POLITEKNIK UNGKU OMAR

E- MEGA COLUMN MANAGEMENT APPLICATION

NUR ASYIQIN BINTI ABDUL WAHID

(01BCT20F3016)

CIVIL ENGINEERING DEPARTMENT

SESSION 2 2022/2023

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Laporan ini dikemukakan kepada Jabatan Kejuruteraan Awam sebagai memenuhi sebahagian syarat penganugerahan Diploma Kejuruteraan Awam

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DECLARATION OF ORIGINAL AND OWNERSHIP

TITLE: E- MEGA COLUMN MANAGEMENT APPLICATION

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1. NUR ASYIQIN BINTI ABDUL WAHID (01BCT20F3016)

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In front of me, SUPERVISOR NAME ……
as project supervisor on date: ……. DR SERI BUNIAN BINTI MOKHTA

APPRECIATION

In the name of Allah SWT, most gracious, most merciful, peace and blessing be upon prophet Muhammad SAW, his family and his friend selected. Firstly, I want to offer my deepest gratitude must be towards Allah because of His grace and His guidance; I can enable complete this report “E- Mega Column Management Application”.

Thank you to my family because never missed to give me a support. They always encouraged me and prayed for me throughout the time of my research. This thesis is heartily dedicated to my parents who took the lead to heaven before the completion of this work.

Next, I convey my sincere gratitude to my academic supervisor Dr. Seri Bunian Mokhtar, without her kind direction and proper guidance this study would have been a little success. In every phase of the project her supervision and guidance shaped this report to be complete perfectly.

I also would like to express sincere thanks to Samsung C&T for giving me opportunity for me to complete my work-based learning session. This award is also given to anyone who is directly involved or indirectly assisted in the production of this project. Successfully completion of this project requires helps from a number of persons including my colleague members. I also have taken help from different people for the preparation of this report. Now, there is a little effort to show my deep gratitude to that helpful person.

Thank you.

ABSTRAK

Perancangan yang tidak mencukupi adalah isu biasa yang dihadapi oleh kontraktor apabila memulakan projek pra-pentauliahan. Pengurusan projek yang berkesan adalah bergantung kepada pelbagai faktor, termasuk pengurusan integrasi, yang penting untuk kejayaan penyelarasan individu dan proses peringkat pembinaan iaitu reka bentuk/perancangan, pra-pembinaan, perolehan, pembinaan dan pasca pembinaan dalam projek pembinaan. Oleh itu. tujuan kajian ini adalah untuk mewujudkan Aplikasi Pengurusan E-Mega Column. Aplikasi Pengurusan E - Mega Column telah dibuat menggunakan alat pengaturcaraan Mit App Inventor. Aplikasi ini telah diuji keberkesanan kebolehgunaannya kepada kakitangan syarikat menggunakan kaji selidik dalam talian yang diadaptasi daripada soal selidik Model Penerimaan Teknologi (TAM) termasuk empat pembolehubah paling biasa TAM iaitu Perceived Ease of Use, Perceived Usefulness, Sikap Terhadap Penggunaan Teknologi dan Niat Tingkah Laku untuk guna. Data dianalisis menggunakan Ujian-T berpasangan dan min. Keputusan ujian-t berpasangan menunjukkan bahawa Aplikasi Pengurusan Lajur E-Mega mempunyai perbezaan yang signifikan berbanding kaedah sedia ada. Ini bermakna Aplikasi Pengurusan E-Mega Column adalah lebih berkesan dari segi kebolehgunaan berbanding dengan kaedah sedia ada. Produk ini sangat disyorkan untuk digunakan dalam menguruskan penyelarasan individu dan proses yang berjaya dalam projek pembinaan.

KATA KUNCI: Pengurusan projek, Pencipta MIT, Model Penerimaan Teknologi, Lajur Mega, Aplikasi

ABSTRACT

Insufficient planning is a common issue faced by contractors when commencing pre-commissioning projects. Effective project management is dependent on various factors, including integration management, which is vital for the successful coordination of individuals and construction stage process which is design/planning, pre-construction, procurement, construction, and post-construction in construction project. Hence. the purpose of this study was to create an E-Mega Column Management Application. The E - Mega Column Management Application was created using the Mit App Inventor programming tool. This application was tested for its usability effectiveness to the company's staff using an online survey adapted from Technology Acceptance Model (TAM) questionnaire inclusive of four TAM most familiar variables which is Perceived Ease of Use, Perceived Usefulness, Attitude Towards Using Technology and Behavioral Intention to Use. Data were analysed using paired T-Test and mean. The paired t-test result showed that E-Mega Column Management Application has a significant different compared with existing method. This mean that E-Mega Column Management Application was more effective in term of usability compared with the existing method. This product was highly recommended to be used in managing successful coordination of individuals and processes within a construction project.

KEYWORDS: Project management, MIT Inventor, Technology Acceptance Model, Mega Column, Applications

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CIDB	Construction Industry Development Board

CHAPTER 1

INTRODUCTION

1.1 Introduction

Optimizing building construction management technology plays a vital role in enhancing construction efficiency, reducing costs, and meeting the evolving demands of the construction industry. With the advancements in construction technology, the management technology of construction can be optimized in various aspects such as project planning, resource allocation, procurement, construction process control, quality control, and risk management. Innovative construction management technologies and concepts such as Building Information Modelling (BIM), Lean Construction, and Agile Project Management can help construction companies streamline their processes, minimize waste, boost productivity, and enhance project outcomes. Besides, optimizing building construction management technology is crucial for the development of the construction industry. It not only helps establish a good work foundation, ensure construction safety, and improve construction quality, but also increases construction efficiency and reduces construction costs. Therefore, construction companies should actively explore and adopt new technologies and management concepts to optimize their construction management practices, meet the ever-changing requirements of the industry, and promote sustainable development (Mohsin K. Siddiqui, et al., 2022).

Next, there have some problem while construction project on going which is the management system imperfect, lack of refined control and poor dissipation of information. Construction management of building construction projects involves optimizing the use of construction technology based on the unique characteristics of each project, providing guidance for project management, and establishing a strong foundation that aligns with national and industry requirements, as well as relevant norms and standards for standardized construction (Yihui, 2022). Building construction is a complex process that involves multiple phases and

management elements, such as quality, schedule, and safety, which vary depending on the project. Thus, construction personnel must exercise precise control tailored to the project type to improve overall process efficiency. Unfortunately, the quality of construction personnel needs to be improved as they generally lack the knowledge of fine management, fail to integrate management concepts of quality, safety, and budget, and do not strictly control material procurement. As a result, construction projects suffer from inadequate consideration of factors from the perspective of fine management, a lack of prevention and control measures, and insufficient quality management of materials, machinery, society, and other aspects. Furthermore, during the engineering design phase, the budget is not fully set according to specific construction situations and site environments, nor is comprehensive analysis work carried out in advance to improve bidding management (kang, et al., 2022). This leads to problems in the project and affects the implementation of project design standards. Additionally, there is a lack of professionalism among workers, and the investment in talent management is insufficient. This results in an overall lack of staff quality and responsibility, which negatively impacts the quality and progress of the project. Safety risks during construction also increase without well-qualified staff and proper safety awareness. Finally, construction technology management is not precisely managed according to the actual situation, and the links between schedule, quality, and safety management are unbalanced. Construction personnel often apply simplistic, non-innovative, and inflexible construction management technology, affecting the overall effectiveness of construction.

Other than that, to effectively carry out building construction projects, it is crucial to implement information management technology that caters to the specific project requirements. However, the current construction industry lacks strict adherence to information management protocols, leading to incomplete and delayed information collection, inadequate analysis, and insufficient real-time information dissemination. Additionally, the established project model does not fully reflect the unique characteristics of construction projects, leading to inconsistencies among workers. These challenges impede the ability to make informed decisions, ultimately impacting the overall construction quality and project implementation (Zheng, Wen, & Qiang, 2020).

Further information, optimization measure of building construction management technology have a lot of characteristic among them is improving the management system. To ensure successful housing construction projects, it's essential to establish a suitable

management standard and system that aligns with the characteristics of the project. While innovative construction technology is essential, corresponding management support is equally important to ensure smooth construction processes. Therefore, it's necessary to define the project's construction requirements, organizational management objectives, control standards, and construction methods when creating the management system. Additionally, construction personnel should be guided to analyse relevant policies based on the project's actual situation and implement construction systems strictly. The management department should also monitor market trends, improve construction management standards according to regulations and policies, and guarantee that the construction quality meets the required standards (Huang, 2023).

1.2 Problem Statement

A construction project might run into a lot of difficulties. It is the responsibility of project managers to maintain a site's efficiency, safety, timeliness, and budget. This request can be very challenging at times. Establishing a precise management approach and implementing a comprehensive management system that emphasizes progress, safety, quality, cost, and other aspects is crucial during building construction projects. In addition, process supervision should be strengthened to ensure that the project adheres to established standards. To achieve this, construction personnel must perform a scientific analysis of the overall construction objectives, establish, and enhance the bidding management mechanism during the design phase, and select top-tier suppliers. In preparation for a construction project, it is essential to conduct a thorough evaluation of the construction design, analyse the construction site environment and relevant data, and meticulously examine all aspects of the construction process using the appropriate data models. These steps are necessary to formulate a comprehensive design and organizational plan. Throughout the construction process, cost control is critical, and the management of materials, equipment, and personnel at all stages must be closely monitored, including pre-construction, construction, and completion. In addition, the budget must be implemented and evaluated quantitatively to ensure that it meets the design requirements, optimize resource allocation, and minimize waste (Zheng, Wen, & Qiang, 2020) . A serious lack of planning is one of the most frequent problems contractors have when starting a site preparation project. The inclination, terrain, and general land arrangement differ from site to site. No matter how skilled a professional, every preparation work will inevitably create different difficulties. Poor planning directly leads to inefficiencies. There is an issue if the contractor you employ merely shows up on site and wants to get started right immediately, even if they have a team of experts dressed in identical uniforms. The right team will want to come out and provide some form of analysis if you engage them. They won't just show up and start setting up the site because they can't determine which machines will function best or what strategy will work best prior to looking at the location.

Ineffective site management may cause project delays and slower growth. Regardless of how difficult the project is, delays happen in the majority of construction projects. Delay in construction projects is the lengthening of the project's completion time. In other terms, a delay is when a project isn't finished on schedule and within the allocated money, as specified in the contract (Sanni-Anibire, Zin, & Olatunji, Causes of delay in the global construction industry: a meta analytical review, 2020). In this problem statement shows a problem that often occurs in construction which is delay is a big common issue that often happens in works on construction sites in any project across the country. The importance of delay in construction projects and the factors affecting delay are explored by many researchers in the past. The author was reviewed and described those 25 recent articles and based on the review, identified most important factors that are affecting delay in construction comes from small issues and poor administration (Shrivas & Singla, 2020).

Providing a basis for contractual commitments between owner and contractor, as well as between contractor and subcontractors (e.g., project manager). Obtaining a better understanding of the objectives, clarifying them, and maximizing the probability of attaining them. Preparing a preliminary model and general guidelines for future plans, to allow sufficient lead timelines for future plans to allow sufficient lead time and to maintain continuity and global perspective. Furthermore, preparing a forecast of performance (product-oriented plans) for ongoing project control and as premises for owner's future planning. For that purpose, planning was classified into functional areas or construction plans, under the following headings: engineering and method (main construction technology), organization and contract, schedule, cost and cash flow, major equipment, site layout and logistics, work methods, manpower allocation and materials allocation. Poor planning in the beginning of the project, according to will cause delays at different phases all throughout the project. As a result, skilled labour and a contractor are needed, particularly for large and mega projects. The project plan can be accelerated, and time burn during delays can be overcome with effective planning and management. Integration refers to coordination among processes. Integration management is one of the most important elements of project management, which encompasses all aspects of a project. Project integration management ensures the successful coordination among project activities (Mills, Nasirzadeh, & Vahabi, 2020). Construction projects vary with the course of development, planning, realization and operating. Despite their uniqueness, recurrent processes of these phases can serve as a cornerstone for the recognition of risks in order to consider project-specific and known risks more closely.

Researchers have made several solutions to the issues that contribute to inefficiencies, which have caused numerous issues for both contractors and other parties. Effective material management is crucial in construction projects as it can lead to cost savings and improved quality. Unfortunately, some manufacturers may compromise on material quality to increase profits. Additionally, some purchasing personnel may intentionally buy substandard materials for personal gain, resulting in material problems and compromising the construction quality, which can lead to safety risks when the building is in use. To enhance material management in construction, measures such as controlling material prices, prohibiting shoddy work, implementing a robust purchasing process, creating a scientific purchase plan, and ensuring the purchased materials meet quality requirements are necessary. These actions can help minimize construction costs and improve construction quality (Parsamehr, Perera, Dodanwala, Perera, & Ruparathna, 2023). Afterwards, in Malaysia some project construction management in terms of aspect time, cost, quality, and project scope are the main determinants of project success. Because they lacked effective management at the time, the majority of projects in the past had trouble with those essential indicators in finishing a project within the time frame stated with a constrained budget.

Table 1.1 Research Finding on IoT

Authors (Year)	Resources	Findings
(Zheng, Wen, & Qiang, 2020)	Understanding Demand for Project Manager Competences	i. necessary to control the cost, strengthen budget management of materials, equipment and personnel at various stages such as preconstruction, construction, and completion.
(Sanni-Anibire, Zin, & Olatunji, Causes of delay in the global construction industry: a meta analytical review, 2020)	Causes of delay in the global construction industry: a meta analytical review	i. Ineffective site management may cause project delays and slower growth. ii. Delay is when a project isn't finished on schedule and within the allocated money, as specified in the contract
(Shrivas & Singla, 2020)	Analysis of interaction among the factors affecting delay in	i. identified most important factors that are affecting delay in construction comes from small issues and poor administration.

Authors (Year)	Resources	Findings
	construction projects using interpretive structural modelling approach	
(Mahmud, Assan, & Islam, 2018)	Potentials of Internet of Things (IoT) in Malaysian	i. Each revolution has had socio-economic impacts on industries, either positive or negative. In the construction industry, the adoption of smart and digital technologies has had a positive impact on project performance and productivity.

Nowadays, the construction industry has been focusing on the concept of the Industrial Revolution (IR) which has become a central topic in recent times. The term 'Industrial Revolution' was coined by the founder and executive chairman of the World Economic Forum, who defined it as a shift from traditional methods to modern ones, incorporating advanced or smart technologies to enhance productivity to its maximum potential (Schwab, 2017). The Fourth Industrial Revolution is an extension of the Third Revolution, which introduced computers and automation during its course (Lekan, Aigbavboa, Babatunde, Olabosipo, & Christiana, 2020). The main focus of the Fourth Industrial Revolution is on digitalization, achieved through Cyber-physical Systems, Internet of Things (IoT), and networking. This transformation is supported by nine pillars, which include advanced robotics, additive manufacturing, augmented reality, simulation, system integration, IoT, cloud computing, cyber-security, and big data analytics. The integration of these pillars has had a significant impact on the construction industry, enabling the efficient and effective management and control of the entire construction process. Each revolution has had socio-economic impacts on industries, either positive or negative. In the construction industry, the adoption of smart and digital technologies has had a positive impact on project performance and productivity. These technologies have helped in saving construction time, reducing costs, minimizing defects or clashes, improving construction quality (including safety and client satisfaction), and streamlining the project management lifecycle. Building Information Modelling (BIM) is an example of a smart technology that has played a crucial role in these positive impacts (Mohammed , et al., 2022).

Although with the IoT application, product development is easier to handle because the entire project progress is digitally tracked through the visualisation of the 3D model. Project management can better utilise project resources, keep track of vehicle equipment, monitor project progress, identify faults and conflicts sooner, give real-time reporting, and control project scheduling and expenses thanks to the digitalization of 3D models. However, not many of the researchers involved in the early studies used MIT App Inventor in their planning. Therefore, the purpose of this study is to develop E- Mega Column Management Application using MIT App Inventor that can help and easier to conduct the project.

1.3 Objective

In terms of planning for construction stage, the goal of this project is to offer a better project management solution. With the use of just a mobile application, this system enables project managers, engineers, consultant, and also sub-contractor to access all information about the site progress and activities that need to be completed at anytime and anywhere. The specified objective includes:

i. To design an E-Mega Column Management Application that can allows users to access information on the details of site work progress.
ii. To develop E-Mega Column Management Application using MIT App Inventor.
iii. To test the usability of E-Mega Column Management Application.

1.4 Scope of Study

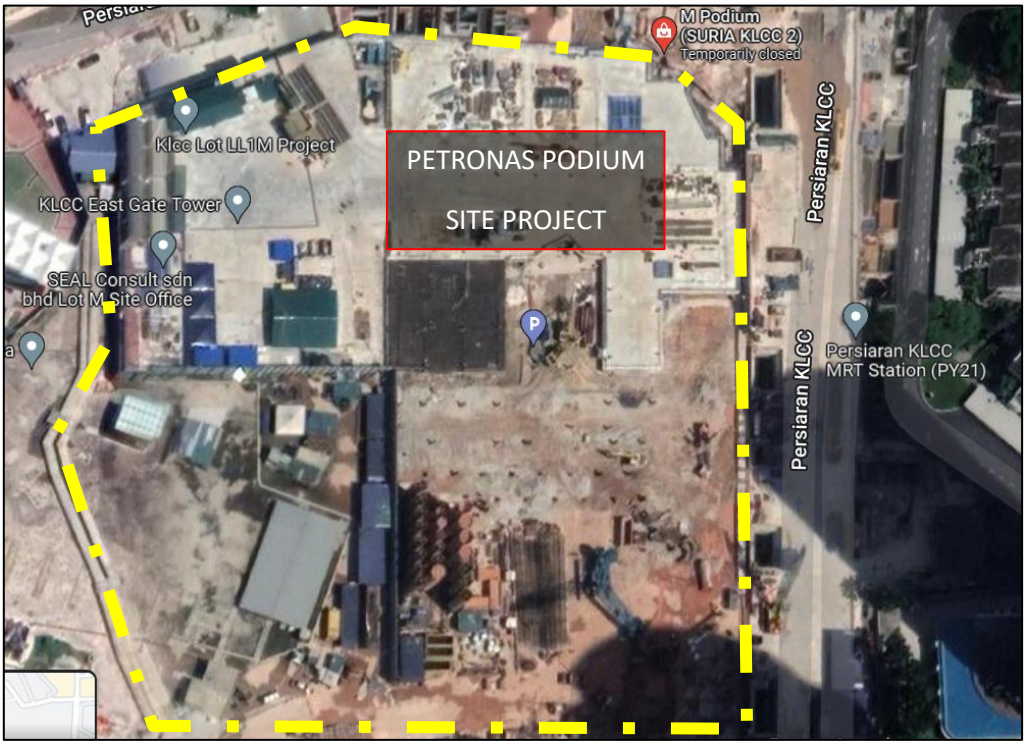


Figure 1.1: The location of [LOT LL1M] Petronas Podium site project

As shown in figure 1.1, the scope of study focusses on the Petronas Podium site project. This project of application will allow all engineers, site supervisor, consultant and also subcon to access the details of work need to be done, and all the details that always up to date need to be used at the site project while project is ongoing/running at that time. These app details will be available for users to use for administrative and informational purposes. To make sure that the user will be able to complete that task by using the E- Mega Column Management Application, this application will have a great deal of possibilities to be used in any construction project.

1.5 Significance of Study

Based on the study, Insufficient planning is one of the errors that construction management frequently commits. E-Mega Column Management Application software can let project managers and engineers access information about the progress of the mega column and tasks that need to be completed at any time. Users can simply receive information on the project's procedure and specifications due to this application.

This apps also enable construction managers, engineers and other interested parties to obtain the information about batching plant and casting task, location and also concrete results without having to contact the supervisor or engineer to always up to date at group WhatsApp's to know how the results of concrete or progress while work of batching plant or pouring is ongoing. Furthermore, this application will save time and prevent project delays because all tasks involving all progress work that always up to date can be pre-planned. Additionally, users of this application may make sure that the necessary task can be completed flawlessly. This is due to working on a building site makes it simple for everyone to get results.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The construction industry has seen the evolution of Building Information Modelling (BIM) into a vital digital tool. Concurrently, advancements in Artificial Intelligence (AI) have enabled effective handling of extensive data in complex and uncertain scenarios. The combination of BIM and AI can enhance construction management and add value. The concept of production planning is being considered in construction since Koskela pointed out the importance of the flow and value production as impartible components of the production system. The production system is defined as a set of resources, such as labour, equipment, tools, and information, defined for the design and production of a product (goods or services) that is valuable to customers (Parsamehr, Perera, Dodanwala, Perera, & Ruparathna, 2023). The construction industry is therefore exposed to greater risks in comparison with other industries due to their unique features such as long project durations, complicated processes, financial intensity, environment constraints and dynamic organization structures. As a result of this, many constructions work in Malaysia consists of a high-risk process that requires a proper follow-up operation involving supervision, implementations and project completion. These risks are generally considered as incidences that influence the principal objectives of a particular project such as the time, cost and quality as reported by (Bahamid , Doh, Khoiry, A. Kassem, & Al-Sharafi, 2022)

The construction industry has been the subject of academic research, but most studies focus on technology-driven design rather than product demand. This lack of research can impact consumer demand and hinder industry growth, which has been performing worse than the overall economy during recessions. Understanding the correlation between economic growth and the construction industry's output components, including commercial, residential, and civil engineering, is critical. The construction industry is a significant economic sector, involving large investments, high costs, and multiple components. Therefore, conducting a demand analysis for each product type is essential to determine the economic impact on

Malaysia's construction sector. A thorough investigation of the industry's development trends is necessary to plan and organize systematically and proactively to face the industry's challenges during a recession (UKEssays, 2018).

Nevertheless, a nation that is at the vanguard of developed nations is greatly impacted by new technology. Make use of Malaysian development construction technology to simplify all the work that has to be done. It is still possible to minimise the use of conventional construction methods in this technological area. As a result, the use of technology in the construction industry will be advantageous because it can increase productivity and save time. Furthermore, it can be used anywhere and makes daily work easier with the touch of a finger thanks to innovations like applications or software systems. To identify current research knowledge, the researcher will present a summary of the literature on the conclusion of ongoing study in this chapter. Predicting a superior resolution to the issue is also appropriate in addition to the previous point. A better answer for the researcher might come from a prior case study involving the other researcher.

2.2 Construction management problem

The planning and execution of construction projects require thorough planning and stringent oversight to achieve success. Across industries and countries, such projects have always presented significant challenges to project teams and stakeholders, including but not limited to issues such as delivery delays, cost overruns, quality control, and profitability. Moreover, due to the inherent nature of construction, it is an industry with inherent risk. One of the factors that contribute to this risk is the difficulty in accurately forecasting project duration. Contractors who estimate projects without a complete understanding of the time components expose themselves to unnecessary risk and potential delays. On previous research, In Africa, many projects have not met the conventional criteria for project success, including timely delivery, adherence to budget, and required quality standards. This has led to a significant impact on the already limited resources of the continent, resulting in the loss of additional resources for initial project implementation, the need for infrastructure maintenance before its scheduled period, and other related issues. While there are various reasons for these failures, the primary reason appears to be the construction industry's failure to embrace

professionalism. Currently, projects are initiated, planned, and executed without following professional project management principles and practices, leading to inefficiencies and ineffectiveness (Padala, Maheswari, & Hirani, 2020).

The construction industry continues to suffer from efficiency and productivity losses such as delays. The effects of delays may include time and cost overruns, litigation and project abandonment. Thus, the global research domain is saturated with studies investigating the causes of construction delay (Sanni-Anibire, Zin, & Olatunji, Causes of delay in the global construction industry: a meta analytical review, 2022). Any project's entire building phase is a crucial time period where a lot of unanticipated events could happen. It will cost more and take longer to complete a building project if the unknown component that caused the issue is not identified. Project delays are time overheads that occur after the project's scheduled completion date and can have an effect on both the owner and the contractor, notably in terms of budget (Bahamid , Doh, Khoiry, A. Kassem, & Al-Sharafi, 2022).

As a result, skilled labour and a contractor are needed, particularly for large and mega projects. The project plan can be accelerated and time burn during delays can be overcome with effective planning and management. Based on these findings, this study classified the delay causes under major groups, for example, client, contractor, consultant, design team, financing, manpower and equipment, project, material, contract, and contractual relationship and external. Besides, from the existing literature, many causes of delay have been identified. According to prior study, there are a variety of factors that contribute to construction project delays. Many different causes of delay were contractor’s experience client’s inadequate financial resources and payments for completed work problems with subcontractors, shortage in material, labour supply, equipment availability and failure , lack communication between parties and mistakes performance of large construction in many countries were conducted some research on time performance of construction in Africa (Padala, Maheswari, & Hirani, 2020). The following are elements that have been researched by researchers is :

i. Shortage of materials
ii. Productivity of labour
iii. Qualification of Contractor
iv. Performances of Contractor

v. Site management
vi. Decision making
vii. Feasibility studies
viii. Weather conditions

i. Shortage of materials

The findings indicate that material-related factors are a critical cause of delays in construction projects across 13 African countries. Material shortages in local markets have resulted in some projects being on the brink of termination. The situation is exacerbated by a liquidity crisis, making it challenging for contractors to acquire necessary materials in sufficient quantities and within the required timeframe. Additionally, materials suppliers are hesitant to provide materials on credit as contractors usually pay only upon receiving payment themselves (Padala, Maheswari, & Hirani, 2020). Shortages of construction materials can have a significant impact on the progress and completion of construction projects, leading to delays and increased costs. Material shortages can be caused by a variety of factors, such as disruptions in the supply chain, production shutdowns, transportation issues, natural disasters, and market imbalances. In some cases, material shortages can result in construction projects being delayed or even cancelled. This is because delays in obtaining materials can cause delays in construction schedules, leading to cost overruns and missed deadlines. When materials are in short supply, prices can also increase, making it more expensive for contractors to purchase the necessary materials.

ii. Productivity of Labour

To avoid project cost overruns and delays in construction project completion, knowledge and consideration of numerous factors affecting construction labour productivity are required (Vidaković, 2020) Working overtime has become one of the factors that can decrease labour productivity in rural areas due to labour shortages and project schedule pressures, resulting in project delays.

iii. Qualification of Contractor

Contractors are less interested in bidding on rural projects than on urban projects due to low rates of skilled labour (Ramli, et al., 2018)

iv. Performances of Contractor

One of the challenges for the contractor in rural projects is the contractor's limited ability to communicate, and they typically do not use scheduling software to reduce the risk of project delays (Ramli, et al., 2018).

v. Site Management

Poor site management is one of the factors influencing the timeline of a construction project. Difficulties with material delivery to the site and dealing with waste or disposal from the project site are related to project management (Perrier, et al., 2020).

vi. Decision Making

Slow decision making will have an impact on the entire construction project. Delays in decision making occurred in rural construction areas due to the extensive physical distance between those involved in the construction project (Wang, Deng, Wang, Peng, & Yu, 2022). One study in a rural area revealed that supervisors at the project site primarily used mobile phones and digital cameras to monitor project progress, as well as e-mail communication to communicate with each other, which lengthens the decision-making process (Perrier, et al., 2020).

vii. Feasibility Studies

One of the factors that contributed to construction project delays was a lack of knowledge and feasibility studies. One of the challenges in rural areas is a lack of historical data and information about the project area (Ramli, et al., 2018).

viii. Weather Condition

The labour productivity of a construction project can be disrupted by a climatic factor. Previous research on rural and urban climate found that urban areas have wetter climates than rural areas due to the effects of topography and urbanisation. In theory, IoT is made up of four layers: the application layer, the perception layer, the network layer, and the physical layer. The application layer refers to common practises such as smart cities, smart transportation, and intelligent homes; the perception layer, on the other hand, refers to technologies such as sensors and devices that communicate with other objects. The network layer is the component of network coverage and network communication. The hardware, which includes smart appliances and other devices, is referred to as the physical layer (Syed, Sierra-Sosa, Kumar, & Elmaghraby , 2021).

There are numerous benefits to implementing IoT in the construction industry. These include improved execution monitoring, effective control, higher quality, lower costs, and shorter turnaround times. Because of the availability of real-time data analytics, it has also been expanded to be used in making quick decisions. Furthermore, it improves crisis management and emergency response by introducing efficient structure monitoring (Zhou, Wu, Xu, & Fujita, 2018). The Internet of Things technology can be applied to environmental issues such as waste management, pond pollution, and flood concentration analysis (Wei & Li, 2011).

The introduction of new technology is fraught with difficulties, which can be divided into three categories: method of introduction, lack of acceptance, and lack of knowledge and expertise This study aims to investigate construction parties' awareness of IoT application and significance; it then identifies the challenges of implementing IoT in construction projects; and finally, it determines the dominant challenges of implementing IoT in the construction industry.

IoT has been widely used in a variety of fields, including consumers, commerce, and infrastructure (Gamil, Abdullah, Rahman, & Asad, 2020). Because of the complexity of construction projects and the high risk of failure, which limits the application, it is difficult to adopt and embrace new technology in the construction sector. Despite these challenges, IoT has been used in the construction industry, with one of the leading applications being the monitoring and control of project executions in a variety of projects such as bridges, railways, tunnels, onshore and offshore facilities (Gamil, Abdullah, Rahman, & Asad, 2020)

It has also been used to monitor building performance during disasters, as well as provide real-time safety warnings and risk detection. According to investigated a wide range of IoT applications in construction, such as smart city design, smart housing, and smart transportation. According to (BIM Engineering U.S, 2018), the following are the most common IoT applications in the construction industry:

a) Preventive Maintenance is essential for on-site machineries where any breakdown is monitored by the embedded system and sensor in the machine to report any need for repair that necessitates maintenance.
b) Reduce administrative expenses by providing data-driven options that aid in the production of accurate forecasts, with the data being used to make quick and precise decisions.
c) Monitoring and Observation in Real Time The information obtained from sensors and embedded systems can be used to monitor the construction process, which also aids in the production of accurate decisions.
d) Construction Management IoT helps to avoid downtime and provides advanced communication with all things such as materials and trucks by assisting decision makers in reducing cost overruns caused by excessive use of materials and machinery.
e) Human Resource Monitoring: IoT assists in tracking the estimated labour hours for any given assignment.
f) On-Site Safety: IoT allows for the tracking of labour on-site and the monitoring of their mobility, which aids in the detection of any hazards that may arise.

2.3 The Fourth Industrial Revolution (IR 4.0)

The Fourth Industrial Revolution (IR 4.0) is based on the Digital Revolution, in which technology and people are linked. The technological breakthrough has discovered new ways to demonstrate its capabilities by blurring the distinctions between physical, digital, and biological entities (Ćwiklicki, Klich, & Chen, 2020). The revolution not only presents modern techniques to support every component of industry, but also sustainability (Alaloul, Liew, Zawawi, & Kennedy, 2020) with renewable energy and energy efficiency being two key components. Renewable energy continues to contribute some percent of consumption, where energy efficiency is influenced by technological innovations in the industry, despite the

difficulty of implementation. The IR 4.0 aims for a viable and sustainable manufacturing system (Alaloul, Liew, Zawawi, & Kennedy, 2020), with a higher level of complexity for integrating production and product processes, where it becomes a part of a sustainable system (Demartini, Tonelli, & Govindan, 2021). All three dimensions of sustainability, social, economic, and environmental, are valued in the creation of a sustainable industry through the use of Industry 4.0 and used for long-term competitiveness. It is critical to consider tactical, operational, and strategic dimensions to have a short and long-term impact on sustainability (Mosavi, et al., 2020).

The progression has altered manufacturing processes by focusing on areas of specialisation, resulting in positive economic prospects. The government of Germany, which originated this futuristic idea, supports it by endorsing the automation of industrial processes. IR 4.0 has been established as a term for the industrial development process comprised of automation and data exchange, and it was first introduced to the public as "Industries 4.0" with the goal of driving IR 4.0 implementation within the German manufacturing industries (Alaloul, Liew, Zawawi, & Kennedy, 2020). This Working Group was formed by a variety of representatives from various backgrounds. The IR 4.0 workgroup created a strategic application work plan to boost German industrial competition globally, which led to the German federal government incorporating it into its 2020 High-Tech Strategy (Marr, 2020)

The digitization, automation, and widespread use of Information and Communications Technology (ICT) in the industry are referred to as IR 4.0. These technologies include cyber-physical systems, the Internet of Things (IoT), cloud computing, and cognitive computing. The industry has completely overturned three previous revaluations, each of which had a significant impact on its practises and productivity. Steam power was the transformative energy in the nineteenth century, and electricity appeared more prominently in the twentieth, before significant computerization began the third major change. The industry will reach the IR 4.0 epoch in the twenty-first century, with intellect as its most important asset. IR 4.0 is defined by a fusion of skills that blurs the distinctions between physical, digital, and biological scopes (Alaloul, Liew, Zawawi, & Kennedy, 2020). The key concepts of IR 4.0 were first published in 2011. It will transform the industry as profoundly and irreversibly as its three predecessors, and it will do so faster. Despite the excessive focus on the perception of IR 4.0 universality, there is no official description for it. However, it can be defined as "the integration of complex physical machinery and devices with networked sensors and software, used to predict, control,

and plan for better business and societal outcomes," or "a new level of value chain organisation and management across the lifecycle of products" (Mrugalska, 2017)

2.4 MIT App Inventor

MIT App Inventor is an environment that leverages a blocks-based visual language to enable people to create mobile applications (”apps”) for Android devices (Xie & Abelson, 2016). An App Inventor project consists of a set of components and a set of program blocks that provide functionality to these components (Blocky, 2016) Components include items visible on the phone screen (e.g. buttons, text boxes) as well as non-visible items (e.g. camera, database, sensors). App Inventor has been used in 195 countries and is taught in formal education environments and also self-taught (Xie & Abelson, 2016). It is taught to people ranging in age and experience from late elementary school students to professionals and end-user developers (Tutorials for MIT App Inventor, 2016). Our analytics find that 50% of users program with App Inventor outside of formal educational settings. These self-taught learners primarily learn by following stepby-step app creation tutorials (Tutorials for App Inventor, 2016). Our vision is to understand how people learn computational thinking using App Inventor so that these online, informal learning experiences can be integrated into STEM curricula. The Internet of Things (IoT) has revolutionized traditional lifestyles into high-tech ones, creating smart cities, homes, and industries, among others. IoT has also played a significant role in areas such as pollution management, energy conservation, smart transportation, and libraries. Although there have been numerous key research studies and investigations to advance technology through IoT, there are still several challenges and issues that need to be addressed to fully realize its potential. These issues and challenges need to be evaluated from various angles, including applications, obstacles, enabling technologies, as well as social and environmental effects.

This study investigates how users of MIT App Inventor might improve their computing abilities. We focus on the connection between mastering App Inventor-specific abilities (allowing app functionality) and mastering skills transferable to other programming domains (computational concepts). We track the development of skills along two dimensions: breadth and depth. Our data represents a haphazard sample of users with at least 20 projects under their belts. We determine the depth of capability for each user by considering the total number of block types at each project as well as the number of new block types introduced at each project.

To compare the development of shown expertise, we isolate blocks that relate computational principles from other blocks. Because it is inexpensive to deploy and has a wide range of potential applications, mobile MIT App Inventor is expected to gain a stronger presence in the construction industry. Its primary challenge is to create scalable applications that can easily conform to the current task or environment for construction.

2.5 Previous Studies

The Internet of Things (IoT) is becoming increasingly important in almost every industry, including construction, where internet connectivity has become the primary medium of communication between humans and technology (Ibrahim, Esa, & Rahman, 2021) According to (Hendriks, 2016), the Internet of Things (IoT) is defined as "intelligent interactivity between humans and things to exchange information and knowledge for the creation of new value." Meanwhile, previous researchers defined it as "a technology that acts as a tool to streamline the communication between smart devices and humans through sensors, actuators, networks, and any other complex IoT integrated system by transferring or sharing the data into digital information, which is essential to effectively monitor, measure, and optimise the industry's productivity" (Ibrahim, Esa, & Rahman, 2021)

As illustrated by (Hendriks, 2016) in Figure 2.1, the concept of IoT consists of three major components: connected things, connectivity and infrastructure, and analytics and apps. According to (Hendriks, 2016) in Malaysia's National Internet of Things (IoT) Strategic Roadmap, the concept of "connected things" refers to smart devices with sensors that detect environmental parameters and transmit the data to a cloud network. Then, data integration and processes are created to generate useful information that can be accessed by all parties involved in the same project via internet connectivity. Finally, the information will be transformed into relevant apps for further action, contributing to accurate project decision-making.

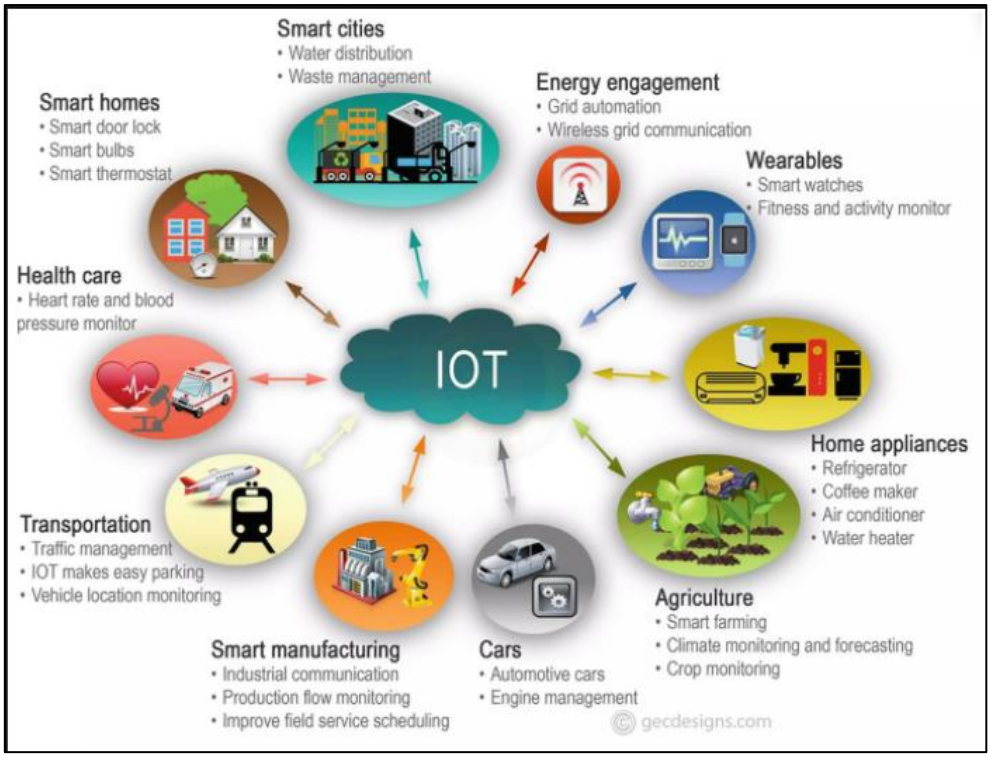


Figure 2.1: The concept of IoT (Embrosio, Mota, Anaya, Bermejo, & Rosales, 2018)

2.6 Site Monitoring

Site monitoring is an important part of the construction process because it ensures that the project's development and the construction site's environment remain smooth and on track at all times (Loosemore, Keast, Barraket, Smith, & Alkilani, 2022). Construction site monitoring is divided into two parts: tracking of human (track worker) and machinery (track machinery) activities on site (Sepasgozar, et al., 2023). The use of IoT for monitoring is to assist the project team in staying on track and automatically recording the massive volume and variety of data throughout the entire project lifecycle, which cannot be handled manually by the project team. Furthermore, information from human tracking and machinery is recorded using GPS, RFID, sensors, and drones via IoT.

2.7 Construction Safety

Construction Safety is of the utmost importance in the construction industry to ensure the safety of both site workers and project teams during the construction process (Singh & C. Misra, 2021). Adoption of IoT practises in the construction industry will make it easier for project managers to track workers' activity, location, and site hazards more efficiently (Olatunde, et al., 2022). When potential hazards are identified, the operators will send a safety alert to the construction site to protect workers from accidents that may occur on the job (Singh & C. Misra, 2021).

Project Management, the primary key indicators for project success in project management are time, cost, quality, and project scope (Loosemore, Keast, Barraket, Smith, & Alkilani, 2022). Previously, most projects encountered difficulties with those key indicators in completing a project within the time frame specified with a limited budget because they lacked efficient management at the time (Stone, 2023). However, with the IoT application, project management becomes more manageable by digitally monitoring the entire project progress using 3D model visualisation. The digitalization of 3D models enables project management to better utilise project resources, monitor vehicle equipment, track project progress, detect errors and clashes earlier, provide real-time reporting, and manage project scheduling and costs (Olatunde, et al., 2022)

2.8 Building Information Modelling (BIM)

Building Information Modelling (BIM) is a new technology approach in the construction industry that improves the planning, design, construction, and documentation processes in order to design, analyse, construct, and manage the project lifecycle (Olanrewaju, Kineber, Chileshe, & Edwards, 2022). The process begins with developing, utilising, and transferring project information via a digitalisation system of 3D model to visualise the true picture of the project in which all project information from various aspects is integrated (Abdul Hamid & Abdul Rahim, 2022). BIM has five main characteristics: "visualisation, coordination, simulation, optimization, and plotting ability" (Alaloul, Liew, Zawawi, & Kennedy, 2020). Simultaneously, BIM is useful for improving project performance by identifying project clashes and errors earlier before the project begins, as well as improving project team collaboration, communication, and decision making. In relation to IoT applications, one of the

IoT components that is important to ensure information and software interoperability is the digitalization system and data integration in cloud computing.

2.9 Conclusion

Finally, the building sector is utilising technology. Construction firms that develop in and use technology contribute to higher production, better teamwork, and outcome of the project on time and within budget, all of which lead to higher gross margins. Even though it may be a bitter pill to chew, businesses who do not invest in cutting-edge technologies and solutions are falling behind those who do. Construction firms that don't use new technologies will collapse. Last but not least, construction industry and the digital revolution of the sector present a number of exciting prospects, from gaining a competitive edge to improving working conditions for people and lowering the carbon footprint of our globe. In the future, all corporate businesses will be required to use modernization technology, the researcher predicts, and the construction industry will reach a stage where it is no longer an option.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Innovative research methods refer to novel and creative approaches employed to gather data, generate insights, and explore new ideas in the research process. These methods are designed to address unique challenges, explore uncharted territories, or provide alternative perspectives to traditional research approaches. They can be particularly useful in fields where traditional methods may be inadequate or where there is a need for fresh approaches to tackle complex problems.

The use of innovative research methods can bring several advantages to the research process:

a) Uncovering new insights: Innovative methods can help researchers uncover new perspectives, phenomena, or relationships that may not be captured by conventional methods. By thinking outside the box, researchers can discover novel patterns or understandings that contribute to advancements in knowledge.

b) Enhancing data collection: Innovative methods offer diverse ways to collect data beyond traditional surveys or interviews. They may include approaches such as participatory research, ethnography, arts-based methods, or data mining from non-conventional sources. These methods can provide rich, contextualized, and multidimensional data, enabling a deeper understanding of the research topic.

c) Engaging participants: Innovative methods often involve active participation from research participants, empowering them to contribute meaningfully to the research process. This participatory approach can foster collaboration, co-creation, and shared ownership of research outcomes.

d) Flexibility and adaptation: Innovative methods are often adaptable to different research contexts and can be tailored to fit specific research goals. They offer flexibility to accommodate evolving research questions and emerging insights, allowing researchers to adapt their approaches as the research progresses.

e) Cross-disciplinary collaborations: Innovative research methods often draw from multiple disciplines, encouraging interdisciplinary collaborations. This interdisciplinary approach can lead to fresh perspectives, creative problem-solving, and the transfer of knowledge between fields.

Examples of innovative research methods include design thinking, arts-based research, virtual reality simulations, mixed methods approach, big data analytics, social network analysis, and citizen science initiatives. These methods can be applied across various research domains, including social sciences, healthcare, technology, sustainability, and more.

While innovative research methods offer exciting opportunities, they also come with challenges. These challenges may include the need for specialized skills or resources, potential biases or limitations, ethical considerations, and the necessity for rigorous validation and replication. Researchers must carefully consider the suitability, validity, and reliability of the chosen methods to ensure robust and trustworthy research outcomes.

In conclusion, innovative research methods provide researchers with alternative ways to approach data collection, generate insights, and explore new frontiers. They offer opportunities to uncover fresh perspectives, engage participants, and address complex research questions. By embracing innovative approaches, researchers can expand the boundaries of knowledge and contribute to advancements in their respective fields.

3.2 Design of the Research

Research design for innovation involves the systematic and structured approach to planning, conducting, and evaluating research activities aimed at developing and implementing new ideas, processes, products, or services. It provides a framework to guide the research process and ensure that the objectives of the innovation are met effectively. The research design for innovation typically consists of several key components:

a) Problem Definition: Clearly defining the problem or challenge that the innovation aims to address. This involves understanding the current limitations or gaps in existing solutions and identifying the specific problem statement.

b) Objectives and Research Questions: Establishing clear objectives and research questions that guide the research process. These objectives and questions should be aligned with the intended outcomes of the innovation and provide a focus for the research activities.

c) Literature Review: Conducting a comprehensive review of existing literature and relevant research findings related to the innovation area. This helps in understanding the current state of knowledge, identifying gaps, and building a theoretical foundation for the research.

d) Methodology: Selecting an appropriate methodology or combination of methodologies to gather data and information. This could involve qualitative methods such as interviews, focus groups, or observations, as well as quantitative methods like surveys, experiments, or statistical analysis. The choice of methodology depends on the nature of the innovation and the research objectives.

e) Data Collection: Collecting data using the chosen methodologies. This could involve primary data collection through surveys, interviews, or experiments, or secondary data collection from existing sources such as industry reports, databases, or case studies. Ensuring data validity and reliability is crucial in producing reliable and accurate findings.

f) Data Analysis: Analysing the collected data using suitable analytical techniques. This may involve qualitative data analysis methods such as thematic analysis or content analysis, as well as quantitative data analysis techniques like statistical analysis or data modelling. The analysis should be aligned with the research questions and aims to derive meaningful insights from the data.

g) Findings and Recommendations: Summarizing and interpreting the research findings and drawing conclusions based on the analysis. The findings should address the research objectives and contribute to the understanding and development of the innovation. Based on the findings, recommendations can be made for further improvement, refinement, or implementation of the innovation.

h) Implementation and Evaluation: Planning and executing the implementation of the innovation based on the research findings. This may involve iterative cycles of testing, refining, and implementing the innovation in real-world settings. Evaluating the impact and effectiveness of the innovation is essential to assess its success and identify areas for improvement.

The research design for innovation is a dynamic and iterative process that requires flexibility, creativity, and collaboration. It allows for the systematic exploration of new ideas, validation of concepts, and evidence-based decision-making to drive successful innovation outcomes. Table 3.1 presents the objectives, materials, and purpose of the E-Mega Column Management Application, as well as the methodology employed in its development.

Table 3.1 Design Research

Objective	Material	Method
To design an E-Mega Column Management Application that can allows users to access information on the details of site work progress.	. Background Company . Planning and progress of work . Problem on site progress . Schedule	Design
To develop E-Mega Column Management	. MIT App Inventor	Develop
To evaluate the efficiency of E-Mega Column Management	. Google Form . Department of Construction A , QAQC ,Sub Contractor and Batching plant	Survey

3.3 Development of the Research

The development of research refers to the process of planning, designing, and implementing a research study to address a specific research problem or question. It involves several key stages that are essential for conducting a rigorous and systematic investigation. Here are the main steps involved in the development of research (Figure 3.1).

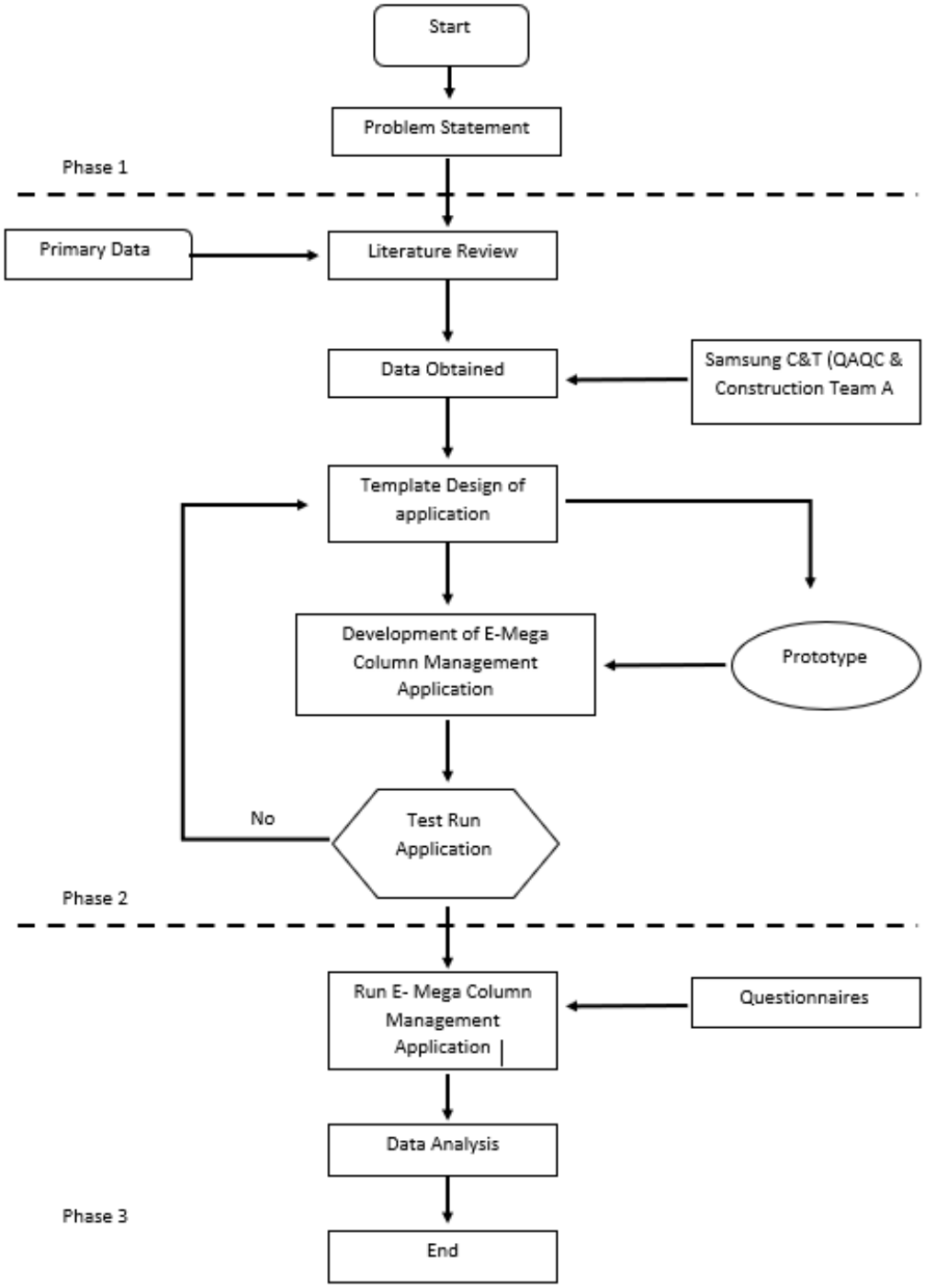


Figure 3.1 Flow of research framework of methodology

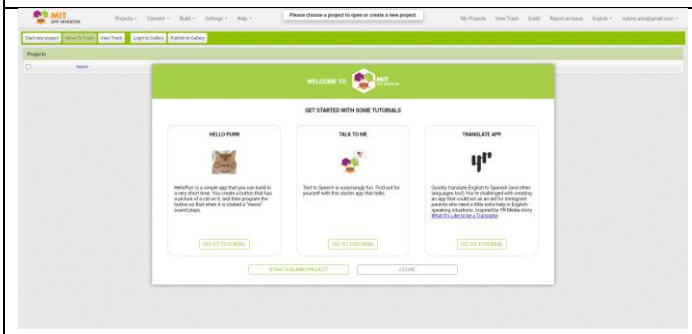
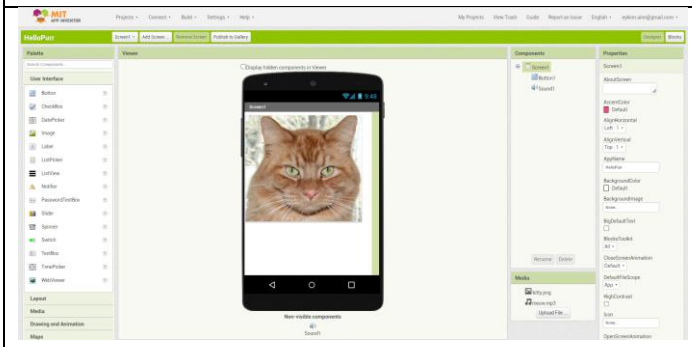
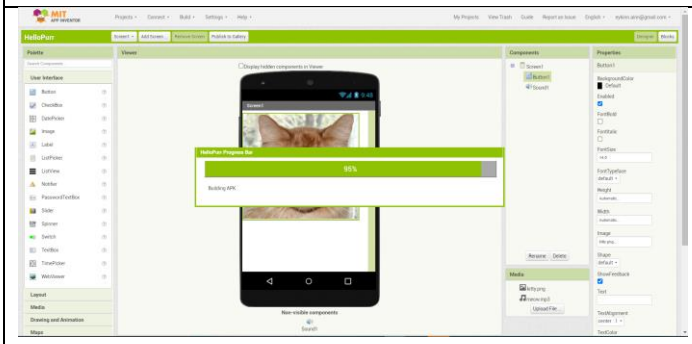
3.4 System Design

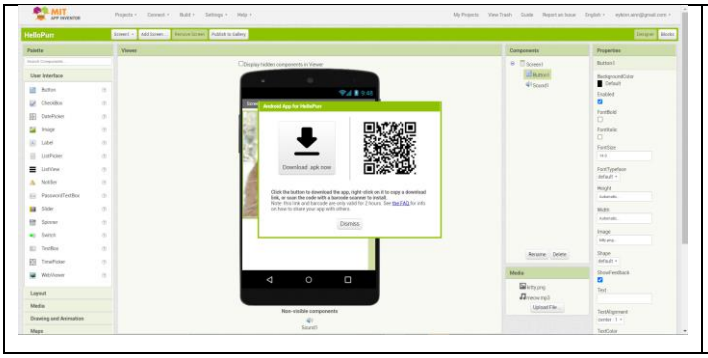
The use of Mit App Inventor in creating the E-Mega Column Management Application has provided an accessible and user-friendly platform for app development. Mit App Inventor utilizes a visual programming environment, allowing users to design fully functional Android and iOS apps without extensive programming knowledge. This ease of use empowers individuals, including young people, to transition from being consumers of technology to becoming creators and contributors in software development.

Mit App Inventor offers a drag-and-drop interface, where users can easily place components and program the app's behavior using visual blocks. This approach eliminates the complexities often associated with traditional programming environments, enabling the development of intricate and powerful applications in a fraction of the time.
To familiarize users with the Mit App Inventor, a tutorial is provided through a YouTube instructional video upon logging into the platform. This tutorial guides users on how to effectively utilize the application before they begin their app development journey.

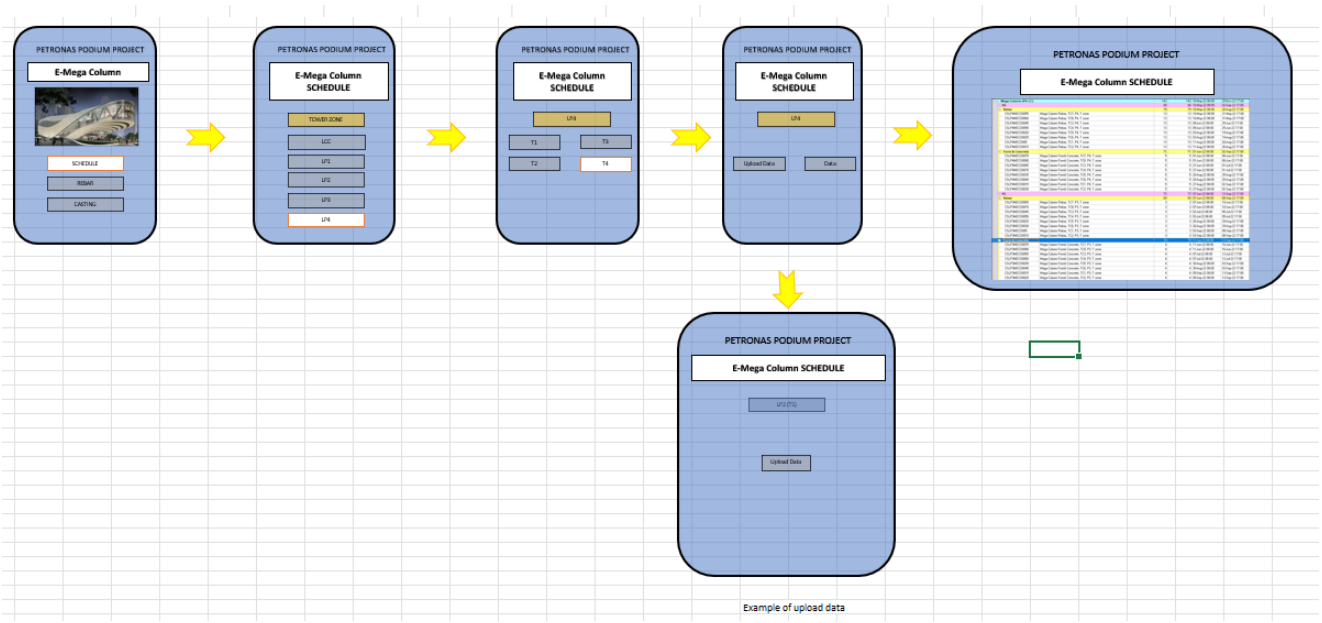
Upon logging in, users are presented with the option to create either a desktop web app or a native mobile app. They can choose to start from scratch or use a template as a foundation for their app. By selecting the "blank" option, users can provide a name for their app, select theme colors, and proceed to create the app. Additionally, Mit App Inventor allows for the integration of features beyond the basic functionalities. For example, users can establish a connection between their web app and mobile app, enabling them to share a common database. This capability demonstrates the potential for collaboration and data sharing between different applications. Overall, Mit App Inventor's user-friendly interface, tutorial resources, and versatility in app development make it a valuable tool for creating innovative and functional applications such as the E-Mega Column Management Application.

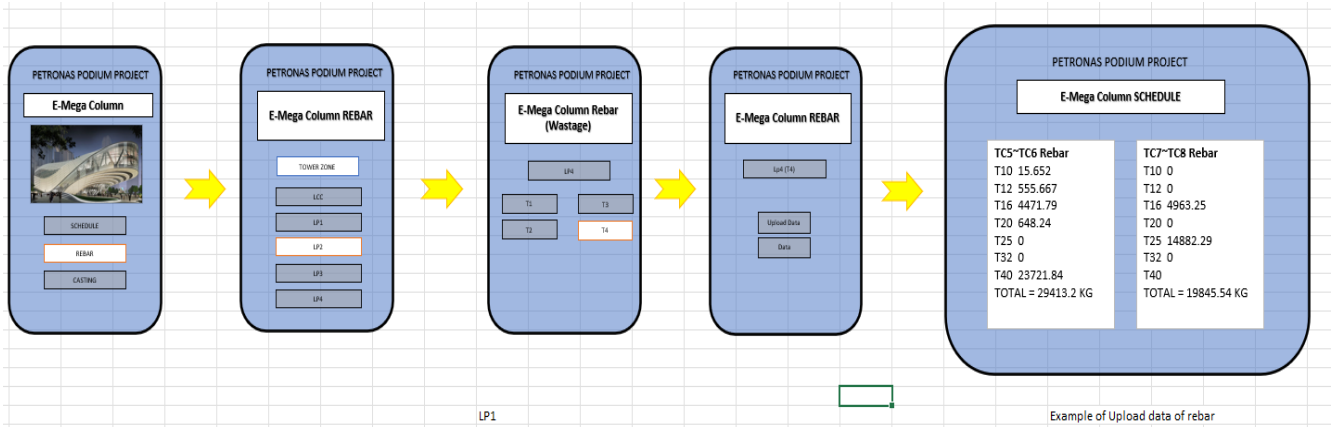
Table 3.2: System Design

Design	Explanation
	Step 1: Open MIT App Inventor at Google search and log in into it and directly 'click' the button of Create App
	Step 2: Once you are logged in, you can choose either 3 of tutorial, which is 1. HELLO PURR 2. TALK TO ME 3. TRANSLATE APP And every tutorial show you how to use your own design of application.
	Step 3: Give your project a name and enter the domain where you will host the MIT Inventor Application experience. MIT Inventor Application will always be free to get started with, then directly you can follow the step of tutorial that will show you some example.
	Step 4: After done follow the step of tutorial , you need to 'click' the build button, and wait for a minutes to generate the project.

	Step 5: the last step is after done generate the project , you need to install this Mit Inventor Apps in your smartphones and scan the codes, then what you design in this app will appear at your smartphones.

3.5 Architecture Diagram





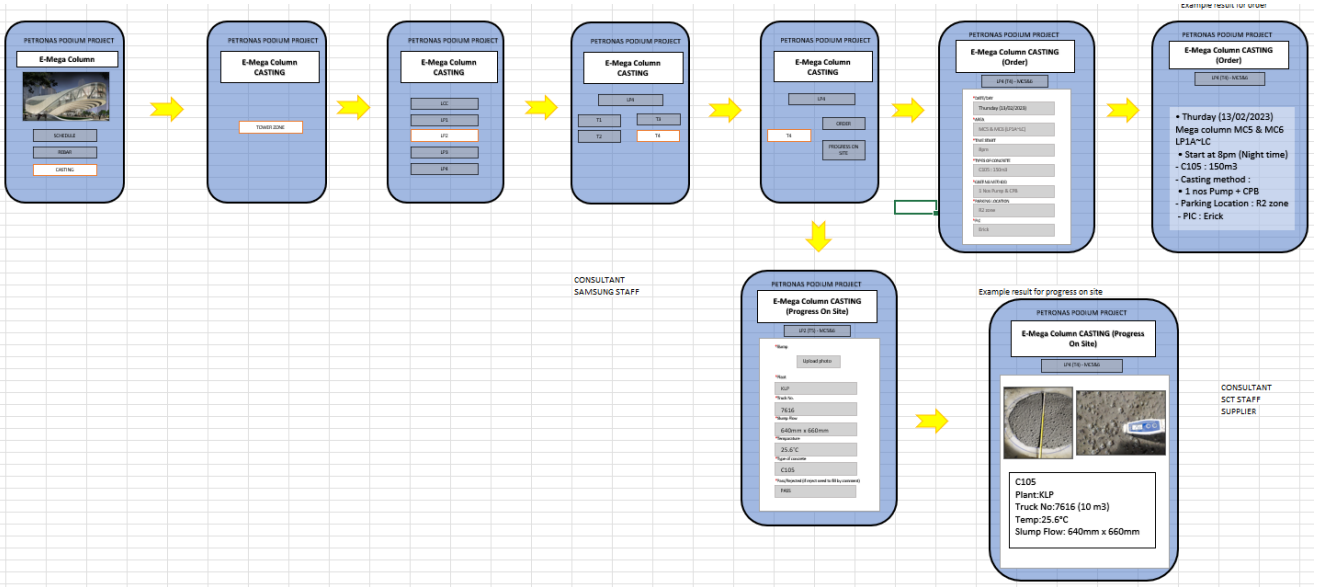
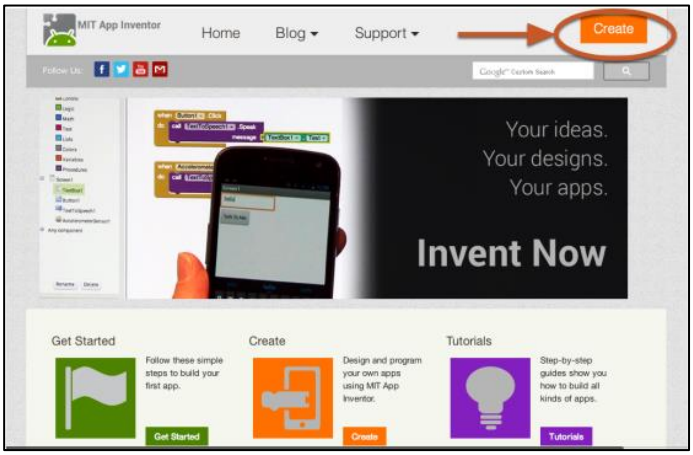


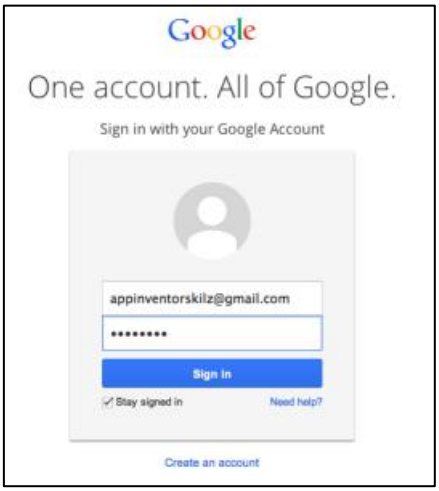
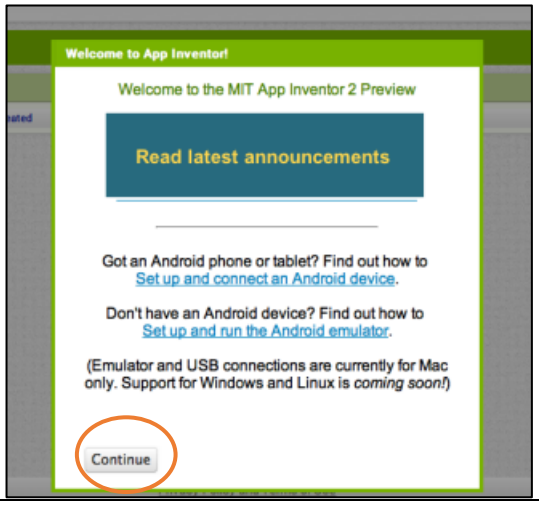
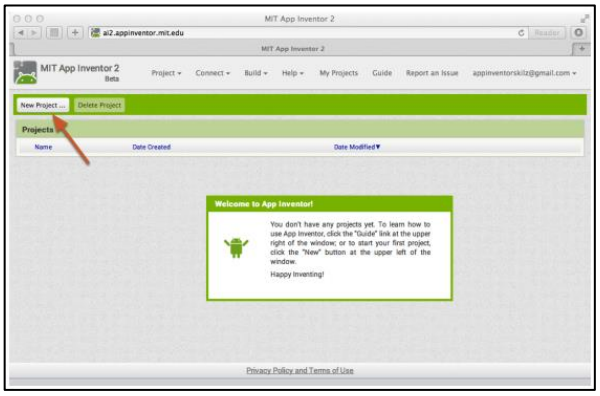
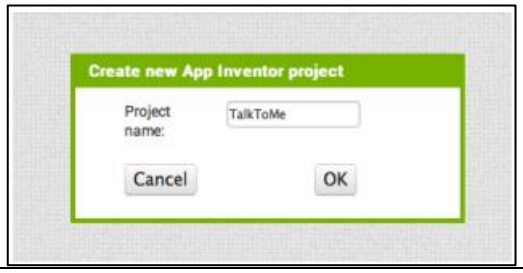
Figure 3.2: Step 1 for guides of E-Mega Column by using Microsoft Excel

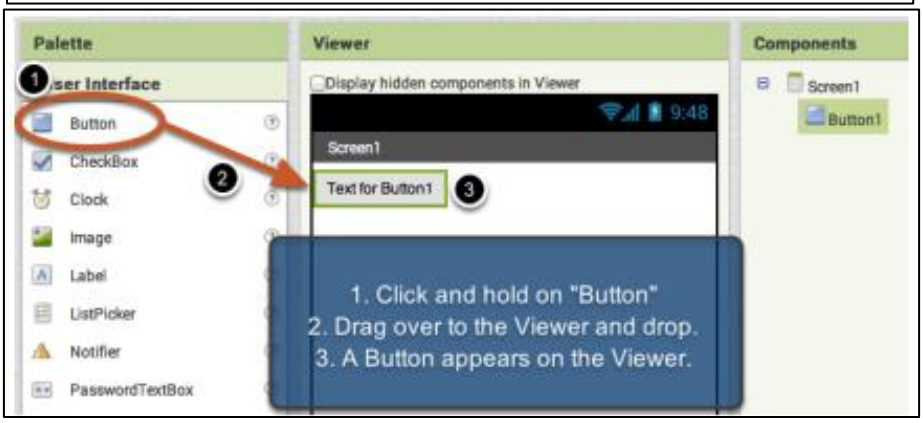
3.6 System Development

To assure the success of the project, the E - Mega Column Management Application was built piece by piece. In this section, the programme was split into two sections: one for administration and the other for users to utilise when working on building projects. The table below lists the processes for using the E - Mega Column Management Application.

Table 3.3: System Development

Development	Explanation
	The following shows To get started, go to App Inventor on the web. Go directly to ai2.appinventor.mit.edu, or click the orange "Create" button from the App Inventor Website.

Development	Explanation
	Log in to App Inventor with a gmail (or google) user name and password. Use an existing gmail account or school-based google account to log in to ai2.appinventor.mit.edu To set up a brand new gmail account, go to accounts.google.com/SignUp
	Click "Continue" to dismiss the splash screen.
 	Start New Project. Then , Name the project "TalkToMe" (no spaces). Type in the project name (underscores are allowed, spaces are not) and click OK.

Development	Explanation
 	The Design Window, or simply "Designer" is where you lay out the look and feel of your app, and specify what functionalities it should have. You choose things for the user interface things like Buttons, Images, and Text boxes, and functionalities like Text-to-Speech, Sensors, and GPS. Add a Button. Our project needs a button. Click and hold on the word "Button" in the palette. Drag your mouse over to the Viewer. Drop the button and a new button will appear on the Viewer

3.7 Testing of Product

The E-Mega Column Management Application was designed with the intention of conducting a trial period to test its effectiveness among the company's staff and other relevant individuals who can utilize the product for testing purposes. This trial period allows the application to be used in real-world scenarios, enabling users to provide feedback and insights on its efficiency.

To gather information about the product's effectiveness, the participants were requested to complete an online survey. The survey was designed to capture data on various aspects of the application's performance and usability. The goal was to assess how effectively the application addresses the problem faced by the company and whether it provides satisfactory

results compared to the existing methods. By incorporating both pre and post methods, a comprehensive evaluation of the innovation can be obtained, ensuring accurate and reliable results.

The survey may have focused on aspects such as the ease of use, usefulness, attitude towards using technology, and behavioural intention to use the E-Mega Column Management Application. These variables were adapted from the Technology Acceptance Model (TAM) questionnaire, a well-established model for assessing users' acceptance and adoption of new technologies. By gathering feedback from the participants, the company can gain valuable insights into the application's strengths, weaknesses, and areas for improvement. This feedback can be used to refine and enhance the application further, making it more effective in solving the specific problem at hand.

Conducting a trial period and soliciting feedback through an online survey is a valuable approach to ensure that the E-Mega Column Management Application meets the requirements and expectations of the users. It allows for the identification of any issues or challenges that need to be addressed before the application is fully implemented. In conclusion, the trial period and the subsequent online survey are essential steps in evaluating the effectiveness of the E-Mega Column Management Application. By involving the company's staff and relevant individuals, their feedback and experiences can provide valuable insights into the application's usability and efficiency. This feedback-driven approach ensures that the final product is well-tailored to address the company's specific needs and effectively solves the identified problem.

3.8 Data Collection and Analysis

In the evaluation of the E-Mega Column Management Application, a questionnaire will be used to gather data from the 15 Samsung C&T employees who participated in the testing. These employees include members of Construction Team A, the QAQC Department, Sub Contractor, and the Batching Plant. The questionnaire was adapted from the Technology Acceptance Model (TAM) by Davis (1988), which focuses on perceived usability and simplicity of use as key factors influencing the intention to utilize new technology. The Technology Acceptance Model (TAM) is a theoretical framework developed by Fred Davis in

1986 and later published in 1989. TAM seeks to explain and predict individuals' acceptance and adoption of new technologies based on their perceived usefulness and perceived ease of use. The model has been widely used in the field of information systems and technology research to understand users' attitudes and behaviors towards technology. Key Components of TAM:

i. Perceived Usefulness (PU): This refers to the degree to which an individual believes that using a particular technology will enhance their performance or improve their productivity. It is influenced by factors such as the user's job relevance, the expected benefits, and the user's goals.

ii. Perceived Ease of Use (PEOU): This component represents the degree to which an individual believes that using a technology will be free of effort. It includes factors such as the user's perception of the complexity of the technology, the ease of learning and understanding it, and the availability of support and training.

iii. Attitude toward Using (ATU): This component reflects an individual's overall positive or negative evaluation of using the technology. It is influenced by perceived usefulness and perceived ease of use. A positive attitude is likely to lead to a higher intention to use the technology.

iv. Behavioral Intention to Use (BI): This component represents an individual's intention to adopt and use a technology. It is influenced by attitude toward using the technology and is considered a direct precursor to actual technology usage.

TAM has been widely used to study the adoption and acceptance of various technologies, including software applications, e-commerce systems, mobile apps, and more. It has also been extended and modified over the years to incorporate additional factors and variables to better explain technology acceptance.O verall, TAM provides a valuable framework for understanding users' attitudes and behaviors towards technology, which can

inform the design, development, and implementation of new technologies to enhance user acceptance and adoption. To determine the sample size, the researchers followed the Krejcie and Morgan Table (1970), which suggested that for a population of 15 respondents, a sample size of 15 would be sufficient. The simulation study done by De Winter (2013) showed that there is no fundamental objection to using a regular t-test with extremely small sample sizes. He emphasized that even a sample size as small as 2 did not pose problems.

Data was collected through a Google form. The researchers provided the respondents with the URL of the Google form to complete the questionnaire. Google forms offer a convenient and user-friendly way to collect data for research purposes. For data analysis, the researchers extracted the collected data from Microsoft Excel software. Then, Paired T-test software was performed using the statistical analysis online software. The Paired T-test software is chosen for its efficiency and user-friendly features, allowing the researchers to derive actionable insights from the collected data.

The analysis process involved several steps, starting from extracting the data from Microsoft Excel and proceeding to perform the Paired T-test analysis using the designated software. This statistical analysis will provide a comprehensive assessment of the application's effectiveness by comparing the responses before and after the implementation of the E-Mega Column Management Application. By employing this methodology, the researchers aim to gather valuable data on the usability and effectiveness of the application. The questionnaire served as an essential instrument for data collection, providing insights into the participants' perceptions and acceptance of the new technology.

3.9 Conclusion

The chapter's discussion of the study's information and data collection strategy serves as its conclusion. The findings of the analysis of the data gathered will be known. The location, respondents, research techniques, data interpretation, and work completed throughout the review process are also highlighted in this chapter. This digital utilisation is better than it was previously, according to the report. Digital use is preferable.

The current approach to detecting the issue with mega columns via WhatsApp and irrelevant communications in light of modern technology. Additionally, it is obviously not advantageous based on the surveys and interviews that were conducted. Additionally, all industries, including the construction industry, should be required to use technology to assist humans. Applications have been utilised to enhance tried-and-true techniques that genuinely boost productivity, efficiency, and time savings. The following chapter will provide a full explanation of data analysis.

CHAPTER 4

RESULTS

4.1 Introduction

The mentioned chapter focuses on data analysis, interpretation of results, and discussions related to the research project. The primary objective of the project is to enhance project management in terms of planning for site work progress. To achieve this objective, the researchers have developed the E-Mega Column Management Application, which serves as a solution to provide access to information regarding the details of site work progress. The specific objectives of the project are as follows:

a) Designing the E-Mega Column Management Application: The researchers aimed to design an application that enables users to access information related to site work progress. This involves creating an intuitive and user-friendly interface that provides relevant details and updates.

b) Developing the E-Mega Column Management Application: The project involves the development of the E-Mega Column Management Application using the Mit App Inventor programming tool. The researchers would have worked on implementing the necessary features and functionalities to ensure the application meets the requirements and objectives outlined.

c) Evaluating the usability of the E-Mega Column Management Application: In order to assess the effectiveness and user-friendliness of the application, an evaluation of its usability was conducted. The researchers likely employed a survey adapted from the Technology Acceptance Model (TAM) questionnaire, including variables such as perceived ease of use, perceived usefulness, attitude towards using technology, and

behavioural intention to use. The collected data from the evaluation would be analysed using statistical methods such as paired t-tests and mean comparisons to determine the application's effectiveness compared to existing methods.

By accomplishing these objectives, the researchers aimed to provide a comprehensive and efficient solution for managing site work progress in the construction project. The E-Mega Column Management Application is expected to improve coordination, facilitate access to information, and enhance project management processes.

4.2 Designing the E-Mega Column Management Application

The E – Mega Column Management application is intended to simplify human task from conventional method to real time update in a mobile device. Previously, engineers, supervisors, managers and consultants were identifying the progress work of mega column until casting work at site via WhatsApp or by calling the suppliers or related person in charge themselves. Not only that, sometimes due to bad reception at the site, it would take a longer time to proceed the order for casting progress or any problem regarding the mega column issue. This action was a waste of time and time consuming. By seeing these circumstances, the old conventional method was not systematic or suitable prolonged. Therefore E – Mega Column Management application were design to solve this problem.

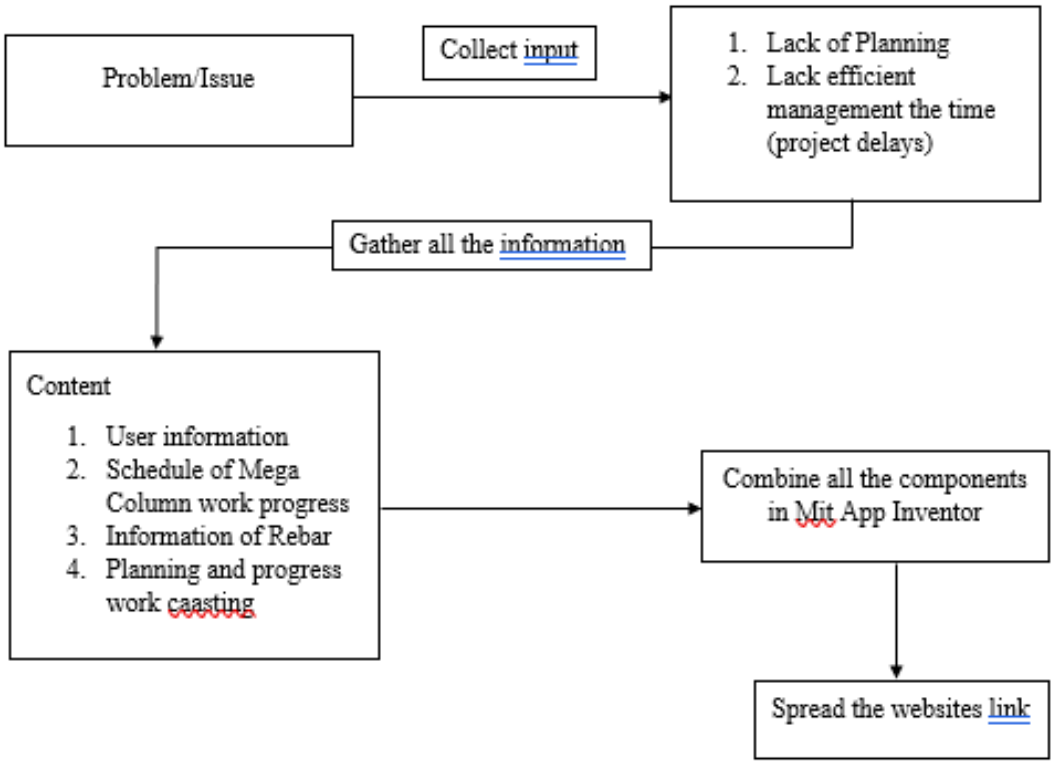


Figure 4.1 Flowchart of Design an E-Mega Column Management Application using Mit App Inventor

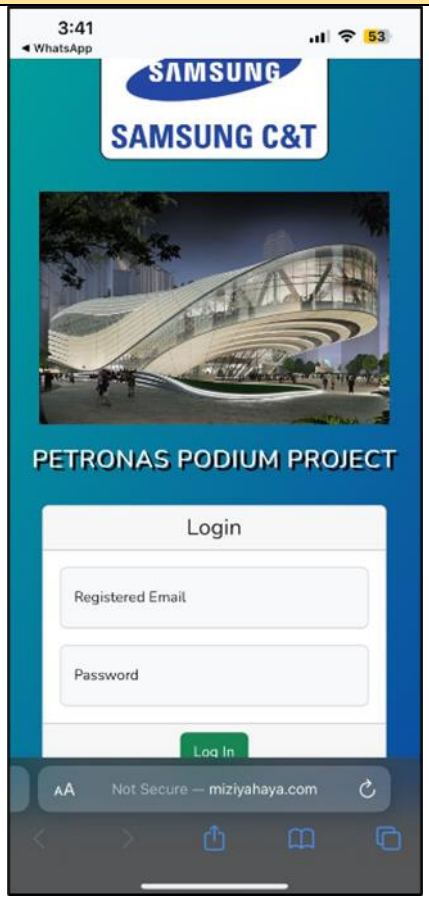
This application enables project managers, engineers, and other specific parties to access information about the progress of the mega column task without the need for frequent meetings to discuss daily updates. By using this application, time can be saved, and project delays can be reduced, as all tasks related to the mega column work and casting progress can be pre-planned. Moreover, the application empowers users to ensure precise completion of required tasks. This is facilitated by the seamless access to real-time results while working on the construction site, enabling users to effectively track and monitor progress.

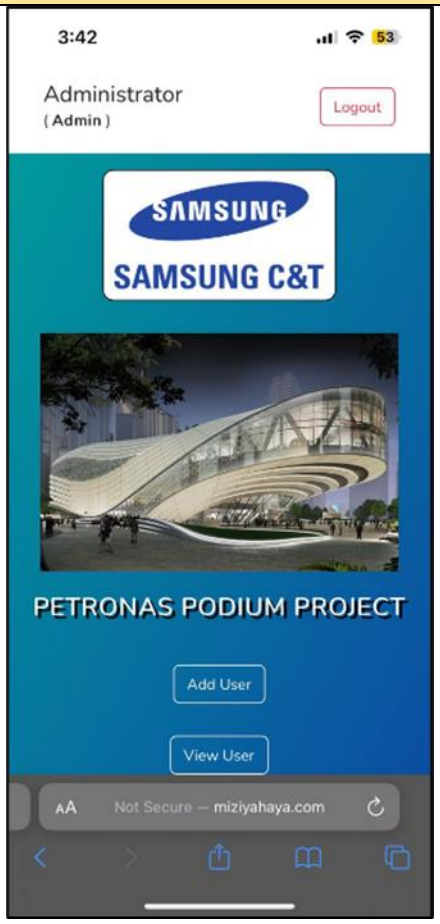
4.3 Developing E-Mega Column Management Application Using Mit App Inventor.

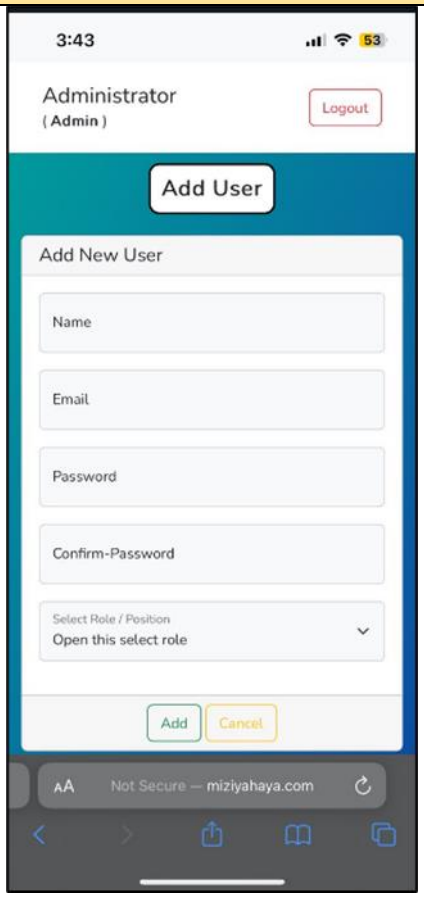
MIT App Inventor is an efficient tool for creating Android applications through a visual programming environment. Employing this platform for product development can result in significant time and cost savings. By utilizing the software development kit, all the relevant information can be consolidated and displayed on a single website. This enables easy access for staff members to track and retrieve information, eliminating the need for manual search of

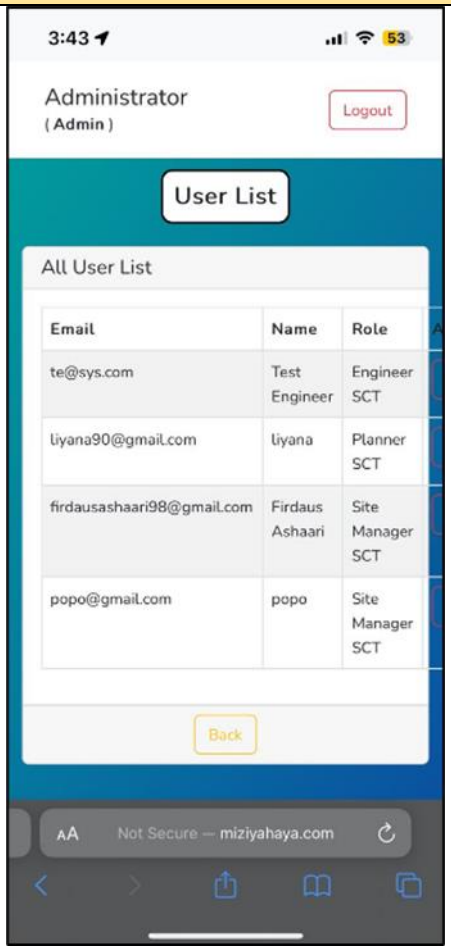
individual documents during weekly meetings. Additionally, the progress of developing the E-Mega Column Management Application is illustrated in Table 4.1.

Table 4.1 E – Mega Column Management application design

Development	Description
	• The first step is to provide all the necessary information to the admin for registration. This website application is designed to prioritize privacy and confidentiality, ensuring that only the admin or HR personnel can register staff and other relevant individuals into the application. • The registration process for users is exclusive to the admin or HR personnel. They need to log in and enter a password to access the registration feature. • There are two options available: "Add User" and "View User." "Add User" allows the admin or HR personnel to add staff members or other relevant parties who require access to the website application. On the other hand, "View User" enables the admin or HR

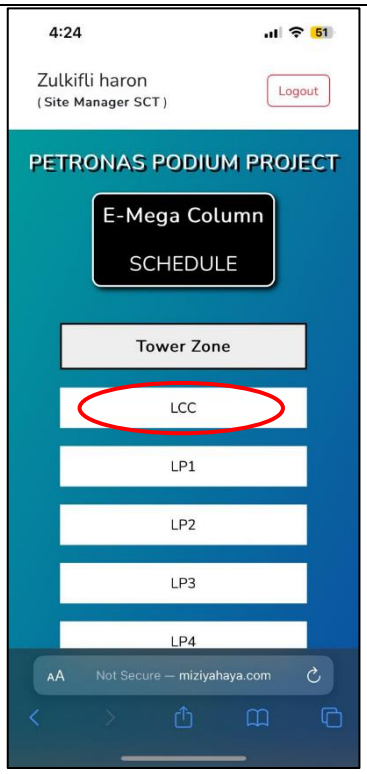
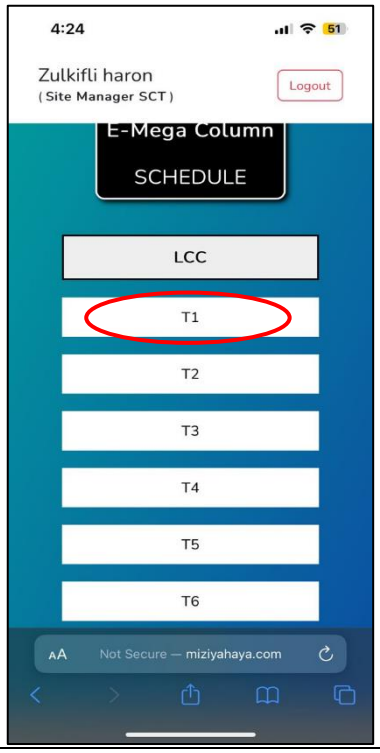
Development	Description
	personnel to delete users or get an overview of all the users using the website. • When adding a user, the admin or HR personnel must provide essential information such as Name, Email, Password, and Roles. • Roles play a vital role as they determine the level of access and information that each user can view. Only Site/Construction Managers have unrestricted access to all the information on the website. Other roles are limited to specific information based on their assigned roles. This ensures that the website's information remains confidential and is not shared with external parties who are not part of the company or involved in the Mega Column progress work.

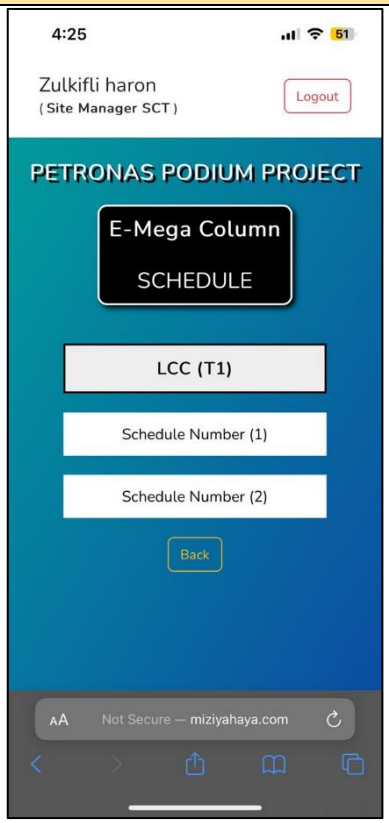
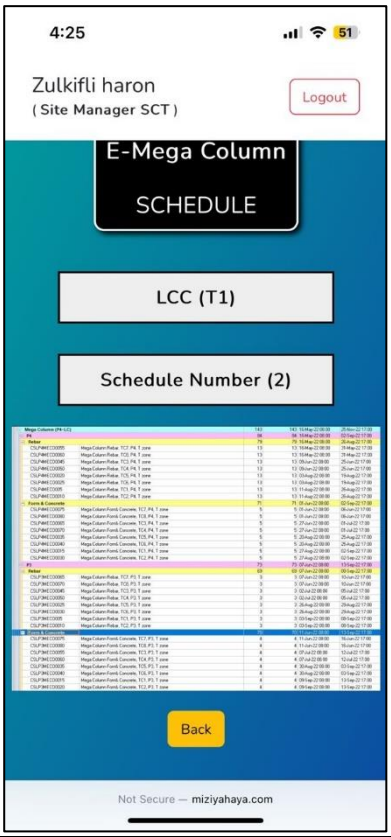
Development	Description
	

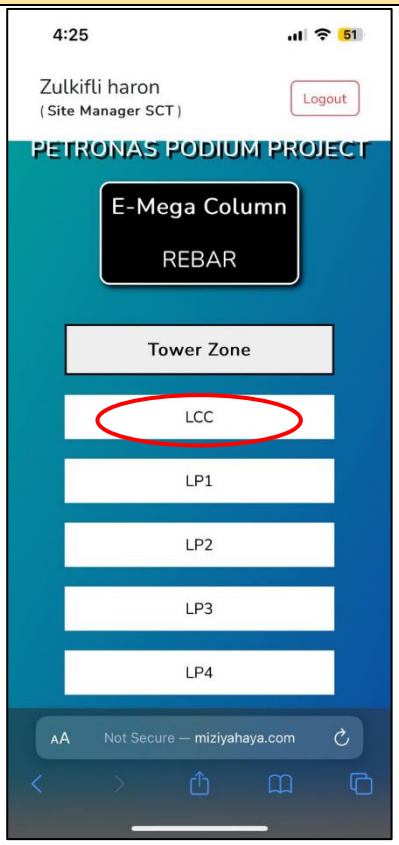
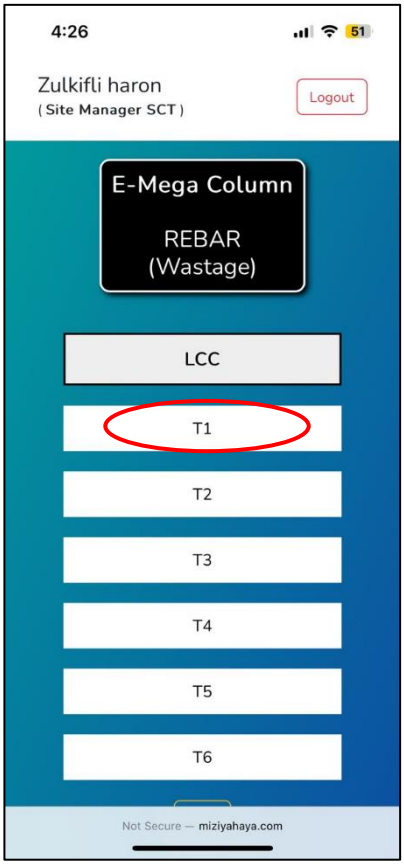
Development	Description
	

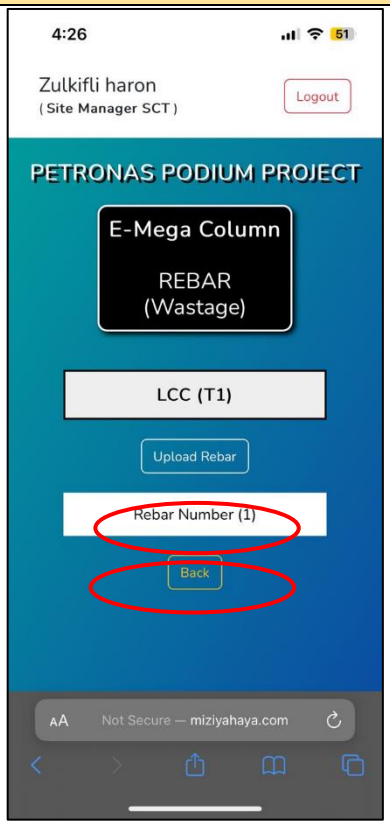
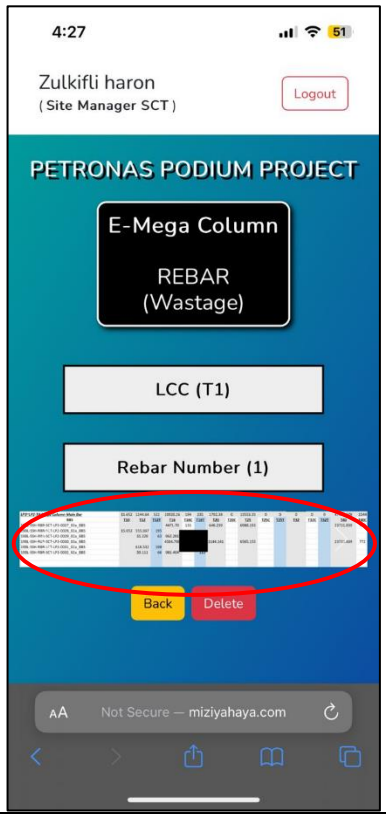
Development	Description
	• Next, after the admin has successfully registered the account, they can proceed to log in using the email and password to access the website.

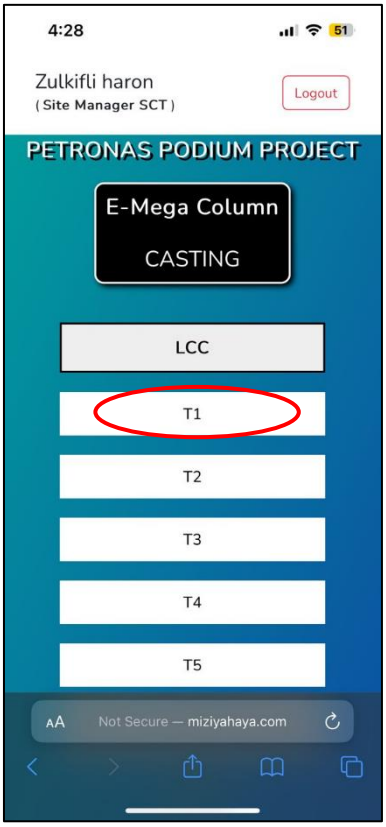
Development	Description
	• Once logged into the website successfully, user will find three options: Schedule, Rebar, and Casting. • These options allow user to choose which specific information you want to access. • In the Schedule section, only users with the role of Planner are authorized to upload the relevant information. • The Rebar section is specifically for engineers involved in the project who need to update information related to rebar or any bar bending schedule (BBS). • The Casting section is of utmost importance. Access to this section is restricted to engineers directly involved in casting work. Engineers in QAQC roles have editing privileges for all the information in this section. Site managers can access all parts of the Casting section.

Development	Description
	Suppliers can only view their respective orders, and consultants can monitor the progress of the casting work on a given day.
 	• When user click on the Schedule section, user will be presented with the interface displaying tower zone areas. Each zone corresponds to a specific mega column. For instance, clicking on "LCC" will reveal the zones associated with the Level Concourse (LCC). • Upon selecting a specific zone, such as "LCC T1," the website will display the schedules labeled as Schedule 1 and Schedule 2, each with its respective revision number (Rev 01 and Rev 02). Clicking on any of these schedules will provide detailed information about the mega column work schedule. • This section of the website allows us to set targets and track the progress of the mega column work, aiming to

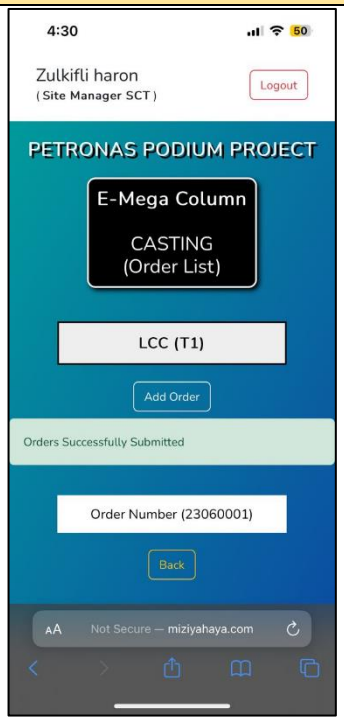
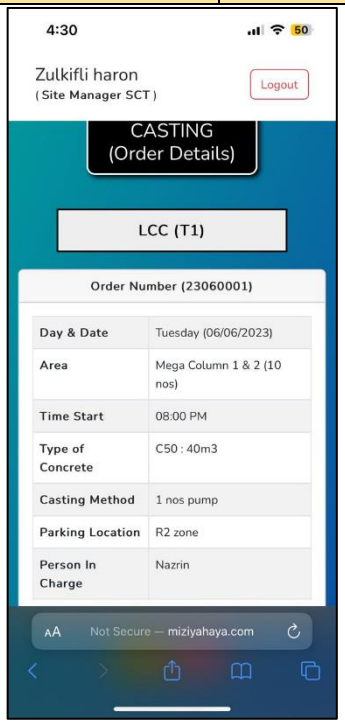
Development	Description
 	achieve the desired casting dates within the specified timeline indicated in the schedule .

Development	Description
 	• Similar to the Schedule section, the Rebar section follows the same steps. It features a familiar interface where users can select the desired zone to view. • In the Rebar section, users can access information specifically related to the rebar wastage for the mega column. This information is updated by the engineer responsible for the mega column work. • It's important to note that only Samsung staff members have access to view the rebar information. This ensures that the data remains confidential within the organization. • By clicking on the relevant zone, users can access the uploaded rebar information provided by the engineer in charge. • By utilizing this website application, all Samsung staff

Development	Description
 	members can easily stay informed about the rebar wastage and make efforts to reduce costs based on the information available.

Development	Description
 	• Similarly to the Schedule and Rebar sections, the Casting section follows a similar process. It presents a user-friendly interface where users can select their desired zone to view. • Within the Casting section, there are two options available: "Order" and "Progress on Site." It's important to note that not all user roles have access to the "Order" option. Only construction/site managers have the authority to place concrete orders. • The "Progress on Site" option is specifically accessible to QAQC engineers, who are responsible for updating the progress of the casting work. Consultants, on the other hand, have access to view the progress on site as updated by the QAQC engineers. • Lastly, the "Supplier" role is limited to viewing the order list without any additional

Development	Description
	editing privileges. This allows suppliers to stay informed about the orders placed. By implementing these access restrictions, the website application ensures that the appropriate roles have the necessary permissions to perform their specific tasks within the casting process.
When it comes to ordering and tracking the progress on the site, the Casting section of the website application provides a comprehensive overview. • Construction/site managers have the privilege to place concrete orders through the "Order" feature. They can conveniently initiate and manage the concrete ordering process. • On the other hand, the "Progress on Site" functionality is dedicated to QAQC engineers. They play a crucial role in updating and monitoring the progress of the casting work. They can regularly input the latest information regarding the site progress into the system.	

Development	Description
  	• Consultants, who are involved in the project, can access the website application to view the updated progress on site. This allows them to stay informed about the ongoing developments in the casting work.

4.4 Evaluating the usability of the E-Mega Column Management Application

The end product was tested using online questionnaire. This product was developed using Mit App Inventor and were tested among 16 Samsung C&T Sdn Bhd employees consist of engineer, site supervisor, construction manager, consultant and supplier. In order to know what team needs to improve the Mega Column preparation and submission progress work. These surveys have been conducted to 16 respondents. The results obtained will present a complete of result and analyzes of the study in the form of tables, graphs and figure so that the key information is highlighted.

This questionnaire has four sections, Section A, Section B, Section C and Section D. Section A is about the demographic profile. Section B related with question Effectiveness Categories Section. In Section C is about Perceived Ease of Use. Lastly in section D about Intention to Use. The questionnaire used in this study was based on the Technology Acceptance

Model (TAM) proposed by Davis in 1989. TAM is a well-known model for understanding technology acceptance, focusing on two key factors: perceived ease of use and perceived usefulness, which influence an individual's intention to use new technology. The variables measured in this study align with TAM, including Perceived Ease of Use, Perceived Usefulness, Attitude Towards Using Technology, and Behavioral Intention to Use.

The sample size for this study was determined using the Krejcie and Morgan Table from 1970. Since the population consisted of 16 respondents, a sample size of 16 was considered sufficient. Therefore, all individuals in the population were included in the study. Additionally, a simulation study conducted by De Winter in 2013 demonstrated that even with extremely small sample sizes, such as 2, there were no significant issues when using a regular t-test.

The following section discussed the demographic data is the background of the respondents, which contains 5 item. Among the item :

i. Gender
ii. Age Group
iii. Organization
iv. Designation
v. Work Experience

vi. Gender

Table shows the number of respondents who obtained in this study. The total number of respondents was about 16 persons. Table 4.2 and Figure 4.2 below show the number of respondents by gender.

Table 4.2: The number of respondents by gender

No	Gender	No respondent	Percentage (%)
1	Male	14	87.5%
2	Female	2	12.5%
Total		16	100%

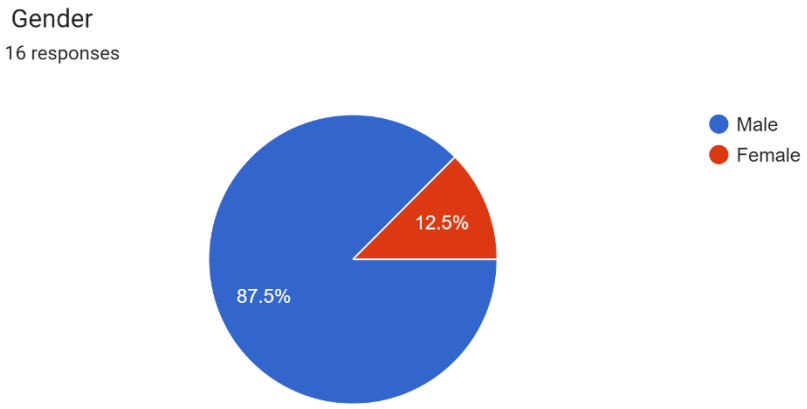


Figure 4.2: The number of respondents by gender

Of these, a total of 14 persons is male respondents and female respondents were 2 persons only. For male respondents is the percentage rate of 87.5%, while 12.5% of female respondents only. By the percentage obtained, it can be identified that more male respondents than female respondent's construction site.

vii. Age Group

Table 4.3 below shows respondent age category involved in this study. The researchers divided the four categories of age. This division is made to facilitate data analysis is done effectively and identify the respondent at the construction site. Thus, the percentage based on age can be seen through the Table 4.3 and Figure 4.3.

Table 4.3: The number of respondents by age

No	Gender	No respondent	Percentage (%)
1	17-25	1	6.3%
2	26-35	5	31.3%
3	36-45	10	62.5%
4	>46	0	0%
	Total	16	100%

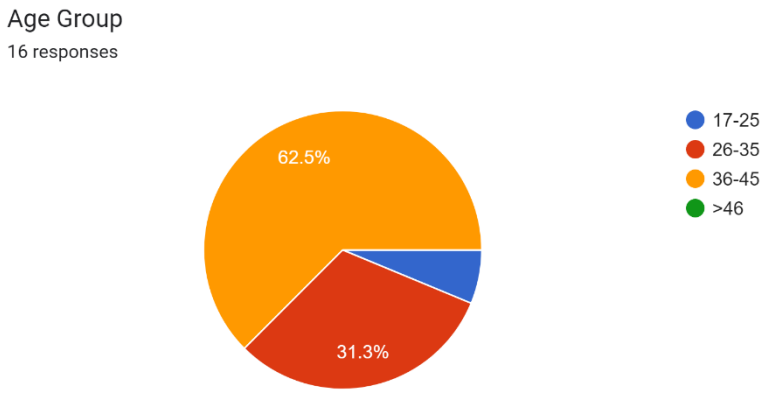


Figure 4.3: The number of respondents by age

Through the findings, the high percentage is the range of 36-45 years representing 62.5%. the percentage of 26-35 years of age was reduce by 5 person and age group 17-25 years only with the percentage of 1%.

viii. Organization

Table 4.4 below show the number of respondents organization that involved in this construction. The total was 16 persons. Table 4.4 and figure 3.7 below show the number of respondents by every organization.

Table 4.4: The number of respondents by organization

No	Gender	No respondent	Percentage (%)
1	Samsung C&T	11	68.8%
2	Seal Consult Sdn.Bhd	1	6.3%
3	Arup Juruunding Sdn.Bhd	1	6.3%
4	HANSON-Batching Plant	3	18.8%
Total		16	100%

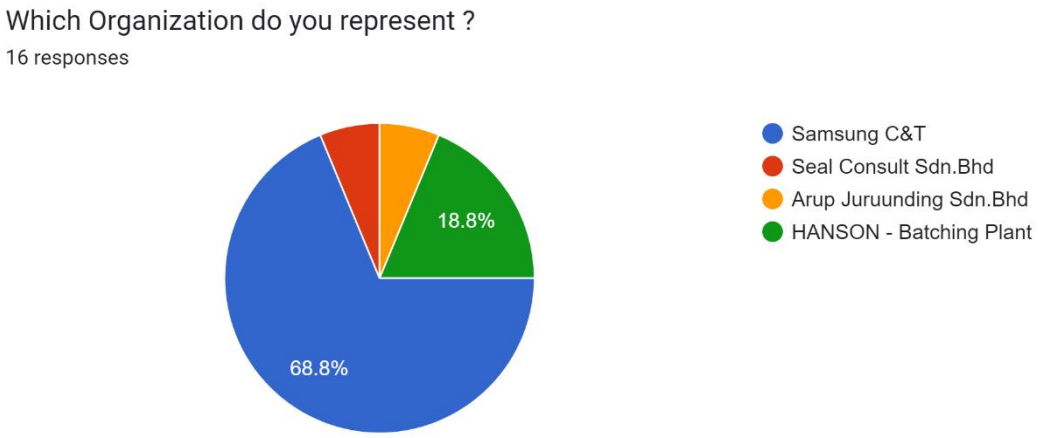


Figure 4.4: The number of respondents by organization

Based on this finding, the high percentage of respondents is Samsung Staff that interest in this product. The range of respondents for Samsung C&T is 68.8% followed by Hanson-Batching plant 18.8%. This showed that 2 organizations quite interested in this product.

ix. Designation

The third item in the demographic data is the position at construction site, where there are various positions of Project Manager, Construction Manager, Engineer, Site Supervisor, Quantity Surveyor and Site Engineer where is responsibility and follow up the progress of Mega Column. Figure 4.5 and Table 4.5 below appointment pie chart illustration and table.

Table 4.5: The number of respondents by position

No	Gender	No respondent	Percentage (%)
1	Project Manager	1	6.3%
2	Construction Manager	2	12.5%
3	Engineer	8	50%
4	Site Supervisor	4	25%
5	Quantity Surveyor	0	0%
6	Site Engineer	1	6.3%
Total		16	100%

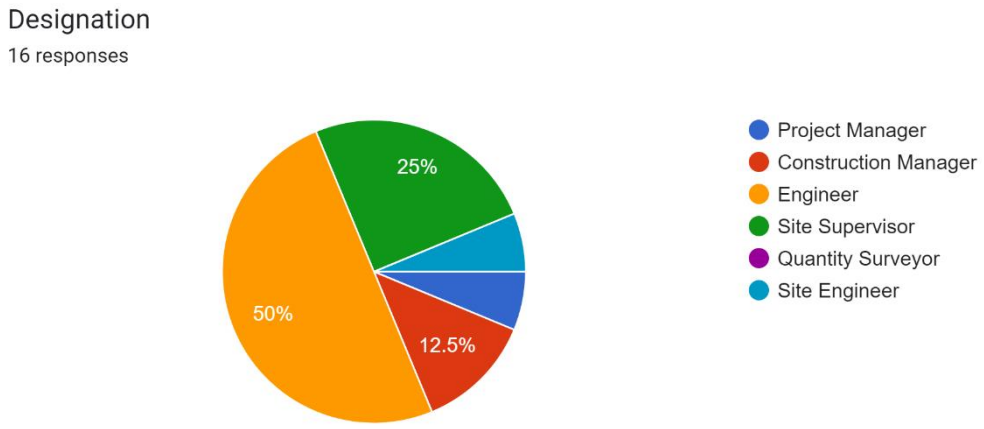


Figure 4.5: The number of respondents by designation

In Table 4.5 above, the number of respondents is a Engineer with the majority registering a as much as 50%. Followed by the Site supervisor representing four people which is share percentage 25%. Meanwhile construction manager represents 12.5%.

x. Work Experience

The last item for section A in the demographic data is the duration of current position, where there is various duration of current positions of less than 1 year, 2-5 years, 6-10 years, ≥11 years, and more than 1 year. Figure 4.6 and Table 4.6 below appointment pie chart illustration and table.

Table 4.6: The number of respondents by work experience

No	Gender	No respondent	Percentage (%)
1	Less than 1 year	0	0%
2	2-5 years	7	43.8%
3	6-10 years	8	50%
4	More than 11 years	1	6.3%
Total		16	100%

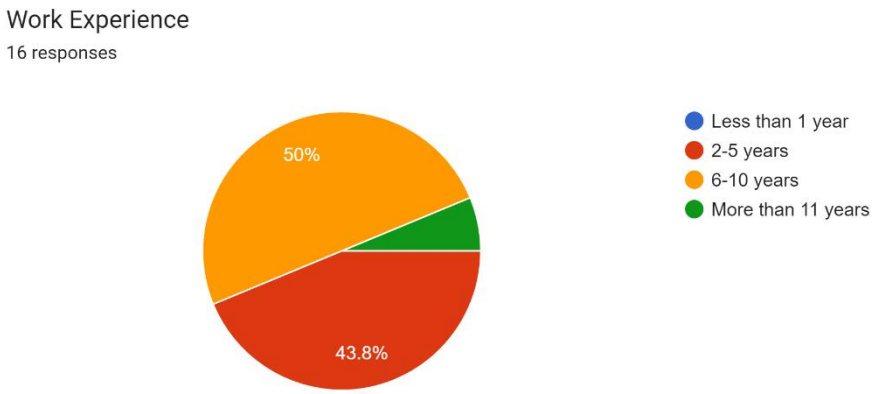


Figure 4.6: The number of respondents by work experience

Next, the following section discussed the concerns with the previous conventional method. Respondents were instructed to circle the appropriate scores on a scale of 5 to 1. The scoring scale was as follows:

i. Strongly agree - 5
ii. Agree - 4
iii. Slightly agree - 3
iv. Disagree - 2
v. Strongly disagree – 1

Section B of the Pre- FYP questionnaires included questions about respondent's attitudes toward the existing method of Mega Column preparation. Table 4.7 below contains the data for Section B of the Pre-FYP questionnaires. Questions 1 (P.U 1) through 4 (P.U 4) collected information on the perceived effectiveness of the existing traditional procedure. According to the findings, the majority of respondents believe that the present traditional strategy is ineffective. In response to question 1 (P.U 1), 56.3% of respondents slightly agree with the existing customary procedure, with 6.2% strongly disagreeing. For question 1 (P.U 2), 56.3% of respondents slightly agree, with 31.3% disagreeing. In response to question 1 (P.U 3), 75% of respondents slightly agree, with 16.7% disagreeing. Finally, for question 1 (P.U 4), 66.7% of respondents slightly agree, with 25% disagreeing and 8.3% strongly agree. This demonstrates that the current standard method is ineffective.

Questions 2 (P.E.U 1) to 2 (P.E.U 4) collected information on the existing method's perceived ease of use. According to the findings, the majority of respondents believe that the present traditional strategy is ineffective. For issue 2 (P.E.U 1), 50 % of respondents slightly agree with the existing conventional procedure, 25.1% disagree and 25% strongly disagree. For question 2 (P.E.U 2), 50% of respondents disagreed that learning to utilise the existing method would be simple for users, while 33.3% slightly agreed. For issue 2 (P.E.U 3), 66.7% of respondents slightly agree, with 25% disagreeing that the interaction with the existing technique was obvious and intelligible. Finally, for issue 2 (P.E.U 4), 83.3% of respondents slightly agree, while 8.3% disagree and 8.3% strongly agree that it would be straight forward for users to manage their project using existing methods.

Questions 3 (I.U 1) through 3 (I.U 3) collected information on the intention to employ the existing conventional approach. According to the findings, the majority of respondents believe that the present traditional strategy is ineffective. In response to question 3 (I.U 1), 68.8% of respondents slightly agree with the existing customary procedure, while 25.1% disagree and 6.3% strongly agree. For question 3 (I.U 2), which is whether the user will utilise the existing method frequently, 83.3% slightly agree, while the remaining 8.3% agree and 8.3% strongly agree. Finally, on question 3 (I.U 3), 83.3% of respondents slightly agree, with 8.3% agree and 8.3% strongly agree. This demonstrates that people have little intention of using the existing method due to its complexities and are exploring for alternatives.

Questions 4 (A.U 1) to 4 (A.U 4) gave information on the current conventional method's actual application. According to the data, the majority of respondents believe that the existing traditional procedure is unsuitable for practical application. For question 4 (A.U 1), Existing approach makes work more fascinating, 41.7% of respondents slightly agree with the existing conventional way, 50% disagree. 8.3% agree with question 4 (A.U 2), while 66.7% disagree with the Working with Existing Method is Fun. In response to question 4 (A.U 3), 75% of respondents slightly agree, while 16.7% disagree. Finally, 8.3% of respondents strongly agree and agree with question 4 (A.U 4), while 66.7% slightly agree and 16.7% disagree. This proves that the existing conventional system is unsuitable for actual application, and an alternative is required to prepare progress of mega column work on the construction site.

Table 4.7: Existing Method survey data

No.	Survey to identify effectiveness of Existing method on Project management at a construction site.	Strongly Agree (5)	Agree (4)	Slightly Agree (3)	Disagree (2)	Strongly Disagree (1)
1	Using existing method would enhance my effectiveness in work (P.U 1)	0.0%	0.0%	56.3%	37.5%	6.2%
1	Using the existing method would improve my performance in work (P.U 2)	0.0%	12.5%	56.3%	31.3%	0.0%
1	Using existing method would increase my productivity (P.U 3)	0.0%	8.3%	75%	16.7%	0.0%
1	I found the existing method useful (P.U 4)	8.3%	0.0%	66.7%	25%	0.0%
2	I found existing method easy to use (P.E.U 1)	0.0%	0.0%	50%	25.1%	25%
2	Learning to use Existing method would be easy for me (P.E.U 2)	8.3%	8.3%	33.3%	50%	0.0%
2	My interaction with Existing method was clear and understandable (P.E.U 3)	0.0%	8.3%	66.7%	25%	0.0%
2	It would be easy for me to manage my project using Existing method (P.E.U 4)	8.3%	0.0%	83.3%	8.3%	0.0%
3	I intend to use Existing method during my work (I.U 1)	6.3%	0.0%	68.8%	25.1%	0.0%
3	I will use Existing method often. (I.U 2)	8.3%	8.3%	83.3%	0.0%	0.0%
3	I intend to use Existing Method frequently. (I.U 3)	8.3%	8.3%	83.3%	0.0%	0.0%
4	Existing method makes work more interesting (A.U 1)	0.0%	8.3%	41.7%	50%	0.0%

No.	Survey to identify effectiveness of Existing method on Project management at a construction site.	Strongly Agree (5)	Agree (4)	Slightly Agree (3)	Disagree (2)	Strongly Disagree (1)
4	Working with Existing method is fun. (A.U 2)	0.0%	8.3%	16.7%	66.7%	8.3%
4	I feel comfortable using Existing method (A.U 3)	8.3%	0.0%	75%	16.7%	0.0%
4	I look forward to those aspects of my job that require me to use existing method (A.U4)	8.3%	8.3%	66.7%	16.7%	0.0%

Section B of the Post - FYP questionnaire included questions about respondents' satisfaction with using the E-Mega Column Management Application to access information on the details of site preparation at the construction site. Table 4.8 below contains the data for Section B of the Post - FYP questionnaire. Questions 1(P.U 1) through 1 (P.U 4) collected information on the perceived usefulness of accessing the E-Mega Column Management Application to get information on the intricacies of site preparation planning. According to the data, the majority of respondents believe that the E-Mega Column Management Application is advantageous to project management on the construction site. For question 1 (P.U 1), 81.3% of respondents strongly agree with the E-Mega Column Management Application and 18.8% agree that the E-Mega Column Management Application method would improve their work effectiveness. Next, for question 1 (P.U 2), which is if using an E-Mega Column Management Application would boost users' work performance, 62.5% strongly agree, with 37.5% agreeing. For question 1 (P.U 3), 68.8% of respondents strongly agree, with 31.3% agreeing that adopting E-Mega Column Management Application would boost their productivity. Finally, for question 1 (P.U 4), 75% of respondents strongly agree, with 25% agreeing. This demonstrates the E-Mega Column Management Application's for project management on a construction site.

Questions 2(P.E.U 1) to 2(P.E.U 4) will offer statistics on the perceived ease of use of the E-Mega Column Management Application to project management on the construction site. According to the data, the majority of respondents believe that the existing method is

ineffective. For question 2 (P.E.U. 1), 75% of respondents strongly agree with the E-Mega Column Management Application, and 25% agree think that it is simple to use. For question 2 (P.E.U 2), saying that learning to utilise an E-Mega Column Management Application would be simple for users, the result was 68.8% strongly agree, with 31.3% agreeing. All respondents felt that using E-Mega Column Management Application was obvious and intelligible in response to question 2 (P.E.U 3). Finally, for question 2 (P.E.U. 4), 68.8% strongly agree, while 31.3% agree believe that it would be simple for users to manage their project using E-Mega Column Management Application.

Questions 3 (I.U 1) to 3 (I.U 3) offered information on the aim to use the E-Mega Column Management Application to allow visitors readily acquire information on the project's details and procedure. According to the findings, the majority of respondents believe that the present key is ineffective. In response to question 3 (I.U. 1), 68.8% of respondents strongly agree and 31.3% agree with the E-Mega Column Management Application. Then, in response to question 3 (I.U 2), all respondents agree that they will use the E-Mega Column Management Application frequently. Finally, for question 3 (I.U 3), 56.3% of respondents strongly agree, while 43.8% agree think that E-Mega Column Management Application makes work more fascinating.

Questions 4 (A.U 1) to 4 (A.U 4) offered information on how the E-Mega Column Management Application was used for project management on the construction site. According to the data, the majority of respondents believe the E-Mega Column Management Application is adequate for actual use. In response to question 4 (P.U 1), 62.5% of respondents strongly agree with the use of E-Mega Column Management Application, 37.5% agree, and 0% neither agree nor disagree. In response to question 4 (A.U 2), 56.3% strongly agree, while 43.8% believe that working with E-Mega Column Management Application is enjoyable. Then, for question 4 (A.U 3), 62.5% of respondents strongly agree, with 37.5% agreeing that users comfortable using the E-Mega Column Management Application. Finally, all respondents agree to use E-Mega Column Management Application for question 4 (A.U 4). while 62.5% strongly agree and 37.5% agree. This proves that the E-Mega Column Management Application system is suitable for actual application, and an alternative is required to prepare progress of mega column work on the construction site.

Table 4.8 Feedback after using E-Mega Column

No.	Survey to identify effectiveness of E-Mega Column on Project management at a construction site.	Strongly Agree (5)	Agree (4)	Natural (3)	Disagree (2)	Strongly Disagree (1)
1	Using E-Mega Column would enhance my effectiveness in work (P.U 1)	81.3%	18.8%	0.0%	0.0%	0.0%
1	Using E-Mega Column would improve my performance in work (P.U 2)	62.5%	37.5%	0.0%	0.0%	0.0%
1	Using E-Mega Column would increase my productivity. (P.U 3)	68.8%	31.3%	0.0%	0.0%	0.0%
1	I found E-Mega Column useful. (P.U 4)	75%	25%	0.0%	0.0%	0.0%
2	I found E-Mega Column easy to use. (P.E 1)	75%	25%	0.0%	0.0%	0.0%
2	Learning to use E-Mega Column would be easy for me. (P.E 2)	68.8%	31.3%	0.0%	0.0%	0.0%
2	My interaction with E-Mega Column was clear and understandable. (P.E 3)	62.5%	37.5%	0.0%	0.0%	0.0%
2	It would be easy for me to manage my project using E-Mega Column . (P.E 4)	68.8%	31.3%	0.0%	0.0%	0.0%
3	I intend to use E-Mega Column during my work. (I.U 1)	68.8%	31.3%	0.0%	0.0%	0.0%
3	I will use E E-Mega Column often. (I.U 2)	68.8%	31.3%	0.0%	0.0%	0.0%
3	I intend to E-Mega Column frequently. (I.U 3)	56.3%	43.8%	0.0%	0.0%	0.0%

No.	Survey to identify effectiveness of E-Mega Column on Project management at a construction site.	Strongly Agree	Agree	Natural	Disagree	Strongly Disagree
		(5)	(4)	(3)	(2)	(1)
4	E-Mega Column makes work more interesting. (A.U 1)	62.5%	37.5%	0.0%	0.0%	0.0%
4	Working with E-Mega Column is fun. (A.U 2)	56.3%	43.8%	0.0%	0.0%	0.0%
4	I feel comfortable using E-Mega Column. (A.U 3)	62.5%	37.5%	0.0%	0.0%	0.0%
4	I look forward to those aspects of my job that require me to use E-Mega Column. (A.U 4)	62.5%	37.5%	0.0%	0.0%	0.0%

Table 4.9 shows respondent level of usability toward using existing method whereby analysis shows for all variables tested the mean score were less than 3.50 meaning that the usability level of existing method was low. Whilst Table 3 shows respondent level of usability toward using E-Mega Column Management Application whereby analysis shows for all variables tested the mean score were more than 4.00 meaning that the usage of E-Mega Column Management Application much easier compare with the existing method.

Table 4.9: Usability Level of existing method among respondants

Variables	Mean	Interpretation
Perceived Ease of Use	2.60	Low
Perceived Usefulness	2.60	Low
Attitude Towards Using Technology	2.60	Low
Behavioral Intention to Use	2.30	Low

Table 4.10: Usability Level of E-Mega Column Management Application among respondents

Variables	Mean	Interpretation
Perceived Ease of Use	4.50	High
Perceived Usefulness	4.50	High
Attitude Towards Using Technology	4.50	High
Behavioral Intention to Use	4.60	High

In order to evaluate the effectiveness of E-Mega Column Management Application in the project, a paired sample t test was performed. Results as shown in Table 4, respondent preferred using E-Mega Column Management Application whereby all variable measured, Perceived Ease of Use (Mean = 4.50), Perceived Usefulness (Mean = 4.50), Attitude Towards Using Technology (Mean = 4.50) and Behavioral Intention to Use (Mean = 4.60) were more higher compared with existing method, Perceived Ease of Use (Mean = 2.60), Perceived Usefulness (Mean = 2.60), Attitude Towards Using Technology (Mean = 2.60) and Behavioral Intention to Use (Mean = 2.30). A paired sample t-test found this difference to be significant for all variables being measured, The value of t of Perceived Ease of Use is 23.15 and the value of p is < .00001. The result is significant at $p < .05$. The value of t of Perceived Usefulness is 15.95 and value of p is < .00001. The result is significant at $p < .05$. The value of t of Attitude Towards Using Technology is 21.52 and the value of p is < .00001. The result is significant at $p < .05$. The value of t of Behavioural Intention to Use is 16.66 and the value of p is < .00001. The result is significant at $p < .05$. This suggests that using E-Mega Column Management Application was much easier and resourceful compared with existing method. This mean that E-Mega Column Management Application was more effective compare with the existing method.

Table 4.11: Paired sample t-test

Pair	Paired Different Mean	t	Significant (two tailed)
Perceived Ease of Use - Existing Method	1.90	23.15	.000
Perceived Usefulness - Existing Method	1.90	15.95	.000
Attitude Towards Using Technology- Existing Method	1.90	21.52	.000
Behavioral Intention to Use- Existing Method	2.30	16.66	.000

4.5 Conclusion

The construction industry, despite its long history, has faced challenges in adopting cutting-edge technologies on job sites. Outdated processes and fragmented communication have hindered the sector, leading to inefficiencies in projects. This emphasizes the crucial role of technology in enhancing quality and productivity within the industry. Project managers acknowledge that integrating the right technologies can create a more productive work environment.

The findings from the survey of Samsung C&T Sdn Bhd employees, including engineers, site supervisors, and project managers, revealed a consensus that the E-Mega Column Management Application is more effective compared to the existing method. The current method of using WhatsApp and paper for reference and submission was considered outdated and difficult to manage. The respondents expressed a high level of agreement, with a mean score greater than 4.00, indicating that the E-Mega Column Management Application is user-friendly and that they have the intention to use it for obtaining information on site progress preparation for mega columns.

The effectiveness of the E-Mega Column Management Application was evaluated using a paired t-test, analyzed through the Social Science Statistics online website. The results demonstrated a significant difference between the application and the existing method, indicating that the E-Mega Column Management Application is not only more effective but also easier to use. Therefore, it is highly recommended for gaining all necessary information on construction sites.

Overall, the construction industry recognizes the importance of technology in improving quality and productivity. The E-Mega Column Management Application presents a valuable solution to the challenges faced in the industry. It streamlines processes, reduces reliance on outdated methods such as paper and WhatsApp, and enhances efficiency. Given these advantages, the application is highly recommended for use in construction site information management.

CHAPTER 5

CONCLUSION, DICUSSION & SUGGGESTION

5.1 Introduction

The study aimed to address the common issue of insufficient planning in pre-commissioning projects by developing an E-Mega Column Management Application. The application was created using the Mit App Inventor programming tool and its usability effectiveness was tested among the company's staff through an online survey. The survey included four variables adapted from the Technology Acceptance Model (TAM) questionnaire: Perceived Ease of Use, Perceived Usefulness, Attitude Towards Using Technology, and Behavioral Intention to Use.

The collected data were analyzed using paired T-Test and mean calculations. The results of the paired t-test indicated a significant difference between the E-Mega Column Management Application and the existing method. This suggests that the application was more effective in terms of usability compared to the existing method. Consequently, the study highly recommended the implementation of the E-Mega Column Management Application for managing the successful coordination of individuals and processes within construction projects.

By utilizing this application, contractors can overcome the challenges related to insufficient planning and enhance their project management practices. The E-Mega Column Management Application provides a platform for integrating various factors crucial to effective project management, including coordination, communication, and process management. It offers features that improve the ease of use, usefulness, and overall attitude towards using technology in construction projects. With the positive feedback received from the staff through the survey, it is evident that the application has the potential to streamline and optimize the management of construction projects.

Implementing the E-Mega Column Management Application can lead to improved efficiency, reduced errors, and enhanced coordination among team members involved in pre-commissioning projects. By leveraging technology and addressing the shortcomings of traditional methods, contractors can benefit from a more streamlined and organized approach to project management. The application's usability, as demonstrated by the survey results, further strengthens the case for its adoption in the construction industry.

In conclusion, the study successfully developed and tested the E-Mega Column Management Application, demonstrating its superiority over the existing method in terms of usability. The application has the potential to greatly benefit contractors by facilitating effective coordination and management of individuals and processes within construction projects. Its implementation is highly recommended to improve project outcomes and mitigate the challenges associated with insufficient planning in pre-commissioning projects.

5.2 Discussion

Efforts were made to address the challenges at this company, including the utilization of the design thinking process. The researcher conducted interviews with construction practitioners, such as project managers, site engineers, site supervisors, suppliers, and consultants, as part of the empathy stage. This allowed them to understand the challenges and develop a project to solve them. A mock-up of the solution was created and distributed to construction personnel for competence testing before it was handed over to the company.

Two questionnaires were designed to gather feedback on the existing old-fashioned system for casting progress at Mega Column and the newly developed E-Mega Column Management Application. The analysis of the questionnaire results showed that the usability level of the existing method was low, with respondents expressing difficulties in executing their casting work. On the other hand, the feedback on the Interactive E-Mega Column Management Application indicated that it was significantly easier to use compared to the previous approach. The mean scores for variables such as Perceived Ease of Use, Perceived Usefulness, Attitude Towards Using Technology, and Behavioral Intention to Use were all higher for the application.

According to the findings in Table 4, respondents preferred using Interactive E-Site Preparation, with all variables measured Perceived Ease of Use (Mean = 4.50), Perceived Usefulness (Mean = 4.50), Attitude Towards Using Technology (Mean = 4.50) and Behavioral Intention to Use (Mean = 4.60) being significantly higher than the existing method. Perceived Usefulness (Mean = 2.60), Attitude Towards Using Technology (Mean = 2.60), and Behavioral Intention to Use (Mean = 2.30). A paired sample t-test revealed that this difference was significant for all variables studied. The value of t for Perceived Ease of Use is 23.15 and the value of p is < .00001.

The outcome is significant at p.05. Attitude Towards Using Technology has a t value of 20.87 and a p value of.00001. The outcome is noteworthy at p.05. The t value of Behavioral Intention to Use is 30.08, while the p value is.00001. significant at $p < .05$. The value of t of Perceived Usefulness is 15.95 and value of p is < .00001. The result is significant at $p < .05$. The value of t of Attitude Towards Using Technology is 21.52 and the value of p is < .00001. The result is significant at $p < .05$. The value of t of Behavioural Intention to Use is 16.66 and the value of p is < .00001. The result is significant at $p < .05$. This suggests that using E-Mega Column Management Application was much easier and resourceful compared with existing method. This mean that E-Mega Column Management Application was more effective compare with the existing method.

The E-Mega Column Management Application proved to be a valuable tool for the company especially for QAQC department in controlling the concreting work progress. Additionally, it could be utilized for other work progress, such as Corewall. Based on the positive feedback and significant improvements observed, the application was recommended for use in the company. It offered increased organization, usefulness, and user-friendliness, eliminating the need for paper-based processes and enabling personnel to stay updated on building site plans with a reliable internet connection.

5.3 Suggestion/Recommendation

Based on the presented findings, the researcher proposes several recommendations to enhance the usage of the E-Mega Column Management Application and guide future actions:

1. Expand the Application Scope: Currently, the application is limited to the Lot L&M Petronas Podium construction site area. To benefit multiple stakeholders, it would be advantageous to extend the application's coverage to include various other projects undertaken by the organization.

2. Enhance Security Measures: As the application deals with sensitive information, it is crucial to improve its security features. Implementing strict access controls and requiring users to enter a code or utilize a login system can help safeguard the confidentiality of project data.

3. Utilize Advanced Application Development Tools: Instead of relying solely on Mit App Inventor, consider exploring other software platforms such as Laravel, Storyboard VR, Pair 3D, Smart Reality, or Dalux Viewer to create the E-Mega Column Management Application. These platforms offer more robust features and capabilities, allowing users to develop applications with greater flexibility and functionality. Additionally, utilizing these platforms can provide an opportunity for users to acquire new skills like coding and blockchain.

4. Embrace Technology for Construction Excellence: Technology plays a crucial role in delivering high-quality projects efficiently. The E-Mega Column Management Application has the potential to reduce time and enhance Mega Column management progress on construction sites. By embracing such technology, the company can attract more users and improve its services, leading to increased competitiveness in the construction industry. This, in turn, can contribute to the overall economic growth of Malaysia and position the country favorably against other industrialized nations.

By implementing these recommendations, the company can further optimize the E-Mega Column Management Application, improve project management across multiple sites, ensure data security, and leverage technology for enhanced construction processes and outcomes.

5.4 Conclusion

The findings indicated that employees of Samsung C&T Sdn Bhd, including engineers, site supervisors, and project managers, agreed that the E-Mega Column Management Application was more effective compared to the existing method. The current method of using WhatsApp and paper as references and submissions was considered outdated and difficult to manage. The respondents strongly agreed that the application was easy to use and expressed their intention to utilize it for obtaining information on site progress preparation, as evidenced by the higher mean scores (>4.00).

The effectiveness of the E-Mega Column Management Application was evaluated using a paired t-test conducted with the assistance of the Social Science Statistics online website. The results showed a significant difference between the application and the existing method, confirming that the application was not only more effective but also easier to use. Therefore, it was highly recommended for managing all information related to the construction site work progress for mega columns.

Additionally, the E-Mega Column Management Application can be accessed as a mobile application, providing convenience and ease of use for all employees. The researcher concludes that technology plays a vital role in the construction business, enabling the production of high-quality projects. By utilizing the E-Mega Column Management Application, the company can reduce paper expenses, save time, and establish a more systematic approach. Moreover, technology adoption can attract more customers to the company's services. Implementing technology in construction activities can also help Malaysia catch up with other successful countries worldwide. Therefore, technology in the construction sector is crucial for the country's economic growth.

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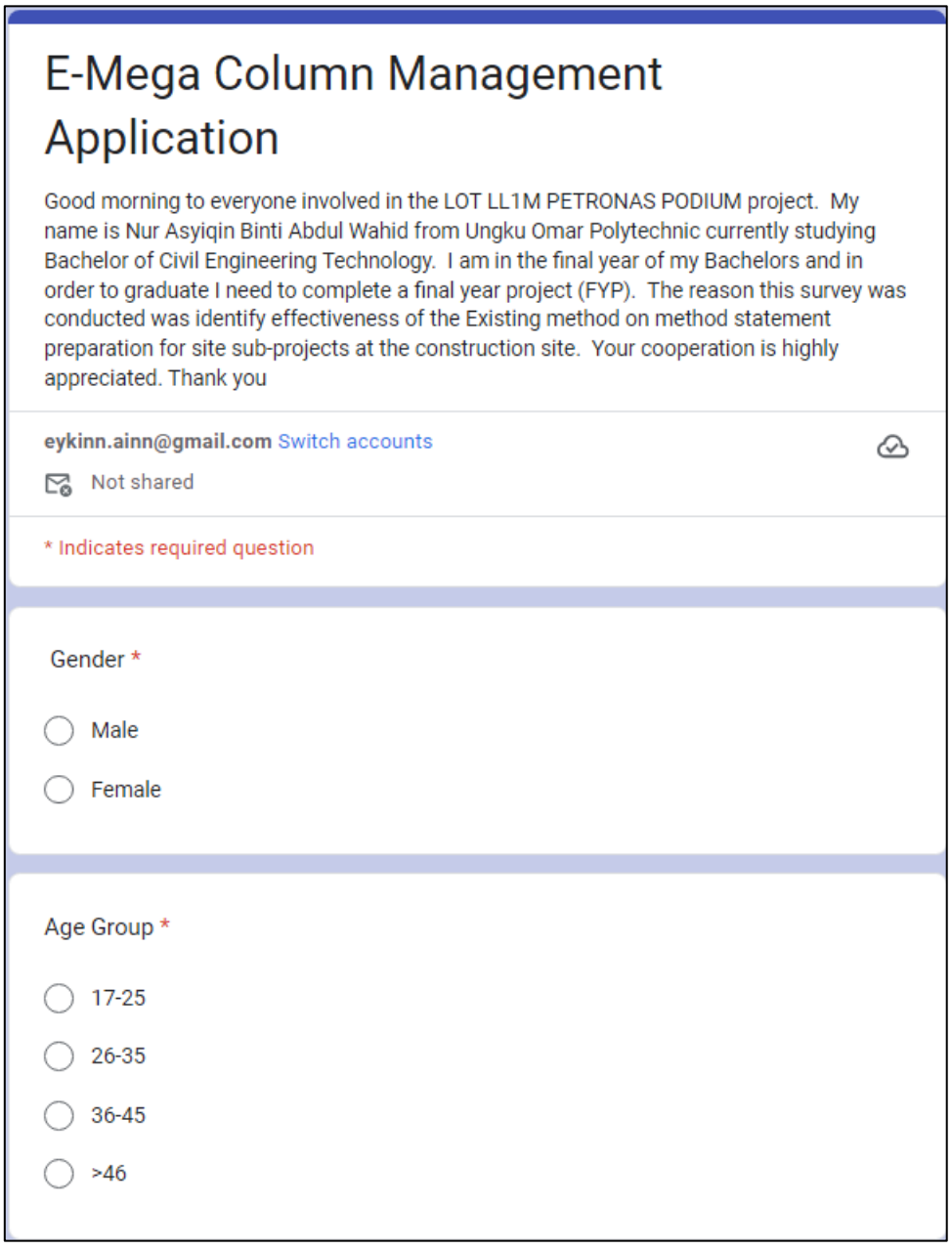
APPENDIX 1

Example questionnaires of E-Mega Column Management Application



E-Mega Column Management Application

Good morning to everyone involved in the LOT LL1M PETRONAS PODIUM project. My name is Nur Asyiqin Binti Abdul Wahid from Ungku Omar Polytechnic currently studying Bachelor of Civil Engineering Technology. I am in the final year of my Bachelors and in order to graduate I need to complete a final year project (FYP). The reason this survey was conducted was identify effectiveness of the Existing method on method statement preparation for site sub-projects at the construction site. Your cooperation is highly appreciated. Thank you

eykinn.ainn@gmail.com Switch accounts

Not shared

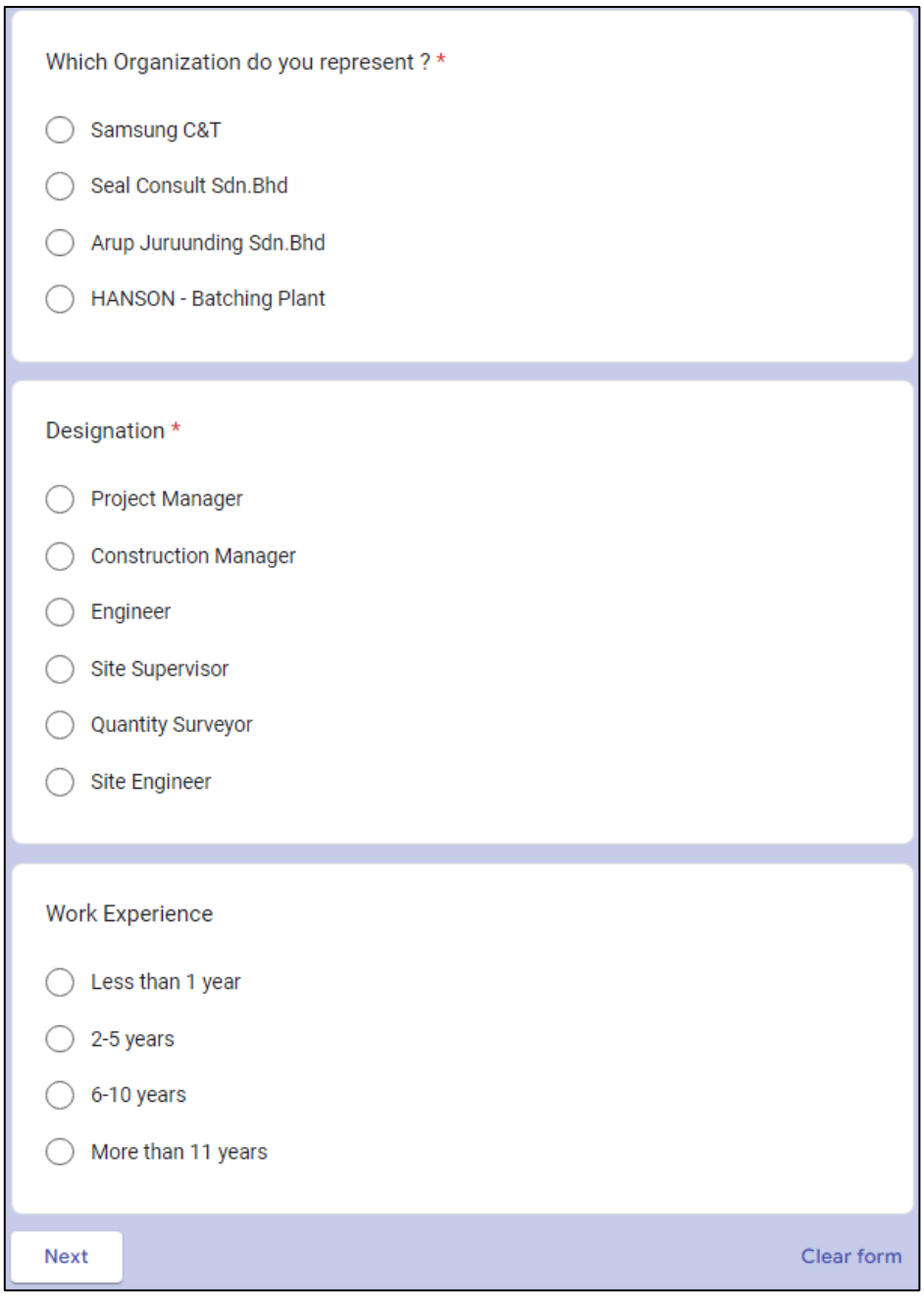
* Indicates required question

Gender *

- Male
- Female

Age Group *

- 17-25
- 26-35
- 36-45
- >46



Which Organization do you represent ? *

- Samsung C&T
- Seal Consult Sdn.Bhd
- Arup Juruunding Sdn.Bhd
- HANSON - Batching Plant

Designation *

- Project Manager
- Construction Manager
- Engineer
- Site Supervisor
- Quantity Surveyor
- Site Engineer

Work Experience

- Less than 1 year
- 2-5 years
- 6-10 years
- More than 11 years

Next Clear form

Section 2 of 5

SECTION B - **Effectiveness Categories**

Issues Related to E-Mega Column Application

1. Using E-Mega Column Application method would enhance my effectiveness in work

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

2. Using E-Mega Column Application would improve my performance in work

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

3. Using E-Mega Column Application would increase my productivity.

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

4. I found E-Mega Column Application useful.

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

Section 3 of 5

SECTION C - **Perceived Ease of Use**

Issues Related to E-Mega Column Application

5. I found E-Mega Column Application easy to use. *

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

6. Learning to use E-Mega Column Application would be easy for me. *

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

7. My interaction with E-Mega Column Application was clear and understandable *

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

8. It would be easy for me to manage my project using E-Mega Column Application . *

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

Section 4 of 5

SECTION D - **Intention to Use**

Issues Related to E-Mega Column Application

9. I intend to use E-Mega Column Application during my work *

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

10. I will use E-Mega Column Application often. *

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

11. I intend to use E-Mega Column Application frequently. *

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

Section 5 of 5

SECTION E - **Attitude Toward Using**

Issues Related to E-Mega Column Application

12. E-Mega Column Application makes work more interesting

- ○ Strongly Agree
- ○ Agree
- ○ Slightly Agree
- ○ Disagree
- ○ Strongly Disagree

13. Working with E-Mega Column Application is fun.

- ○ Strongly Agree
- ○ Agree
- ○ Slightly Agree
- ○ Disagree
- ○ Strongly Disagree

14. I feel comfortable using E-Mega Column Application

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

15. I look forward to those aspects of my job that required me to use E-Mega Column Application

- Strongly Agree
- Agree
- Slightly Agree
- Disagree
- Strongly Disagree

APPENDIX 2

View of DataBase

```
<?php
namespace Database\Factories;
use Illuminate\Database\Eloquent\Factories\Factory;
use Illuminate\Support\Str;
class UserFactory extends Factory
{
    /**
     * Define the model's default state.
     *
     * @return array
     */
    public function definition()
    {
        return [
            'name' => $this->faker->name(),
            'email' => $this->faker->unique()->safeEmail(),
            'email_verified_at' => now(),
            'password' =>
'$2y$10$92IXUNpkjO0rOQ5byMi.Ye4oKoEa3Ro9llC/.og/at2.uheWG/igi', //
password
            'remember_token' => Str::random(10),
        ];
    }
    /**
     * Indicate that the model's email address should be unverified.
     *
     * @return \Illuminate\Database\Eloquent\Factories\Factory
     */
    public function unverified()
    {
        return $this->state(function (array $attributes) {
            return [
                'email_verified_at' => null,
            ];
        });
    }
}


<?php
namespace Database\Seeders;
use Illuminate\Database\Seeder;
class DatabaseSeeder extends Seeder
{
    /**
     * Seed the application's database.
     *
     * @return void
     */
    public function run()
    {
```

```
        // \App\Models\User::factory(10)->create();
    }
}
```

```
<?php
use Illuminate\Database\Migrations\Migration;
use Illuminate\Database\Schema\Blueprint;
use Illuminate\Support\Facades\Schema;
class CreateUsersTable extends Migration
{
    /**
     * Run the migrations.
     *
     * @return void
     */
    public function up()
    {
        Schema::create('users', function (Blueprint $table) {
            $table->id();
            $table->string('name');
            $table->string('email')->unique();
            $table->timestamp('email_verified_at')->nullable();
            $table->string('password');
            $table->integer('is_admin')->nullable();
            $table->string('role', 255)->nullable();
            $table->rememberToken();
            $table->timestamps();
        });
    }
    /**
     * Reverse the migrations.
     *
     * @return void
     */
    public function down()
    {
        Schema::dropIfExists('users');
    }
}
```

APPENDIX 3

The Gantt chart of the development progress from semester 7 to semester 8