method in terms of effectiveness.

4.6 Summary

Despite its extensive history, the construction industry continues to attempt to integrate cutting-edge technologies on construction sites. Outdated systems and disconnected communication have impeded the sector, resulting in inefficiencies in projects. This emphasizes the critical role that technology plays in improving industry quality and productivity. Project managers recognize that integrating the appropriate technologies can result in a more productive work environment.

The responses to a survey of Sunway Construction Sdn. Bhd. staff, including the project manager, quality assurance engineer, site engineer, and site supervisor, revealed a consensus that the Defect Monitoring Mobile Application (e-DM) is more effective than the current method. The existing method of defect monitoring, which uses paper, is deemed redundant and difficult to maintain. The respondents stated a high degree of agreement, with a mean score more than 4.00, indicating that the Defect Monitoring Mobile Application (e-DM) is easy to use and that they are planning on using it to collect information on the defect rectification at the construction site.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

The study developed the Defect Monitoring Mobile Application (e-DM) to solve the prevalent issue of defect monitoring in the projects. The application was developed using the React Native programming tool, and its usability was evaluated by the company's employees via a survey conducted online. The survey includes variables derived from the Technology Acceptance Model (TAM) questionnaire, such as Perceived Usefulness, Perceived Ease of Use, and Behavioural Intention to Use.

The information gathered was analysed with the paired t-test and mean calculations. The findings of the paired t-test revealed a substantial difference between the Defect Monitoring Mobile Application (e-DM) and the current method. This shows that the application worked significantly in terms of usability than the current method. As a result, the study strongly advocated the use of the Defect Monitoring Mobile Application (e-DM) to manage the successful coordination of individuals and processes within construction projects.

Contractors can use this application to address any challenges associated with defect monitoring issues. The Defect Monitoring Mobile Application (e-DM) is a platform for integrating numerous variables critical to good project management, such as coordination, communication, and process management. It includes aspects that boost usefulness, ease of use, and intent to use technology in construction projects. With the positive feedback from staff through the survey, the mobile application has the ability to streamline and optimise construction project management.

Implementing the Defect Monitoring Mobile Application (e-DM) can increase efficiency and reduce waste in the defect monitoring process. Contractors can benefit from a more streamlined and organized approach to project management by leveraging technology and resolving the inadequacies of existing methods. The survey findings verify the app's usefulness, which supports its argument for adoption in the construction industry.

Finally, the study successfully developed and assessed the Defect Monitoring Mobile Application (e-DM), indicating that it is more usable than the current method. The application has the potential to significantly assist contractors by allowing for better coordination and administration of persons and procedures inside construction projects. Its deployment is strongly advised to improve the defect monitoring process.

5.2 DISCUSSION

Efforts were taken to solve the difficulties at this organization, including the implementation of the design thinking process. During the empathy stage, the researcher interviewed construction practitioners such as a project manager, quality assurance engineer, site engineer, and site supervisor. This enabled them to comprehend the difficulties and create a project to address them. A mock-up of the solution was built and sent to construction people for competence testing before being handed over to the company.

Two questionnaires were created to gain input on the existing defect monitoring process and the newly constructed Defect Monitoring Mobile Application (e-DM). The study of the questionnaire’s findings revealed that the current method had a low usability level, with respondents reporting difficulty in executing with it. On the other hand, feedback on the Defect Monitoring Mobile Application (e-DM) showed that it was substantially easier to use than the previous approach. The mobile application received higher mean values for criteria such as perceived ease of use, perceived usefulness, and behavioral intention to use.

Table 4.16 shows that respondents preferred using the Defect Monitoring Mobile Application (e-DM), with all variables measured significantly higher than the existing

method, including Perceived Usefulness (Mean = 4.80), Perceived Ease of Use (Mean = 4.67), and Behavioral Intention to Use (Mean = 4.50). Perceived usefulness (Mean = 1.83), Perceived Ease of Use and Behavioral Intention to Use (Mean = 1.67). A paired sample t-test found that the difference was statistically significant for all variables examined. Perceived Ease of Use has a t-value of 8.91 and a p-value of less than 0.00001.

The Defect Monitoring Mobile Application (e-DM) has proven to be a helpful tool for the company, particularly for the QAQC department, in terms of monitoring the progress of defects. Based on the good feedback and significant improvements seen, the application was recommended for use in the company. It improved organization, utility, and user-friendliness by reducing the need for paper-based operations and allowing personnel to stay up to date via a stable internet connection.

5.3 SUGGESTION/RECOMMENDATION

Based on the information provided, the researcher proposed several suggestions to improve the use of the Defect Monitoring Mobile Application and guide actions to come.

1. Offline Mode: Adding an offline mode to a defect tracking mobile application is highly recommended for improving its functionality and reliability. This feature would enable users to continue reporting and tracking defects even when they are in locations with limited or no internet access. By allowing offline data entry and storage, users can avoid having their observations and reports delayed or lost due to connectivity issues. When the device regains internet access, the offline data will be automatically synchronized with the central database, ensuring smooth data integration and consistency. This technique not only improves the user experience by ensuring continuous access, but it also improves data accuracy and dependability, making the defect monitoring process more efficient and resilient.

2. Smart Search: Implementing a smart search option in a defect monitoring mobile application is highly suggested for improving productivity and user experience. A smart search feature would allow users to rapidly identify specific problems,

historical reports, or relevant material by utilizing keywords, filters, and predictive text. This functionality can use powerful algorithms to deliver appropriate suggestions and auto-complete alternatives, decreasing the time spent traversing large amounts of data. By improving the search process, users can track, analyze, and manage faults more effectively, resulting in increased productivity and faster resolution time. Furthermore, smart search can help with data organization and retrieval, ensuring that vital information is easily accessible when needed, thereby improving the overall defect management workflow.

3. In-App Messaging: In-app messaging should be included into a defect tracking mobile application to boost its effectiveness and user engagement even more. This feature would allow users to communicate in real time, discussing faults, sharing updates, and collaborating on solutions all within the app. In-app messaging can shorten the feedback loop, resulting in shorter reaction times and more effective problem solving. Users can effortlessly attach photographs, documents, and other important things to their messages, ensuring that all pertinent information is communicated quickly and clearly. Furthermore, this tool improves teamwork and accountability by centralizing and making all defect monitoring-related communication available. Finally, in-app messaging can facilitate more cohesive and proactive defect management, resulting in a more responsive and successful product.

4. Data Visualization: Incorporating data visualization into a defect monitoring mobile application is highly suggested to improve its analytical capabilities and user experience. This tool allows users to examine and evaluate defect data via straightforward charts, graphs, and dashboards, making complex data more understandable and actionable. By visualizing trends, patterns, and anomalies, users may immediately identify significant concerns, track the effectiveness of corrective efforts, and make informed choices. Data visualization tools can also help improve defect reporting and communication to stakeholders by offering a clear and concise summary of the present condition. This addition not only improves the app's usability and efficacy, but also provides users with insights to drive continual improvement in defect management processes.

Implementing these recommendations will allow the organization to further optimize the Defect Monitoring Mobile Application (e-DM), improve project management across different sites, protect data security, and use technology to improve construction processes and outcomes.

5.4 CONCLUSION

The outcomes showed that Sunway Construction Sdn. Bhd. employees, including the project manager, quality assurance engineer, site engineers, and site supervisors, agreed that the Defect Monitoring Mobile Application (e-DM) was more effective than the previous method. The current method of use was considered primitive and difficult to execute. The respondents strongly agreed that the application was simple to use and expressed a desire to use it to acquire information on site progress preparation, as evidenced by their higher mean ratings (>4.00).

In addition, the Defect Monitoring Mobile Application (e-DM) is available as a mobile application, making it convenient and easy to use for all personnel. The researcher finds that technology is critical in the construction industry, enabling the creation of high-quality projects. The Defect Monitoring Mobile Application (e-DM) allows the company to decrease paper costs, save time, and implement an approach that is more systematic. Furthermore, technological adoption might lead to increased client demand for the company's services. Implementing technology in construction can also help Malaysia catch up with other successful countries across the world. Thus, technology in the construction industry is critical for the country's economic progress.

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APPENDIX

APPENDIX A : Questionnaire before developing the application

APPENDIX B : Expert Testing Instrument

APPENDIX C : Gantt Chart