POLITEKNIK UNGKU OMAR

THE APPLICATION OF DIESEL BALANCE MONITORING (DBM) FOR CONSTRUCTION SITE MANAGEMENT

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(01BCT20F3009)

CIVIL ENGINEERING DEPARTMENT

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

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STATEMENT OF AUTHENCITY AND PROPRIETARY RIGHTS

THE APPLICATION OF DIESEL BALANCE MONITORING APPLICATION (DBM) FOR CONSTRUCTION SITE MANAGEMENT

1. **I, MUHAMMAD ASY SYIBLI BIN HASSAN (NO KP: 990123-11-5867) am a student of Bachelor of Civil Engineering Technology, in Politeknik Ungku Omar, at the address Jalan Raja Musa Mahadi, 31400 Ipoh, Perak.**

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APPRECIATION

In the name of Allah SWT, most gracious, most merciful, peace and blessing be upon Prophet Muhammad SAW. Firstly, I would like to offer my deepest gratitude towards Allah SWT because of His Grace and His Guidance which I can successfully complete this report “The Application Of Diesel Balance Monitoring Application (DBM) For Construction Site Management”.

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ABSTRACT

In this era, the involvement of technology in construction has develop and spread widely. Civil engineering technology involves planning the work structure in parallel with the timeline. Construction work requires the use of various types of heavy machinery and the number depends on the type of project being that being carried out. These heavy machines are necessarily dependent on fuel and each project has a budgeted cost that must be controlled for the material. Cost control for these materials is not an easy matter for project operators. Therefore, the purpose of this study is to design and develop application of Diesel Balance Monitoring (DBM) mobile application for Construction Site Management that allows user to monitor their fuel capacity in their site project. This product was developed using Bubble software and tested by 30 employees of Pembinaan Tetap Teguh Sdn Bhd consisting of project managers, construction managers, engineers, assistant engineers, site safety supervisors, site supervisors and operators. The effectiveness of the "Diesel Balance Monitoring (DBM)" application was tested on four aspects, namely, real-time information, efficient monitoring, official medium and systematic information. All analyzes were carried out using the IBM SPSS statistical version 26. The findings show that DBM has the potential to promote among the construction industry.

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ABSTRACT

Pada era ini, penglibatan teknologi dalam pembinaan telah berkembang dan tersebar luas. Teknologi kejuruteraan awam melibatkan perancangan struktur kerja selari dengan garis masa. Kerja pembinaan memerlukan penggunaan pelbagai jenis jentera berat dan bilangannya bergantung kepada jenis projek yang sedang dijalankan. Mesin berat ini semestinya bergantung kepada bahan api dan setiap projek mempunyai kos anggaran yang mesti dikawal untuk bahan tersebut. Kawalan kos untuk bahan-bahan ini bukanlah perkara yang mudah bagi pengendali projek. Oleh itu, tujuan kajian ini adalah untuk mereka bentuk dan membangunkan aplikasi mudah alih Diesel Balance Monitoring (DBM) untuk Pengurusan Tapak Pembinaan yang membolehkan pengguna memantau kapasiti bahan api mereka dalam projek tapak mereka. Produk ini dibangunkan menggunakan perisian Bubble dan diuji oleh 30 kakitangan Pembinaan Tetap Teguh Sdn Bhd yang terdiri daripada pengurus projek, pengurus pembinaan, jurutera, penolong jurutera, penyelia keselamatan tapak, penyelia tapak dan operator. Keberkesanan aplikasi "Pemantauan Baki Diesel (DBM)" diuji pada empat aspek iaitu, maklumat masa nyata, pemantauan cekap, medium rasmi dan maklumat sistematik. Semua analisis telah dijalankan menggunakan statistik IBM SPSS versi 26. Dapatan menunjukkan bahawa DBM berpotensi untuk mempromosikan dalam kalangan industri pembinaan.

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

A huge construction project necessitates a number of considerations. From job progress planning to workers, and much more. Planning & Scheduling plays a vital role in completing projects within time and cost (Gaur,2022). The quantity of gear and equipment that must be regularly monitored for performance, theft, misplacement, problems, and bottlenecks is tremendous in most major, multi-site projects. The same is true for the amount of diesel balance remaining in a site. Because all machinery is fueled by diesel, this is an important subject that must be handled to ensure project progress. Construction projects depend upon having the right people with right skills and equipment that are able to deliver the project on time and on budget (Kulkarni, et al. 2017). Manually monitoring the quantity of fuel using spreadsheets or pen-and-paper records, on the other hand, is frequently impracticable, especially when the locations are geographically distant. Diesel delivery are performed infrequently due to a lack of time due to the procedure of making order usually took a while. Furthermore, manual work management raises the likelihood of mistakes while making inventory management a time-consuming and labor-intensive procedure.

Diesel fuel is the popular name for distillate fuel oil marketed for use in automobiles powered by the compression ignition engine named after its inventor, German engineer Rudolf Diesel. In 1892, he received a patent for his original design. Diesel fuel is produced by refining crude oil and biomass sources. Diesel engines power the majority of freight and delivery trucks, as well as railroads, buses, boats, farm, construction, and military equipment, as well as certain cars and light trucks. Diesel fuel is also utilized in diesel-engine generators to create energy, which is used in isolated

settlements across the world. Despite all improvements in renewable energy technologies, numerous remote sites and applications are still dependent on DGs and fossil fuels to produce electricity (Mobarra et al.2022). Diesel generators are used for backup and emergency power supply in many industrial sites, huge buildings, institutional facilities, hospitals, and electric utilities.

Rudolf Diesel, the creator of the diesel engine, originally intended for his engine to run on coal dust. Before the petroleum industry began producing petroleum diesel fuel, he also experimented with vegetable oil. The vast majority of diesel fuel used in the United States is refined from crude oil. Biodiesel derived from vegetable oils and other sources is now widely used. On January 6, 1930, the first diesel engine vehicle excursion was completed. The journey from Indianapolis, Indiana, to New York City was about 800 miles long. The excursion highlighted the importance of the diesel engine design, which has been employed in millions of cars since its debut.

Diesel engines in vehicles, railroads, boats, and barges assist in the transportation of practically all items consumed by people. Diesel fuel is frequently utilized in public and school buses. Diesel fuel is used to power the majority of agriculture and construction equipment in Malaysia. the diesel engine is being extensively utilized in isolated locations (e.g. remote areas and islands) for power generation because of its reliability and fuel efficiency (Mustayen, 2022). The power provided by diesel fuel is often used in the construction sector. Diesel engines are capable of doing difficult construction tasks like as lifting steel beams, excavating foundations and trenches, drilling wells, paving roads, and transporting earth in a safe and efficient manner. Diesel fuel is also utilized to create power in diesel engine generators. Diesel generators are used for backup and emergency power supply in many industrial sites, huge buildings, institutional facilities, hospitals, and electric utilities.

It is vital for a project developer to ensure that their fuel supply is enough in order for the construction to continue. The sector has an important role in the economy in terms of the inputs it uses, due to the demand for goods and services produced by directly or indirectly connected sub-sectors (Niyazi Berk,2018). It should raise everyone’s eyes to the importance of taking these concerns seriously since it will help to ramp up the progress of a project. Diesel is used as fuel in most of construction equipment operation and It contributes more then 35 % of operational costs of

construction equipment, the fluctuation of the price of fuel and fuel consumption have a major impact on the profits of the company (Kumar,2020). By considering this item, it will give no problem for a project developer to assigned various type and amount of machinery in their site.

There are a lot of advantages by having a lot of machinery in site such as, a machine can readily do tasks that are too heavy or delicate for typical human muscles. Works such as lifting heavy material and excavating can be easily executed which will save a lot amount of time Hydraulic excavators, the most important production equipment, are widely used for soil improvement in agricultural engineering and for removing soil and ore materials in the construction sites and mines (Chen et al. 2017). Besides that, having machinery in site can help to carry out tasks that cannot be done manually or perform them more inexpensively and quickly. Plus, it can help to maintain the project rate of production if skill or unskilled workers are limited. So, it will give the project developer a various option to executed a work if there are not enough manpower. Last but not least, they'll aid in raising output rates through work progress using the most effective and efficient approaches.

Some of the advantages of having machinery on-site include assisting in operating a certain job that are too heavy for human muscles. mechanization and automation offer many benefits to the betterment of the Malaysian construction industry (Kamaruddin et al., 2016). Beside that, they can carry out task that cannot be done manually, or performing them will be more inexpensively and quickly. Plus it will contribute in maintaining the projected rate of production if skilled or unskilled labour are limited. Finally, they will aid in raising output through work progress using the most effective and efficient approaches. Those mentioned benefits are a several examples that will aid in contributing the balancing of a project development, thus a further step should be taken to attempt in controlling all of the machinery usage in such an efficient and planned manner.

1.2 PROBLEM STATEMENT

Diesel is a very important material as diesel power most of the construction equipment and machinery in site. Plus, the construction industry also depends on the power diesel fuel provided. Diesel engine can do demanding construction works, such as lifting steel beams, digging foundations and trenches, drilling wells, paving roads, and moving soil safely and efficiently.

It is very important for material department to control the amount of the mentioned material so that all works on site will be running per schedule. Many material departments today "fight fires" rather than addressing problems in a methodical manner. Preventing issues is considerably preferable to attempting to tackle them as they emerge. While this technique may be initially pricey, it is far less expensive than allowing issues to emerge. Capability to coordinate and integrate purchasing, shipping and material control from suppliers is required for material cost control. (Madhavi, 2019). To outcomes this issue, it best if an organization create an alternative solution that can help to reduce the losses of money to the company.

Problem-solving regarding this issue are largely concerned with four areas: maintaining vital systems, resolving problems promptly and more efficiently than the previous time, and discovering what is causing the failure to occur so frequently.

Diesel balance in site will be routinely updated via applications in smartphones. If any of the sites are low in diesel, it will alert the material department so that they can arrange their time to arrange delivery because the site projects are geographically isolated. Communication is one of the most critical factors contributing to success because of the numerous parties involved to work together and address the issues occurring on project sites (Ahmed et al, 2021). Mobile devices are quick to deliver information in a construction sites. It's convenient and a no-brainer for anybody participating in the project, from engineers to non-tech aware workers.

According to Zaher et al.,2018 in the USA, a 2012 survey revealed that 93 per cent of general contractors and 87 per cent of subcontractors sampled were using mobile devices on their job sites to increase productivity. So, there will be no problem for employees in a construction works to use this application. This application is designed

to be user-friendly, and the user may access information anywhere and at any time by utilising a mobile device or any other gadget. This will save them time, and the progress of their job will be unaffected.

According to the staff at PTT Terengganu, there are also issues that are has been identified which is related to the uses of paper based document. The issues are include it is not very systematic to refer the paper based document since all the document are at the site office and most of the employee are designated to be on site. To travel from site to office took a several kilometre (KM) and consume a high amount of time. Through the exchange of electronic information with suppliers and customers, a business can make information quickly accessible anywhere, ensuring privacy and security with the use of encryption, passwords and other security measures. Because of fire, deterioration, water damage or loss, paper files also disappear, so paper documents are hardly one hundred percent safe either (Shenoy and Aithal, 2016). This scenario shows that this conventional method is not practicable and not environmental to be used anymore. There are a lot of document will be print out and save into the file. Sometime there are a mistake on the document so employee need to print out back for new copies and it's occur a lot of paper wastage.

Human activities generate waste materials. Normally, solid wastes are often discarded because they are considered useless. Waste is a by-product of human activities. They are materials that are abandoned or discarded because they are of no value to the producer. Usually solid waste can be classified as follows:

i. Municipal Solid Waste
ii. Hazardous waste
iii. Agricultural waste
iv. Industrial waste

Municipal Solid waste (MSW) is mostly home garbage, but it also includes business and institutional waste. Municipal Solid Waste is sometimes referred to as trash or waste. This category of trash covers all wastes (excluding wastewater and sewage) created by municipalities' households, enterprises, and institutions (universities, schools, and colleges). MSW in industrialised nations is made up of the

following materials: paper, metal, plastic, food scraps, wood, glass, rubber, leather and garden clippings.

Hazardous waste is a waste with properties that make it potentially dangerous or harmful to human health or the environment. There are currently 77 categories defined in the First Scheduled Waste of the Environmental Quality in Malaysia as EHS, which are classified into five groups. The hazardous wastes in the five groups are from different sources such as industrial sector, agricultural sector, health sector, and households (Chikere Aja et al. 2023). The universe of hazardous wastes is large and diverse. Hazardous wastes can be liquids, solids, or contained gases. They can be the by-products of manufacturing processes, discarded used materials, or discarded unused commercial products, such as cleaning fluids (solvents), pesticides and motor oil.

Agricultural Waste is unwanted or unsalable materials produced wholly from agricultural operations directly related to the growing of crops or raising of animals for the primary purpose of making a profit or for a livelihood. Agriculture is responsible for 21% of greenhouse gases emissions. In recent years, this new situation has driven a model with more sustainable development, which implies important changes in the current agricultural production systems (Duque-Acevedo et al. 2020).

Industrial waste is defined as waste generated by manufacturing or industrial processes. The types of industrial waste generated include cafeteria garbage, dirt and gravel, masonry and concrete, scrap metals, trash, oil, solvents, chemicals, weed grass and trees, wood and scrap lumber, and similar wastes. Industrial effluents are one of the major causes of irreversible damage to the ecosystem. Improper treatment and direct release of these hazardous effluents in the sewerage drains eventually pollutes the groundwater as well as other major water bodies, causing adverse effects on the health of animals as well as aquatic life (Ahmed et al. 2021).

Due to rapid urbanization which is include the growth of construction activity rate, it have been one of a major contribution factor to the MSW production rate in Malaysia. In 1980, the urbanization growth in Malaysia was the most rapid in Southeast Asia. From 1970 to 2005, Malaysia recorded a great growth in urban population by 91.5%. In 2005, the rate of urbanization in Pulau Pinang, Wilayah Persekutuan Labuan, Selangor and Wilayah Persekutuan Kuala Lumpur, Melaka, and Johor were higher than

the average rate of national urbanization (2.5%) (Tarmudi Z,2012). Figure 1.1 below shows the percentage of municipal waste in Malaysia that have been recorded on 2016. According to the federal policies in the MP's, an upgoing trend of urbanization is expected for upcoming years. These policies advance a hierarchy growth conurbation approach which includes national, regional, intermediate and urban centers (Fazeli et al. 2016)

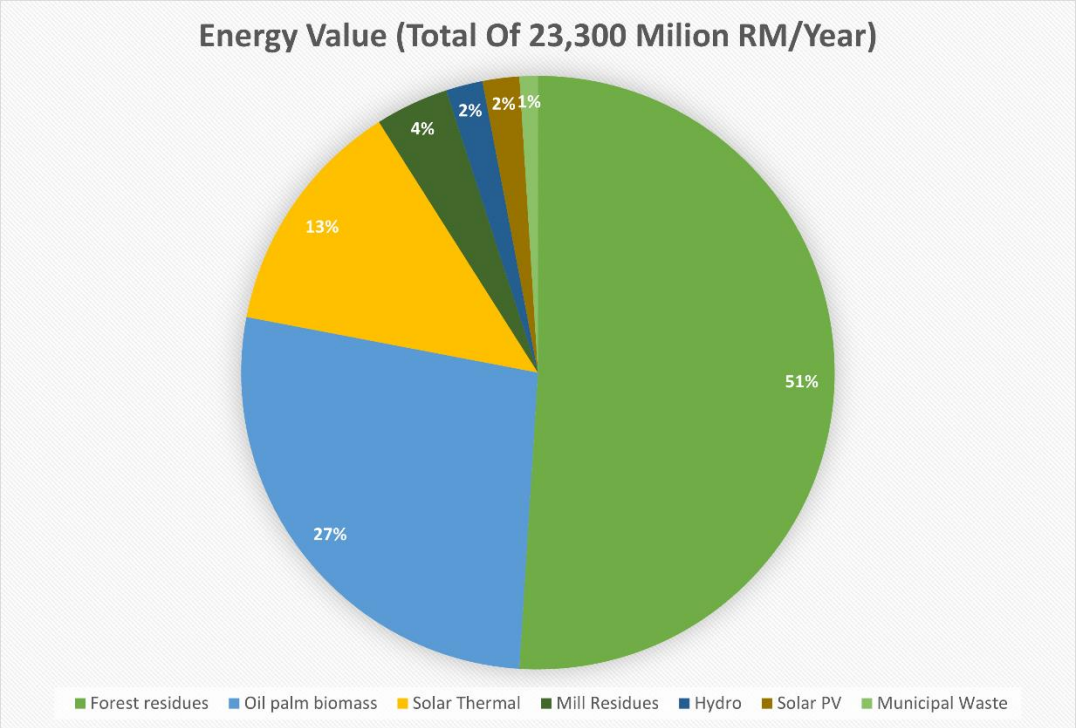


Figure 1.1 Municipal waste in Malaysia

Source : Malaysia′S Stand on Municipal Solid Waste Conversion to Energy

Furthermore, a lot of paper is utilised in the construction industry to generate documentation. Because such materials are in the form of papers, their usage is not sustainable. Many papers will be used, and if the document is not approved, it will be submitted in the new form, and the old form will be discarded. To reduce paper waste in Malaysia, researchers determined to innovate the traditional way by using technology, since the government has declared the objective to achieve Innovation Revolution 4.0 (IR.4.0) in all sectors. Implementing technology in the building business may aid in a country's global growth.

As a result, if the paper was difficult to locate and refer to on the spot. It will take time for project participants to discover information on the specifics of diesel material on site. The organisation is still using the traditional manner, such as a paper-based form. The paper may be missing and must be reprinted for use on the job site. If there is a system that can track and list all of the content online, the worker will be able to refer to it anywhere and at any time. It will save time and systemize the work process on the job site or in the office especially when they are geographically distance.

Previous studies show that there were a connection between latest technology and construction management such as "The Use of Robotics Technology in the Production of Industrial Building System (IBS) Components Towards Industrial Revolution 4.0 in the Construction Sector" this research may conclude the technology is more efficiency to be apply for saving the environment (Hafizy Md Arif et al. 2020). Next is "The Use of Internet of Things (IoT) in the Construction Industry in Malaysia" this study shows the construction industry by making progress in today's use of IoT technology can upgrade the business sector in industries (Sabri et al. 2020).

Even though the usage of technology seems to assist the management in construction but Pembinaan Tetap Teguh Sdn Bhd. the tracking and ordering of material process is still using conventional method which is paper based. This will result in increasing number of paper wastage at Pembinaan Tetap Teguh Sdn Bhd day by day. Therefore, the aim of this project was to develop Diesel Balance Monitoring application (DBM) using latest technology which is parallel with Industry Revolution 4.0 (IR 4.0) technology towards achieving the green construction for company.

1.3 OBJECTIVE OF THE STUDY

Aim of this project is to share information of diesel balance to all workers in a construction project effectively via an application. This programme is user-friendly, and the user may access information anywhere and at any time by utilising a mobile device or any other gadget such as a tablet and computer. The objectives of this project are as follows:

i. To design diesel tracking application in construction site

ii. To develop Diesel Balance Monitoring Application using Bubble software

iii. To evaluate the effectiveness of the Diesel Balance Monitoring (DBM) application.

1.4 SCOPE OF THE STUDY

This apps will be used at site section 3, Kuala Terengganu. It can be use by all the personnel but the Assistant project manager (APM), Site engineer and site supervisor can have the authorities to update the detail regarding the diesel balance in site as they have the responsibilities to make order and handle the schedule of diesel delivery in site.

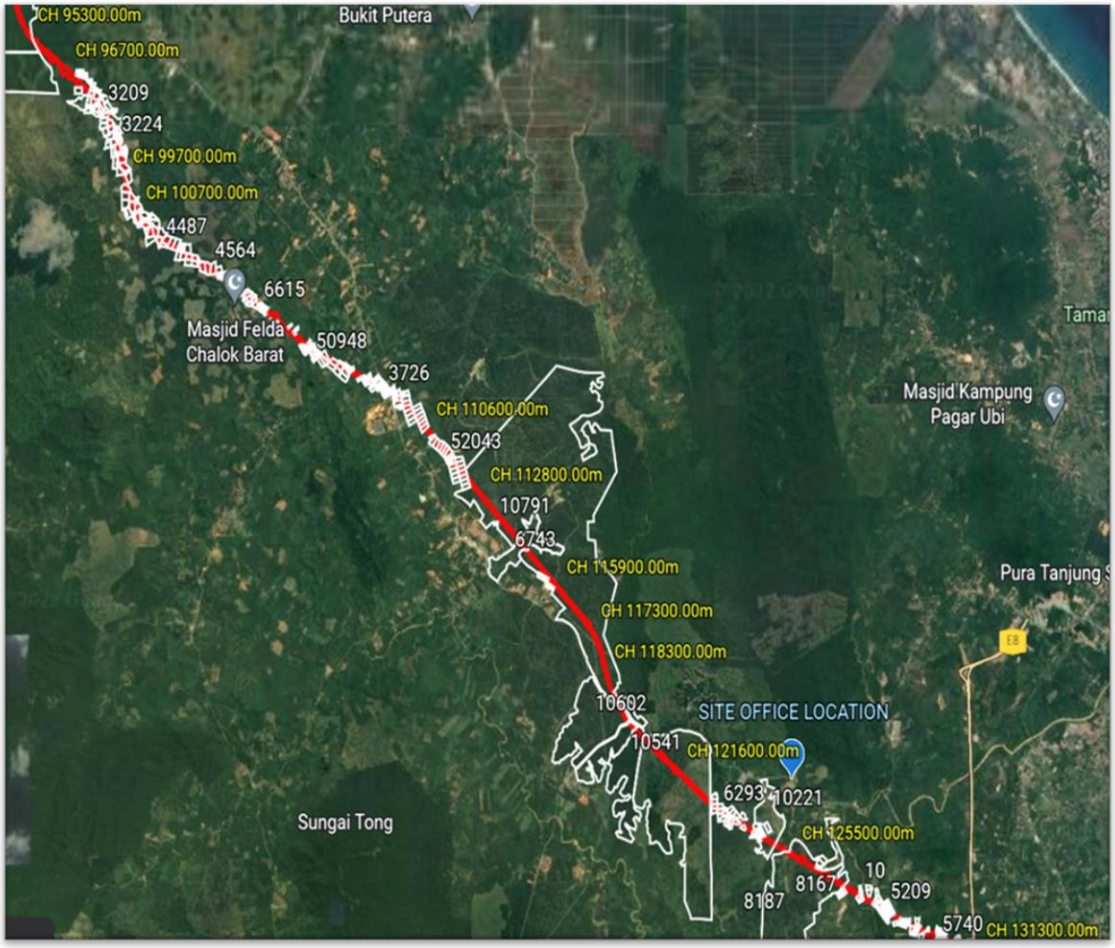


Figure 1.2 ECRL project Section 3, Kuala Terengganu

This project focuses to ease the user to get more detail information such as the allowable quantity of diesel in every site, number of intermediate bulk container (IBC) tank or skid tank, diesel balance left in site every day and the amount of diesel used in per month. The authorized user is required to key-in correct details so that it will tally with the diesel delivery and usage. In advance, The application can generate precise report regarding the targeted material so it will help to improve the information sharing within a company.

1.5 RESEARCH BACKGROUND

The world joined the digital era a long time ago, and it has drastically changed many sectors. Almost all company today rely on the internet and computers to streamline their operations. Those that actually want to modernize their businesses, on the other hand, are turning to smartphones as a replacement for the traditional desktop. Construction management software has been around for a while. One is used for almost all construction projects for planning, scheduling, monitoring, and communication. It has been shown to be a useful tool for increasing the agility of various operations. Construction software, on the other hand, already provides mobile application versions for convenience.

Mobile devices are quick to deliver information to construction sites. It's convenient and a no-brainer for anybody participating in the project, from engineers to non-tech aware workers. Almost 80% of smartphone owners check their phones much too frequently during the day. They also spend almost 4 hours a day on their phones. According to Pew Research Center 4 as many as 54 percent of adults in 21 developing countries are already using the internet. There are 21 percent of adults who use smartphones and will rise to 37 percent in 2014. In developed countries, 87 percent of adults are internet users and 68 percent already have smartphones. Smartphones are used for much more than calling, texting, or basic internet browsing. Users are turning to these mobile devices as they navigate a wide range of life events; 62% of smartphone owners have used their phone. Only 30% to take a class or get educational content and 18% to submit a job application (Ramadiani, et al. 2017).

Supervisors and managers consider smartphones as the most effective way to communicate with their subordinates. Smartphones increasingly are playing a central role in the life of older participants, although the frequency of app access is negatively correlated with age. (Rosales, A., & Fernández-Ardèvol, M. ,2016,) As a result, the usage of a mobile app on a project site is well justified.

1.6 SIGNIFICANT OF THE STUDY

This research was carried out to keep track of the fuel balance at a construction site. Utilizing this programme can assist in preventing diesel storage from running out and affecting project's work progresses. The researcher created the innovations and methodologies, which may be used in this investigation. As a result, it is important to focus on the study to build an application to track the fuel balance on site since it will aid project developers in lowering the amount of diesel wasted during construction. It also helps to build an efficient collaboration between project participants in handling this challenge within a project. Efficient collaboration among project participants is a key factor in completing construction projects on time and within budget. The precedent of collaboration is to share accountable information among the participants (Dongmin Lee, 2021).

This application's nature makes it user-friendly and ecologically responsible. It may promptly advise the user and the designated person in charge (PIC) of how much diesel left on site each day. With the help of this monitoring programme, users of the diesel storage may receive information that will allow them to create more organised planning of future work progress. As results, it will increase the effectiveness of resources utilization within a project. Project resources (material, human and financial) are closely monitored and evaluated to ensure effective resource utilization and project accountability. The contrast of progress information serves as lessons for decisions to be made on the project or for future project implementation (Callistus, et al. 2017).

By having this application in site, project participants can easily gain information since all they need is a smartphone. Material department also can use this application to

record the consumption of diesel in site online. So they don't need to find the related document and print out to refer. Effective information sharing will significantly enhance the effectiveness of supply chain practices and further contribute to good supply chain performance (Zheng, et al. 2022)

Resolving conventional method document by paper can be seen as not sustainable. It can be seen from the problems that have been stated that a job or task cannot be completed in good way and misunderstanding occurs within process run. The document can be missing or can be used a lot of paper. In addition, the wastage of paper also happens on site office just because of there is no info can be refer through online. This scenario occurs due to no systematic systems to pin all the information in one place but can be access anywhere.

Therefore, this system has been applied to the project since users are satisfied with this upgrading the technology in construction. This system makes it much easier to process if necessary. It also helps to minimize the mistake in print out the wrong document and also reduces usage of paper. Besides that, it can help saves time in process of ordering diesel fuel in site, tracking the diesel left and update the status of the material. Site information can provide feedback for various purposes, including progress measurement, equipment and material tracking, safety planning, and productivity tracking (Omar et, al. 2016). The Diesel Balance Monitoring Application (DBM) will also improve the productivity of technology for the company. Because the construction industry is one of the major contributors of the country's economy, the industry must adopt the emerging technologies for effective management of construction projects and improve the productivity and value chain (Hossam et, al. 2019).

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

The construction industry is one of the sectors that both contributes to and influences the country's growth. In Malaysia, the highest value of construction work was recorded in 2019, at approximately RM 146.37 billion. The value of construction work increased annually by approximately RM 10 billion from 2012 to 2018. (Alaloul, Wesam Salah, et al. 2021). This shows that construction industry also contributes in increasing Malaysia economic growth. Furthermore, much study has been driven by the fact that the economy would grow as a result of the contribution of the construction sector. The major goal of this vision is to make Malaysia an affluent, competitive, dynamic, robust, and resilient country by 2020. Former Prime Minister Tun Dr. Mahathir Mohammad proposed a vision for a strong industrial economy and transformed Malaysia in February 1990. Because of its dynamic nature, the construction industry can play an important and effective role in this respect, expanding backward and forward ties with other sectors of the economy.

This is the sector that provides socio-economic infrastructure for industrial growth and production and basic amenities such as residential and commercial spaces, parks, playgrounds and stadiums, health care facilities, roads, highways, rail, ports, airports, dams, power generation and supply stations, communications utilities, and also the other basic infrastructure necessary for the country and for the development and improvement of society's living standards (Liew, 2014). Malaysia is growing more evolved than ever before as new developments become increasingly important economic factors.

The construction industry contributes significantly to the creation of wealth and the enhancement of the nation's quality of life, both of which are necessary for the country's growth. The rapid economic development has increased the demand for construction of infrastructure and facilities globally. (N A Haron et al. 2017). It also leads to the creation of a large number of employment opportunities in the economy not only for local citizen but also migrants and refugee. The construction industry is a major source of potential employment for migrants and refugees and emerging social and sustainable procurement policies in many parts of the world are also requiring construction supply chains to employ refugees and migrants as a condition of public sector contracts (Loosemore, Martin et al.. 2021). Malaysia acknowledge the importance of the construction sector during its early days of independence, and the sector began to flourish.

Today, it is one of the key sectors of the Malaysian economy, however its contribution is minimal in comparison to other sectors such as services, manufacturing, and agriculture. However, both emerging and established countries have acknowledged and appreciated the importance of the construction industry in the country's socioeconomic and sustainable growth. Technological advancement is propelling developed countries forward, and it has a significant influence on the country. Refer to the Malaysian development to make it easy to finish all work on this development. Even in this realm of technology, standard building methods can be reduced.

Although the majority of construction industry studies are focused on the study of technology as a design analysis. A lack of research will have an impact on product demand and the growth of the construction industry. Housing demand is increasing with the rapid growth of population in developing countries and the conventional/traditional construction falls behind to meet this increasing demand (Hossain, et al. 2020). This is most likely one of the causes of diminishing surplus output growth in the construction industry sector, which is doing worse than the national economy during an economic depression.

The product demand analysis and the link between economic growth and the construction sector have been demonstrated. The study of the evolution of the construction sector and its relationship to the output components to be carried out, such as commercial, residential, and civil engineering, is being conducted. Since the

construction sector involves investments or high expenditures and diverse components, it is frequently tied to the request's outcome.

Demand analysis for each type of product development is critical in order to determine the amount of the economic influence on the growth of Malaysia's construction sector. The utilization of innovative technology makes collaboration easier among companies and has the potential to create financial and operational benefits (Attaran, 2017). Analyze the trends in the construction sector and their link to the demand for its products. This will provide a comprehensive picture of the construction industry's historical progress as well as a forecast of its future. The strong association between the construction sector and a country's economic prosperity is frequently noted. People are concerned about investing in Malaysia because of the construction industry sector's unpredictability.

However, new technology has a tremendous effect on a nation that is at the vanguard of developed nations. Refer to Malaysian building techniques to simplify the work done in this development. Even in this technical industry, conventional construction usage may be reduced. As a consequence, the employment of technology in the construction sector will have a beneficial impact on efficiency and time savings. Furthermore, by leveraging technologies such as application or software systems, it can be accessed from any location and simplifies daily work with the tap of a finger. The advancement of technologies has laid a foundation to share information (Dena Mahmudnia, et al. 2022). This chapter will provide an overview of a small quantity of literature based on the completion of current research in order to illustrate the issues being discussed. Plus, it will also highlighted the solution to any problem through a previous case study or on site solution skills.

2.2 CONSTRUCTION TECHNOLOGY

The Construction Industry Institute defines construction technology as the collection of innovative tools, machines, modifications, software, etc. used during the

construction phase of a project that enables advancement in field construction methods, including semi-automated and automated construction equipment (Jones, 2020).

The construction sector encompasses a wide range of structures suited for all social groups. Commercial construction, household construction, industrial construction, heavy or civil constructions are a few instances of master works of construction technology that are presently on show. Each of them necessitates distinct technological solutions. Simple technical approaches and readily available materials are typically selected for household building. These are often low-cost, short-term initiatives. The primary issue in commercial building is infrastructure, which is responsible for the project's strength and longevity. These are often initiated by government agencies. These projects necessitate the use of cutting-edge construction methods, equipment, and materials.

With the passage of time, the construction sector has advanced. One of them is the concentrate on designing structures before actually constructing them. Technology advancements have resulted in successful strategies for creating robust and long-lasting structures. The advancement of information technology has become the primary source for the most recent design approaches in building technologies. Building Information Modeling (BIM) is one of these digital systems that allows for the frequent collection of information about structures under development. This approach significantly improves communication among engineers and designers working on the project. Computer-aided design assists in the design of excellent structures by allowing problems to be identified and corrected before to the physical construction of buildings.

New construction technologies are being created at an astounding level. What looked to be futuristic technology 10, 20 years ago like linked equipment and tools, telemetric, mobile apps, autonomous heavy equipment, drones, robots, augmented and virtual reality, and 3D printed buildings are now here and being implemented and used in workplaces all over the world.

There are software and mobile solutions available today to assist in the management of all aspects of a building project. From preconstruction to scheduling, project management and field reporting to back office administration, there is a software solution to assist you optimize your procedures and increase efficiency. Most software

solutions are cloud-based, which allows for real-time modifications and updates to documents, schedules, and other management tools, encouraging greater communication and cooperation.

Furthermore, mobile technology enables real-time data gathering and transfer between workplace and back-office project management. On-site personnel can submit timecards, expense reports, requests for information (RFIs), work logs, and other validated paperwork using cloud-based systems. This may save hundreds of hours of data input time each year and automatically organize essential information and no more sifting through folders looking for outdated reports. More and more software vendors are forging strategic alliances to allow people to effortlessly connect data with other software solutions, making business operations easier than before.

2.3 TECHNOLOGY PRODUCTIVITY ISSUES

While embracing new technology amongst the construction industry, there are some challenges and motivations for adopting these technologies that are different from some construction project to others. Technology can help improve productivity in a number of ways, whether it's by automating tasks or by managing projects more effectively to free employee mental bandwidth. But be sure to consider the impact of implementing any technological tools. The higher the productivity, the lower the input, and consequently the lower the product cost. The latter improves a company’s competitiveness. Improving productivity is an important part of business management in terms of cost reduction and profit growth (Jin et al. 2015).

Research conducted by Deloitte shows that productivity across industries has improved by 25% over the past 20 years. The manufacturing industry alone managed to enhance performance by 60%. Surprisingly, productivity within the construction sector has only grown by 5% (Khaldi,2020). This low productivity growth can be attributed to setbacks construction workers are experiencing in the field. For example, mistakes in building design can significantly delay the construction process. Additionally, it is challenging to estimate the timeframe of some processes such as

concrete curing, which can delay the entire project. It is time for the construction industry to consider Digital Transformation to overcome this productivity lag.

The more likely organisations to embrace technology systems are the ones that are already using digital tools to tackle various issues they are facing within their projects. The more sophisticated organisations may present a shallower method and would probably sign up for using digital only because it seems interesting and innovative but ultimately leading to uncertainty of what to use it for. Some others would see such opportunities as an investment and are open to lead in a particular technology only because their clients would buy their services under this innovative umbrella which would help organisations win work (CITB Research, 2018).

Very often across the construction industry, technology is not seen as a solution to the problems encountered but more as a burden in some cases. As such, problems always persist and processes continue in a less efficient manner. Also, the lack of understanding creates limitations towards using technology. The use of technology as a preventive tool for stemming the observed disproportionate rate of worker injuries and fatalities in the construction industry as compared with other industrial sectors has gained substantial attention over the last two decades (Chukwuma Nnaji, & Ali A. Karakhan, 2020).It is crucial to understand the benefits of the technology used in construction as to the extent of problem-solving because on the contrary, investing in digital tools to facilitate construction businesses would prove to be pointless.

Implementing digital construction methods can be frustrating at times especially when there is no clear understanding of why and how these methods shall be used. when facing complex projects, it is difficult to reach comprehensive management: the sequence of tasks in construction involves space, resources, time, procurement, dimension constraints, and other issues in the project process (Adel et al, 2022). As a result, having justified investments in new digital tools it is also important on focusing on acquiring technologies that address specific problems identified on site. Some adopted technologies may result in being used for the wrong purposes or not being able to fix the problem they’ve been adopted for which is budget and time consuming. This fragmentation of construction industry participants causes major problems. (Saka & Chan, 2020) such as repetitive work, the waste of resources and labor, cost increase, construction schedule delay, and even safety risks.

However, the issue is when workers fail to predict what effect the data will have in practice. Another limitation, while adopting technology construction that are often referred to as digitalization, requires the development of skills around it, and this often appears to be practice. Digitalization causes changes for companies due to the adoption of digital technologies in the organization or in the operation environment (Parviainen, P. et al. 2022). Whenever an organization goes through fundamental changes, it is expected to also experience various challenges and difficulties. This also applies to digital transformation, and if the transition does not happen smoothly, it might gave the organization some hard times in managing them.

2.4 TECHNOLOGY I.R 4.0

Industry 4.0 is changing the way businesses develop, enhance, and distribute their products. Manufacturers are incorporating new technologies such as the Internet of Things (IoT), cloud computing and analytics, artificial intelligence (AI), and machine learning into their manufacturing facilities and processes. The makeover, not only completely change the way on how physical structures are designed, developed and preserved, but also how they are used in the future with applications of avant-garde technology. (Mohd. Aripin, Irrma Diana, et al, 2019)

These smart factories are fitted with cutting-edge sensors, embedded software, and robotic systems that gather and analyse data to help in decision making. When data from manufacturing operations is coupled with operational data from ERP, supply chain, customer service, and other business systems, whole new levels of visibility and insight from previously isolated information are formed.

This digital technology leads to improved automation, predictive maintenance, self-optimization of process improvements, and most importantly, a formerly unachievable level of efficiency and customer responsiveness. Developing smart factories gives the manufacturing industry an excellent potential to enter the fourth industrial revolution. Analysing massive volumes of big data received from factory

floor sensors offers real-time view of production assets and can give tools for doing predictive maintenance to reduce equipment downtime.

IoT is a man-made technology conceptualized by intelligent virtual objects, which capable of knowing all things and allows the devices around themselves to interact automatically without human control. Every year, the number of IoT devices usage is exponentially increasing and estimated as much as 75.44 billion devices will be connected in IoT network (Mahmud, Syamsul H., et al. 2020). Using high-tech IoT devices in smart manufacturing increases productivity and quality. Using AI-powered visual insights to replace manual inspection business models decreases production mistakes and saves money and time. Quality control staff may set up a smartphone connected to the cloud with minimum expense to monitor production operations from nearly anywhere. Manufacturers may spot mistakes sooner rather than later, when repair work is more expensive, by using machine learning algorithms.

The principles and technologies of Industry 4.0 may be applied to all sorts of industrial businesses, including conventional and process manufacturing, as well as oil and gas, mining, and other industrial divisions.

The Ministry of Works/Kementerian Kerja Raya (KKR) through CIDB are in the midst of the development of Construction Strategy Plan 4.0 (2021 – 2050). The fourth industrial revolution marks the emergence of a physical cyber system that will change the future of the construction process. Emphasis on the use of technology plus the need to enhance skills and knowledge is a vital basis for dealing with these changes.

The Construction Strategy Plan 4.0 has additionally identified 12 essential technologies, commonly referred to as "disruptive technologies," that will alter the ecology of construction in the future. These are:

i. Building information modelling (BIM)
ii. Pre-fabrication and modular construction
iii. Augmented reality and virtualization
iv. Cloud and real time collaboration
v. 3D scanning and photogrammetric
vi. Big data and predictive analysis
vii. Internet of things (IoT)

viii. 3D printing and additive manufacturing
ix. Advanced building materials
x. Block chain
xi. Artificial intelligence (AI)

In the 4.0 Industrial age, complex and dynamic modifications are required to keep up with the pace of the technological transformation that we will eventually face in the future. The situation calls for effective governance and excellent cooperation between the various parties, including government, industry, academia and society (CIDB,2021)

2.5 GREEN ELEMENT IMPLEMENTATION

By implementing this application on site, fellow user would have a great benefit and this application also could implement sustainability along with it. Some of the benefits in this application are reduce the quantity of paper usage which is sustainable for environment, it also could reduce the time and cost consume in ordering diesel supply for site usage. Fastly it is easy to handle and work progress will become much easier to manage in term of increasing the productivity of users on construction project. In the long run, the construction industry should not rely on the incentives, but they should facilitate more on the supply of the green technology (Norsalisma, 2017).

2.5.1. Sustainable systems

During construction projects, care must be taken to reduce waste and energy consumption where possible and protect the natural environment around the site. The goals of sustainable systems construction are to reduce the industry's impact on the environment. Sustainable construction methods include: using renewable and recyclable materials. With the increasing demand of using sustainability as the business

and economic practice, the manufacturing units all over the world are now adopting the notion of sustainable manufacturing. Sustainable manufacturing is a subset of the broader philosophy of sustainable development (M.S. Najiha, 2016). In this case, creating application to be use in site project management will reduce the usage of paper.

Applying this system will result in cutting the number of paper use by the organization. The paper usage will become much lesser because every information regarding the diesel storage and usage will be in the application. Environmental degradation remains a grave threat to our future that has been largely created by yet ignored in organizations (Oppong-Tawiah et al. 2020). To overcome this, the application will help the growth of the tree because it doesn't use the paper anymore which will help increasing the environment air quality.

2.5.2. Time And Cost Management

The positive effect of utilizing this application on site, is that it aid in minimising the time required to locate and store the diesel information document. Besides that, This action will minimise the process to planning of diesel delivery and diesel storage in site.as we know diesel aren't cheap. The cost in ordering a diesel would cost a fortune to the company. By managing these factors, it will help company to order the precise amount of diesel for a precise period of time. The importance of managing costs and aligning them with the business strategy of an entity is critical especially in the midst of challenging economic times faced by businesses today (Rounaghi et al.2021).

The fact that it is portable and simple to handle means that there is no risk of it being lost. So, the Project participants don't have to contribute their time in making duplication of a lost document or print the document all over again. Instead of that, they can focus on more to the project progress and work. Management of a project has to deal accurately and attention to times of completion of a project, costs and quality of work and to avoid the risks and knowledge of what was requested by the beneficiaries of the project (Ahmed Mohamed Keshk, et al. 2018). The cost of paper waste can be

reduced by reducing the amount of paper consumed. This technique will also be able to cut down on time and money waste since information in paper sometimes are incorrect.

2.5.3. Improve Productivity

Productivity is a major factor to consider in the construction industry. And without paying proper attention to it, a project may get delayed and budgets may quickly become overwhelming. On the other hand, ensuring proper levels of productivity can provide many benefits in terms of time as well as money. Productivity is important because it is a key determinant of living standards in the long term. Increasing productivity over time allows businesses to produce more goods and services per unit of input. This ultimately enables higher wages, aids economic growth, increases profitability, and boosts tax revenues.

By implementing this application, it will aid in maximise the efficiency of a work process. Improving construction productivity (CP) enables to save the cost of per capita and also increased the revenue of the firms (Saurav Dixit, et al. 2019). Since there is no delay in making order of the focused material, the work progress in site will run smoothly without any stalling from diesel storage aspect. In an official meeting, this data can be used as a conformation and reference of the amount of diesel use and the amount of diesel order on site per month. Fellow user will find this application providing a lot of accommodation in increasing the productivity and work progress stability.

2.6 SUSTAINABLE TECHNOLOGY

Sustainable development can be categorized into three categories: environmental sustainability, social sustainability, and economic sustainability. Sustainable

development is defined as development that satisfies the needs of the present without jeopardising the capacity of future generations to satiate their own needs. Construction are presumed sustainable if their environmental, economic, and social impacts on the community are properly resolved and contributed to the sustainable development of society (Santos et al, 2019)

In respect to the building construction sector, the three pillars of sustainability have also evolved over time from environmental sustainability to resource management, social sustainability to design for people, and economic sustainability to life-cycle design. The building and real estate sectors now use a variety of methods to achieve sustainability in construction and to conform to the aforementioned policies. Therefore, the application that will be used on the targeted site, ECRL Project Section 3, Kuala Terengganu, is about the use of the Diesel Balance Monitoring (DBM) application. This application will have a positive impact on the progress of the work as well as on the quality of the work since it will minimise the problems caused by insufficient diesel fuel on site.

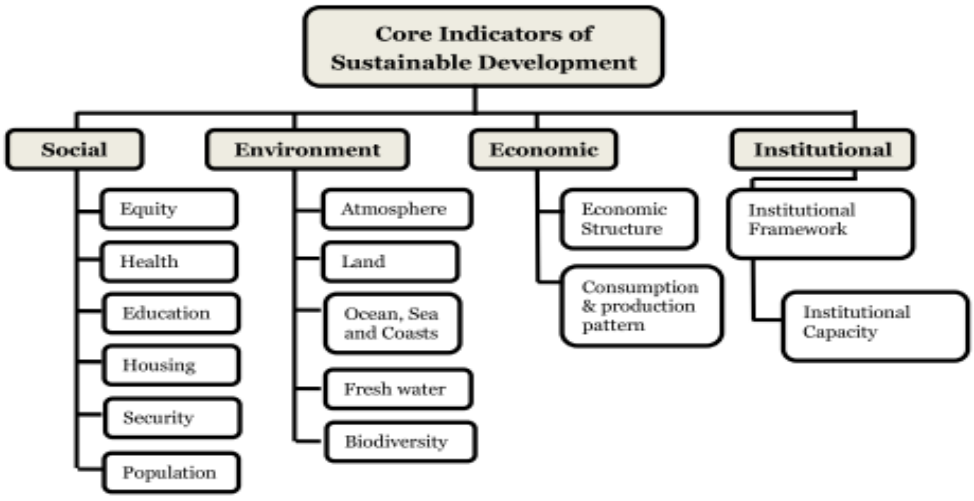


Figure 2.1 Core indicators of sustainable development

Source : Informetric Analysis and Review of Literature on the Role of BIM in Sustainable Construction

2.7 CONCLUSION

In construction, not only the building needs to achieve the green element, it should be all of the project need to achieve the green requirement. It is because when the project has been following the entire green element, it will help to manage the construction management with runs systematically and smoothly. Compared to conventional architecture, green buildings have some significant advantages and benefits, including a low negative environmental impact, no toxic gas emissions, a preference for recycled materials and renewable energy utilization, and high residential satisfaction. (Cao et al., 2022). In implementation of sustainability for this project, construction site is the perfect location to create a new system. The construction industry must adapt with the technology system compare with using conventional method on construction project. The title for this digital technology application is Diesel Balance Monitoring (DBM). This application will be used to aid construction management at both office and site. This application are designed to facilitate the diesel supply of in a construction project, which can lighten up and have a positive impact to the user's company management system.

CHAPTER 3
METHODOLOGY

3.1 INTRODUCTION

This chapter goes into depth about the type of analysis chosen and the data collection method used. The observation would be taken while working on an activity to evaluate the website's efficiency. This chapter will feature a process route that will be developed for this project and implemented to the on-site work environment. Following this chapter, the process route for this project will be attached and implemented to the work environment on site. The prototype is tested on the intended consumer to check if they like the solution. Any accessible enhancement can be incorporated to update the prototype. This is based on all substantial studies, including records, questionnaires, interactions, and other variables.

The observation would be made while working on an activity to assess the efficiency of the website. This chapter also includes design modelling. To add value to the project, research were conducted utilizing both primary and secondary sources. Primary sources, surveys, and observations were used. The secondary source comes from data collecting and analysis. This chapter will include a process route that will be established for this project and applied to the work environment on site. The observation will be carried out while working on the mission by implementing the applications to determine their viability.

Furthermore, the strategies to be utilized will be completely defined based on the difficulties presented as well as the selection of suitable systems to be used and when a suitable approach within the platform to apply is picked. This is based on all feasible work, references such as records, interviews, encounters, and other variables. Following

this chapter, the process route that will be executed for this project and applied to the work environment on site will be attached.

At this step, the prototype is tested on the targeted consumer to see if they are pleased with the solution. To update the prototype, any available improvement can be implemented. The questionnaire should be distributed to all construction workers, including the project manager, assistant proje1ct manager, construction manager, project engineer, site engineer, and all employees at the site office. The implementation would do the observation while working on a job to determine the system's efficacy. To bring value to the project, the feasibility utilizing primary and secondary sources must be completed. For the primary source, questionnaires and observations were used. The secondary source comes from data collecting and analysis. The goal of the questionnaire that was sent is to learn about people's perceptions and knowledge about the researcher's endeavour. Aside from that, to gather feedback that may be utilized to enhance the program. Following that, the goal of this questionnaire is to get input from targeted users on whether they agree or disagree with the researcher's concept to construct this website.

3.2 RESEARCH DESIGN

Design research is the framework of research methods and techniques chosen by a researcher. The design allows researcher to hone in on research methods that are suitable for the subject matter and set up researcher studies up for success. This method is very important for planning any observation. Steps from implementation should be monitored to identify the problems that will arise during implementation. Changes need to be made if there is a critical issues that is a major cause of failure in the implementation of the work.

Generally, design research means a structure to plan and execute a particular research. Design research is the crucial part of the research as it includes all the four important considerations; the conceptual framework, the identification of whom and what to study on and the tools and procedures to be used for collecting and analyzing

data. The purpose of the design research is to discuss and explains method used by researcher in provide a plan of study that permits accurate assessment in conducting the usability of using Diesel Balance Monitoring (DBM) applications.

Problem such as delay information in an organization often happen especially when the site project are geographically distance. This factors may lead to problem in arranging schedules, making order for diesel in site and making report for diesel consumption per projects. The most common factors for the employer's delays include lack of previous experience, delay in delivering the site to the contractor, delay in giving the order to commence or cease work, and delay in the approval of schedules. (Hindawi, et al., 2021). By creating an easy mobile application can helps many construction company in handling their diesel as all the data are stored in one place.

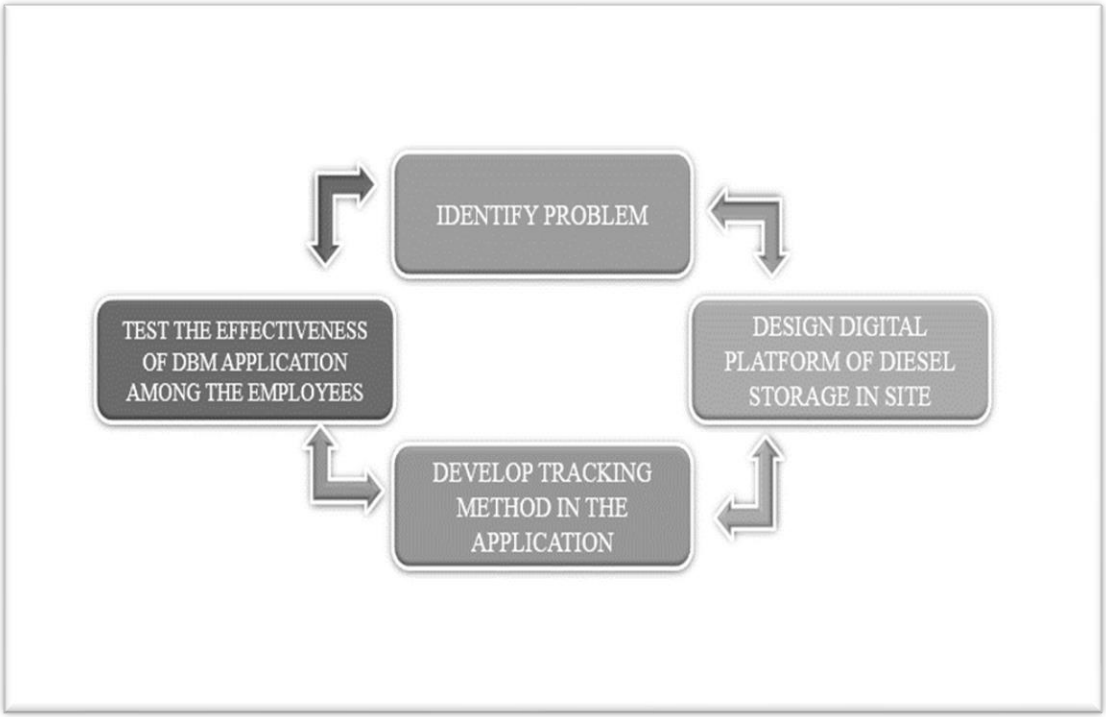


Figure 3.1 Design Research Chart

3.3 SYSTEMS DESIGN AND DEVELOPMENT

The system design and development web-based system is important to make sure the process is smoothly created and run. To develop a website need a systematic system to guide all the work process.

Figure 3.2 Application Logo

3.3.1 Systems Design

The development of research is shown as a research framework in this study. Figure below show the research development of this study. The diagram show the flow of research development starting from literature review, identifying problem statement, ideating the innovation, creating the system or product, testing and evaluating the effectiveness of the product.

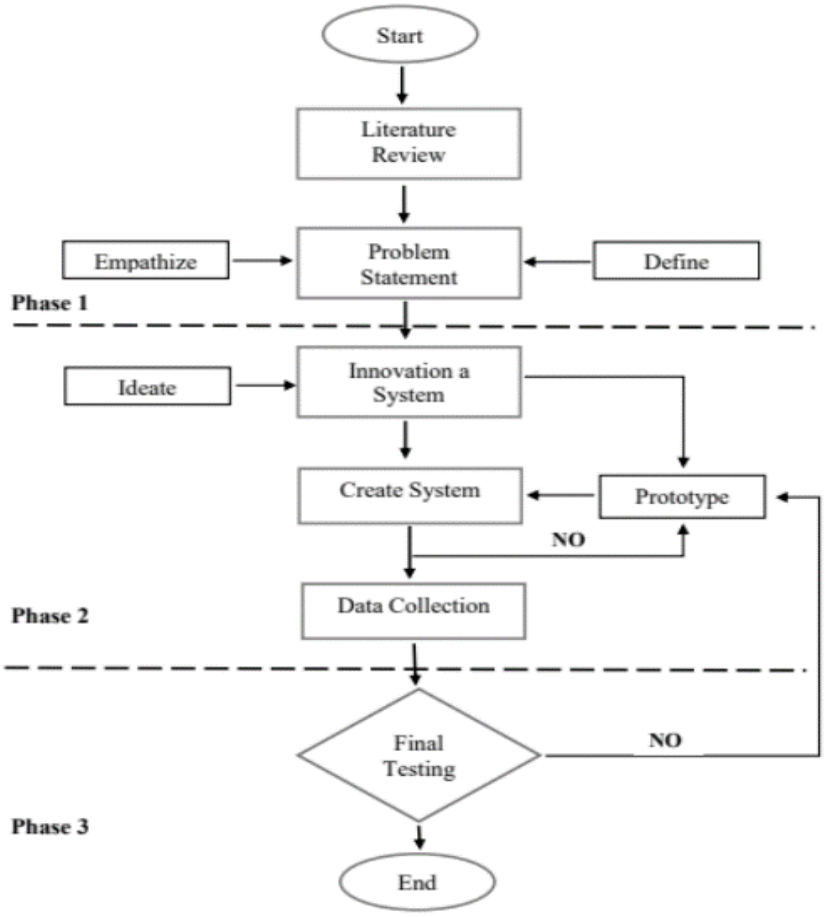


Figure 3.3 Flow Chart Guidelines

This framework was used as a guide line to execute the project accordingly. The process in this study is divided into several phases as show in diagram. This development research is a process of starting up from the beginning of the process until the end of the process in implementing the Diesel Balance Monitoring (DBM) application. This process is to develop the flow chart of the system to ensure that the project run smoothly as planned.

The system design explains the application and how the system functions overall. This section is essential for users and researchers to understand how the application works. According to Bennett, 2021 it is the process of defining, developing and designing systems which satisfies the specific needs and requirements of a business or organization.

Furthermore, each function of the button contained within it is described. In the future, the application might be made more user-friendly for employees to utilise.

Systems design is the process of designing system aspects such as modules, architecture, components and their interfaces, and data for a system based on the requirements stated. Below shows the flowchart to visualize the systems design before developing the actual application.

Figure 3.4 Project Flow Chart

3.3.2 Systems Development

To construct this application, the main idea is to use Bubble software. Bubble is a visual programming language, an easy code development platform and an construction application platform as a service, developed by Bubble Group, that enables

non-technical people to build web or applications without needing to type complex code. Bubble's visual development platform is used to create websites and web applications with more advanced functionality than what is possible with template-oriented website builders such as Wix and Squarespace. It is used by non-technical startup founders, in schools for education purposes, and by other organizations for commercial purposes. Bubble allows users to build web applications including social media sites like Twitter, marketplaces like Airbnb and Uber, services like Instacart, and more through tutorials. Bubble offers its own Application Programming Interface (API) integrations, templates and plugins. Users of the platform have also created new third-party templates, plugins and service built within the Bubble eco-system.

Figure 3.5 Bubble Software

The application will give the site admin the authority to control all the activity of the application. Which means, importance information such as allowable diesel storage in site and balance can be changed by the designated role only. Other employees only can send report of daily consumption of diesel and monitor their site diesel balance so that further planning for upcoming works can be managed neatly. Besides that, the application will shows report of how much consumption of diesel in every site. The reports will be visualized in written, graphs and pie charts. According to Huestegge & Pötzsch, 2018 pie charts remained as the most common method for displaying shares and percentages, probably due to their space effectiveness and availability in typical graph software. Besides that, the graphs analyzed show significant measurement distortion. Graphs presented tended to overstate the underlying trend as opposed to an understatement (Varachia & Yasseen, 2020). So, it’s relevant to be used in the

application to insure the report are detail and easy to comprehend. Below shows how the application interface.

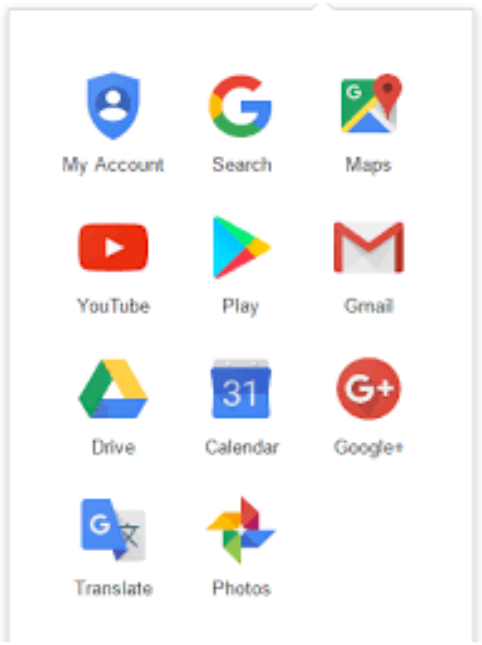
3.4 MATERIAL USED

Tables 3.2 shows the material used to developed The Diesel Balance Monitoring Application (DBM) for Construction Site Management. The listed material are essential in developing the application. Researcher must identify all the item needed so that the developing process will run smoothly and according to plan.

Table 3.2 Material Used

MATERIAL	FUNCTIONS
Computer/laptop/smartphone etc 	To create the applications and access.
Internet	To link the computer and smartphone to develop the applications.

Table 3.2 (Continuation)

Email/ google account 	To get access in creating the application
The data of diesel consumption 	To input the data into the application that will be construct.

3.5 TESTING OF PRODUCT

The diesel balance monitoring application DBM have been installed into respondent smartphones via an android package kit (APK) so that the respondent can test the effectiveness of the application. After that, the respondent will be asked to fill an online questionnaire to get the data of the effectiveness of the application. The questionnaire will be in two variant which is pre-test and post-test questionnaire. An advantage of a pre-test and post-test study design is that there is a directionality of the research, meaning there is testing of a dependent variable (knowledge or attitude) before and after intervention with an independent variable (training or an information presentation session) (Stratton, 2019).

Pre-tests are a non-graded assessment tool used to determine pre-existing subject knowledge. Basically, the pre-tests are administered prior to the research to determine understanding on the event that will be carried out based on sets of question given. The pre-test questionnaire will help researcher determine if the respondents understand the questions as well as if they can perform the tasks or have the information that questions require. Pre-tests also provide the most direct evidence for the validity of the questionnaire data for most items. The questionnaire specialist should then provide a brief description of the pretest procedures to the subject. To avoid respondents to randomly answer the questionnaire, a small brief had been given to the respondents so that they will understand and aware of the aim of the event.

Meanwhile the post-test is carried out after the product had been tested on respondents. The post-test are made to see the respondents reaction and interest towards the research that carried out. The post-test questionnaire sets of questions are share via link to google form. Respondents are asked to answer the question after using the developed application for two weeks. The same procedure is used in the post-test questionnaire given which, the respondents will be given a short brief on what the event are all about.

Figure 3.6 Pre-test questionnaire

3.6 DATA COLLECTION AND ANALYSIS

The result of the application are listed by using online questionnaire. This product are developed using a coding software named Bubble and the application were tested among 15 of Pembinaan Tetap Teguh Sdn Bhd, ECRL section 3 employees consists Project manager, Construction manager, Site engineer, Site safety supervisor, Site supervisor and document controller. The questionnaire was adapted from Technology Acceptance Model by Davis (1989). TAM and its many different versions are worldwide acknowledged as solid frameworks for planning and conducting empirical research in the field of education (Granić, A., & Marangunić, N. 2019). The sample size was determined using Krejcie and Morgan Table (1970) whereby for population of 15 respondents, 14 samples were adequate. Therefore all population were involved in this study. Therefore, all population were involved in this study. 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 any problems.

Table 3.2 Questionnaire for pre test

No	**The Need of systematic centralized information application**	**Issues Related to monitoring diesel balance in site**	**Level of Agreement**				
			1	**2**	**3**	**4**	**5**
1	Delay information	a) Existing method gives delay information					
		b) Existing method is inconvenient to planning for further delivery					

The scale of level of agreement as below:

1 – Strongly Disagrees

2 – Disagrees

3 – Slightly Agree

4 – Agree

5 – Strongly Agree

In order to evaluate the effectiveness of the product, paired t-test was used. The paired t-test is a method used to test whether the mean difference between pairs of measurements is zero or not. Researcher can use the test when the data values are paired measurements. For example, researcher might have before-and-after measurements for a group of people. Also, the distribution of differences between the paired measurements should be normally distributed. The paired t-test is also known as the dependent samples t-test, the paired-difference t-test, the matched pair t-test and the repeated-samples t-test. If the sample sizes are very small, researcher might not be able to test for normality. Researcher might need to rely on the understanding of the data. Or, you can perform a nonparametric test that doesn't assume normality. This section is discuss what is needed to perform the test, checking our data, how to perform the test and statistical details. For the paired t-test, researcher need two variables. One variable defines the pairs for the observations. The second variable is a measurement. Sometimes, it already has the paired differences for the measurement variable. Other times, it has separate variables for "before" and "after" measurements for each pair and need to calculate the differences (Sall, 1989).

$$\mathbf{t} = \frac{\text{Average difference}}{\text{Standard Error}}$$

Figure 3.7 The formula for 't' value

3.7 CONCLUSION

This chapter explains the procedure for gathering data and information for this project, and that is the conclusion that can be drawn from it. Also, this chapter focuses on the study's setting, respondents, research methodology, data interpretation, and work carried out throughout the review process.

According to the analysis, using this program has improved the way the problems are organize. Employees can use the built-in application to carry out their everyday tasks. As it is user-friendly and flexible, this program may be used in a variety of projects, particularly those that are geographically remote. This aspect enables the person in charge (PIC) to refer to the fuel balance still remaining at each site much more quickly than if they were to rely on other employees to follow up on it on a regular basis.

The approach to be taken will also be thoroughly discussed, based on the situation at hand as well as the choice of systems that are appropriate to utilize on the given location. This is based on all available work, including publications, interviews, experiences, and other sources of information. The process route that will be used for this project and applied to the working environment on location is connected to the next chapter.

CHAPTER 4
DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

In this chapter, the expected results from the project has been carried out were to be explained. The findings of this project are been showed according to the following objectives:

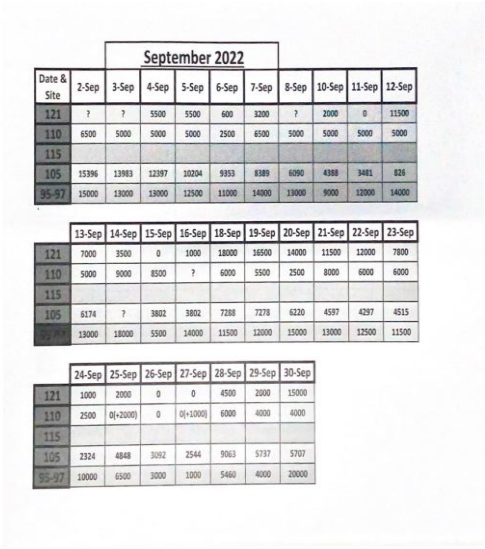
i. To design diesel tracking application in construction site
ii. To develop Diesel Balance Monitoring Application using Bubble software
iii. To evaluate the effectiveness of the Diesel Balance Monitoring (DBM) application.

4.2 TO DESIGN DIESEL TRACKING APPLICATION IN CONSTRUCTION SITE.

The purpose of the application is to track and gather all relevant data in one location for simple monitoring and recording. The researchers must determine and be clear on how much diesel is stored in each site in order to design the application for monitoring the diesel balance at that location. The quantity is often determined by the number of machines and active work tasks. Researcher must collect all this data before starts to design the tracking application. This data will provide researcher the idea on how the application interfaces will be.

Researchers must consult with those in charge and inspect the location to identify these objects. List every important thing visually, verify it twice, and receive approval from the person in charge so that the information is accepted as accurate. Table 4.1 shows how the researchers consulted by the person in charge and list down the details.

Table 4.1 Listing important item

	List out the entire Site number including the detail and quantity.
	List out the date of delivery to each site monthly.

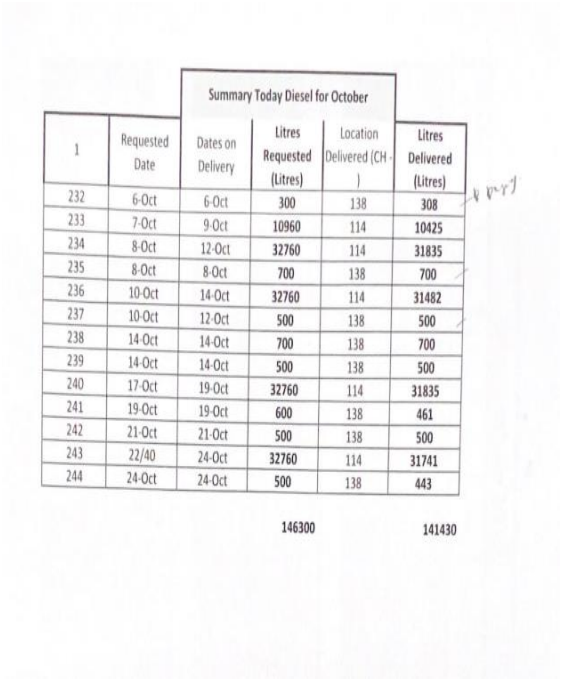
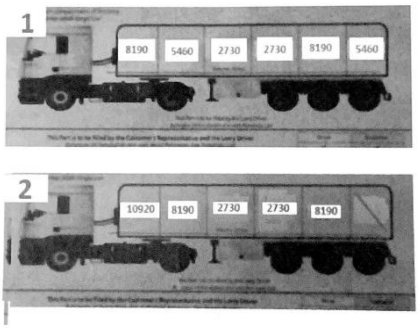
September 2022

Date & Site	2-Sep	3-Sep	4-Sep	5-Sep	6-Sep	7-Sep	8-Sep	10-Sep	11-Sep	12-Sep
121	?	?	5500	5500	600	3200	?	2000	0	11500
110	6500	5000	5000	5000	2500	6500	5000	5000	5000	5000
115										
105	15396	13983	12397	10204	9353	8389	6090	4388	3481	826
35-97	15000	13000	13000	12500	11000	14000	13000	9000	12000	14000

	13-Sep	14-Sep	15-Sep	16-Sep	18-Sep	19-Sep	20-Sep	21-Sep	22-Sep	23-Sep
121	7000	3500	0	1000	18000	16500	14000	11500	12000	7800
110	5000	9000	8500	?	6000	5500	2500	8000	6000	6000
115										
105	6174	?	3802	3802	7288	7278	6220	4597	4297	4515
35-97	13000	18000	5500	14000	11500	12000	15000	13000	12500	11500

	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep
121	1000	2000	0	0	4500	2000	15000
110	2500	0(+2000)	0	0(+1000)	6000	4000	4000
115							
105	2324	4848	3092	2544	9063	5737	5707
35-97	10000	6500	3000	1000	5460	4000	20000

Table 4.1 (Continuation)

 Summary Today Diesel for October 1 | Requested Date | Dates on Delivery | Litres Requested (Litres) | Location Delivered (CH-) | Litres Delivered (Litres) 232 | 6-Oct | 6-Oct | 300 | 138 | 308 233 | 7-Oct | 9-Oct | 10960 | 114 | 10425 234 | 8-Oct | 12-Oct | 32760 | 114 | 31835 235 | 8-Oct | 8-Oct | 700 | 138 | 700 236 | 10-Oct | 14-Oct | 32760 | 114 | 31482 237 | 10-Oct | 12-Oct | 500 | 138 | 500 238 | 14-Oct | 14-Oct | 700 | 138 | 700 239 | 14-Oct | 14-Oct | 500 | 138 | 500 240 | 17-Oct | 19-Oct | 32760 | 114 | 31835 241 | 19-Oct | 19-Oct | 600 | 138 | 461 242 | 21-Oct | 21-Oct | 500 | 138 | 500 243 | 22/40 | 24-Oct | 32760 | 114 | 31741 244 | 24-Oct | 24-Oct | 500 | 138 | 443 146300 141430	Making summary so that the information can be sort out more efficiently.
 32760L 21840L 10920L	List out the standard delivery volume quantity .

4.3 DEVELOP DIESEL BALANCE MONITORING APPLICATION USING BUUBLE SOFTWARE

The tables 3.1 shows the Application of Diesel Balance Monitoring (DBM) interfaces. The interfaces are developed by using Bubble software. The interfaces are designed to be user friendly and easy to maneuver by the targeted respondents.

Table 4.2 The application interface

<table>
<tr>
<td>Step 1: Users need to log in the application once they have created their account.
 
</td>
<td>Step 2: Users can access the home page of the application. Here they may choose to create their site alias or to browse the site alias that have been created.
 
</td>
</tr>
<tr>
<td>Step 3: This section shows the detail needed to create their site alias. The detail are based on their site project.
 
</td>
<td>Step 4: Here shows the picture of the site location and animated figure that visualize the quantity of diesel in their site.
 
</td>
</tr>
</table>

Table 4.2 (Continuation)

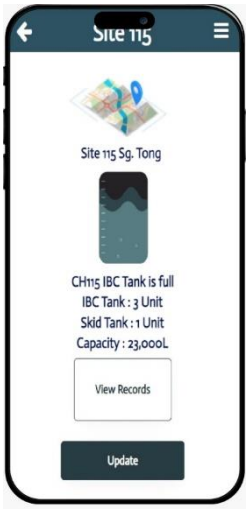
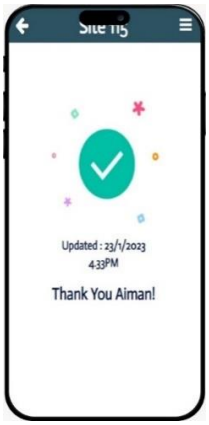
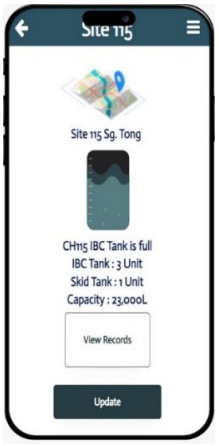
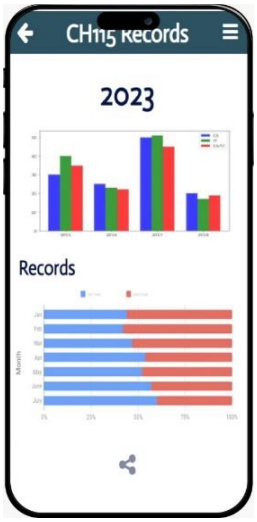
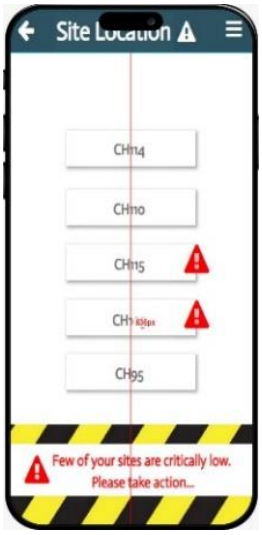
Step 5: To update the diesel balance on site the users may choose between site that they wanted in this listed section. 	Step 6: This section shoes the detail that have been fill during updating session. The users need to press update so that the information may go online. 
Step 7: Once the users press update. This animation will pop up as conformation that the user has have successfully updated their site diesel balance. 	Step 8: To view the records of the diesel usage. The users may press the view records button. 

Table 4.2 (Continuation)

Step 9: The records will be shown as below. 	Step 10: The update session are programmed until the end of working hours. In case the users forget to update. Thee application will notify the users smartphone to inform that they need to update the diesel balance in site. 

4.4 EVALUATE THE EFFECTIVENESS OF DIESEL BALANCE MONITORING APPLICATION

This survey displays the results of a questionnaire distributed to respondents, which included project manager, construction manager, engineer, site supervisor, assistant engineer and others. This questionnaire has two parts, which is pre-test questionnaire and post-test questionnaire. each questionnaire has two sections which is section A (demography) and section B. The section A is involved background information of each respondents. Respondents will be given a set of question regarding their background and the answers will be recorded.

For the pre-test questionnaire in section B, respondent's perspective on the existing method will be presented based on the set of questions that have been answered by each respondent. Meanwhile, the section B in post-test questionnaire is regarding the respondent's viewpoint in the developed application (DBM) in which will also be presented based on the fulfilled questionnaire.

4.4.1 Demographic information

All characteristics of respondents are explained in terms of frequencies and percentages in this section. This section discusses several demographic profiles, including the respondent's age, position and working experience in construction sector. Profiles for each of the items analyzed are shown in the table.

Table 4.3 Respondent Profile

No	Gender	No. Of Respondent	Percentage (%)
1.	Male	26	86.7%
2.	Female	4	13.3%
No	Age	No. Of Respondent	Percentage (%)
1.	< 25	5	16.7
2.	26-35	10	33.3
3.	36-45	13	43.3
4.	> 46	2	6.7
No	Work Experience	No. Of Respondent	Percentage (%)
1.	< 2 years	0	0
2.	2 – 5 years	9	30
3.	> 10 years	14	23.3
4.	6 – 10 years	7	46.7
No	Position	No. Of Respondent	Percentage (%)
1.	Project Manager	1	3.3
2.	Construction Manager	1	3.3

Table 4.3 (Continuation)

3.	Engineer /Architect	11	36.7
4.	Assistant engineer/Site Supervisor	14	46.7
5.	Others	3	10

Table 4.2 shows the number of respondents that are involved in this research are consists of 30 persons. The respondent profile are listed in several demographic profiles, including the respondent's age, position and working experience in construction sector. The male respondents involved are 26 persons (86.7%) and female are 4 (13.3%).

The range of age of the respondents are divided into four categories which is Below 25 years old, 26-35 years old, 36-45 years old and above 46 years old. The table 4.2 shows that the number of respondents that are in the first categories of below 25 years old are 5 (16.7%). The second categories of 26-35 years old are 10 (33.3%), the third categories of 36-45 years old are 13 (43.4%). Finally, for the fourth categories which are 46 years old and above are 2 (6.7%).

The third item in the respondent demographic profile are the work experience. The table 4.2 shows that the number of respondents and their work experience in the construction sector. There are 9 (30%) that are experience for 2-5 years in construction sector. Next, there are 14 (23.3%) respondents that have experience in construction industry for more than 10 years. Finally, the data shows that there are 7 (46.7%) respondents with the experience of 6-10 years in the construction industry.

The final item in the respondents demographic profile are the position of the respondents that are involved in this research. The table 4.2 shows that 2(6.6.%) of respondents are project manager and Construction manager respectively. 11(36.7%) of the respondent are Engineer/architect and there are 14 (46.7%) respondent that held the

position of Assistant Engineer/Site Supervisor. Finally, there are 3 (10%) respondents that are consists of operator that are involved in this research.

4.4.2 Respondents perspective

Section B presents respondents perspective on the constraint element of the current method to monitor diesel balance in ECRL site project section 3, Terengganu. Respondents were asked to select their level of agreement on the following issues according to scale 1 to 5. This survey displays the results of a questionnaire distribute to respondents via google form link. This action will help researchers to determine what needs to be resolved regarding the current method issues that have been listed in the questionnaire. the table 4.4 shows the level of agreement on a scale of 1 to 5. The table 4.5 shows the respondents perspective on the constraint element of the current method to monitor diesel balance in ECRL site project section 3, Terengganu.

Table 4.4 shows the level of agreement on a scale of 1 to 5

Level of Agreement				
Strongly Disagree	Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5

Table 4.5 The respondent perspective on the constraint element of the current method

No	The need of systematic centralized information application	Constraints element in current method to monitor diesel balance in site at ECRL project section 3, Terengganu	Level of agreement				
			1	2	3	4	5
1	Delay information	a) Existing method gives delay information	26	4	0	0	0
		b) Existing method is inconvenient to planning for further delivery	27	3	0	0	0
2	Difficult to monitor balance	a) Existing method is difficult to follow up status with person in site	21	9	0	0	0
3	WhatsApp group medium	a) Existing method are difficult for PIC to update diesel balance on site using WhatsApp group	17	13	0	0	0
		b) Existing method is inconvenient to update diesel balance in Microsoft Excel refer to WhatsApp medium	16	14	0	0	0

Table 4.5 (Continuation)

		c) Existing method staff missing important information in WhatsApp group might causes paperwork to be delayed	14	16	0	0	0
		d) Existing method can result in diesel order to be delayed due to overlook information in WhatsApp group	16	14	0	0	0
		e) Existing method lead to balance not being recorded due to overlook information in WhatsApp group	18	12	0	0	0
		f) Existing method may causes refueling schedule delayed	17	13	0	0	0
4	Overlapping information	a) Existing method may lead to overlapping information due to no specific PIC to update the diesel balance	21	9	0	0	0

Table 4.5 (Continuation)

5	The need of Application for site management in this construction site	Do you need a systematic centralized information application	17	13	0	0	0
		Question 1: delay information a) Do you need a systematic monitoring application to solve diesel issues in site ?	20	10	0	0	0
		b) Do you think a systematic centralized information application can avoid run out of diesel in site issues from happening?	16	14	0	0	0
		Question 2: Difficult to monitor balance a) Do you agree a systematic centralized information application can help to monitor the diesel balance in each site much easier?	22	8	0	0	0

Table 4.5 (Continuation)

		Question 3: WhatsApp Group Medium a) Do you agree a systematic centralized information application can help PIC to update diesel balance in site much easier?	24	6	0	0	0
		b) Do you agree systematic centralized information application are convenient to update in Microsoft excel?	25	5	0	0	0
		c) Do you agree application can prevent missing information in WhatsApp group that might cause paperwork to be delayed?	23	7	0	0	0
		d) Do you agree systematic centralized information application can prevent diesel order to be delayed due to overlook information in WhatsApp group?	18	12	0	0	0

Table 4.5 (Continuation)

		e) Do you agree a systematic centralized information application can prevent diesel balance not being recorded due to overlook information in WhatsApp group?	15	15	0	0	0
		f) Do you agree a application can prevent refueling schedule to be delayed as a result of missing information in WhatsApp groups?	15	15	0	0	0
		Question 4: overlapping information a) Do you agree a systematic centralized information application can prevent overlapping information due to no specific PIC to update the diesel balance?	16	14	0	0	0

4.4.3 Data Analysis

SPSS is an acronym that stands for statistical Package for The Social Science and it is used by a wide range of academic to analyze complex statistical data. In this study, SPSS will be used to analyze the data. The methodical application of statistical and logical approaches to explain, demonstrates and condense. Data analysis assists in reducing massive volumes of data into smaller, more consumable parts.

4.4.4 The constraints element of the current method to monitor diesel balance in ECRL site project section 3, Terengganu.

This section describes statement about the constraints element in current method to monitor diesel balance in site at ECRL project section 3, Terengganu. The current method data are collected in this project is based by online questionnaire using google form. Respondent indicates level agreement or disagreement with the following statement by tick on the appropriate response. The respondent's perspective on the current method of handling document of material product is presented in Section B pre-test questionnaire. Respondents are obliged to rate their level of agreement on a scale of 1 to 5.

Table 4.6: Issues related to existing method

No	Constraint elements in current method to monitor diesel balance in site at ECRL project section 3, Terengganu.	Level of agreement (%)				
		1	2	3	4	5
1	Delay information	(88.34%)	(11.67%)	(0%)	(0%)	(0%)
2	Difficulty in monitoring diesel balance	(53.33%)	(46.67%)	(0%)	(0%)	(0%)
3	WhatsApp group medium	(32.50%)	(67.5%)	(0%)	(0%)	(0%)
4	Overlapping information	(58.06%)	(41.95%)	(0%)	(0%)	(0%)
5	The need of application for site management in this construction site	(33.4%)	(65.76%)	(1%)	(0%)	(0%)

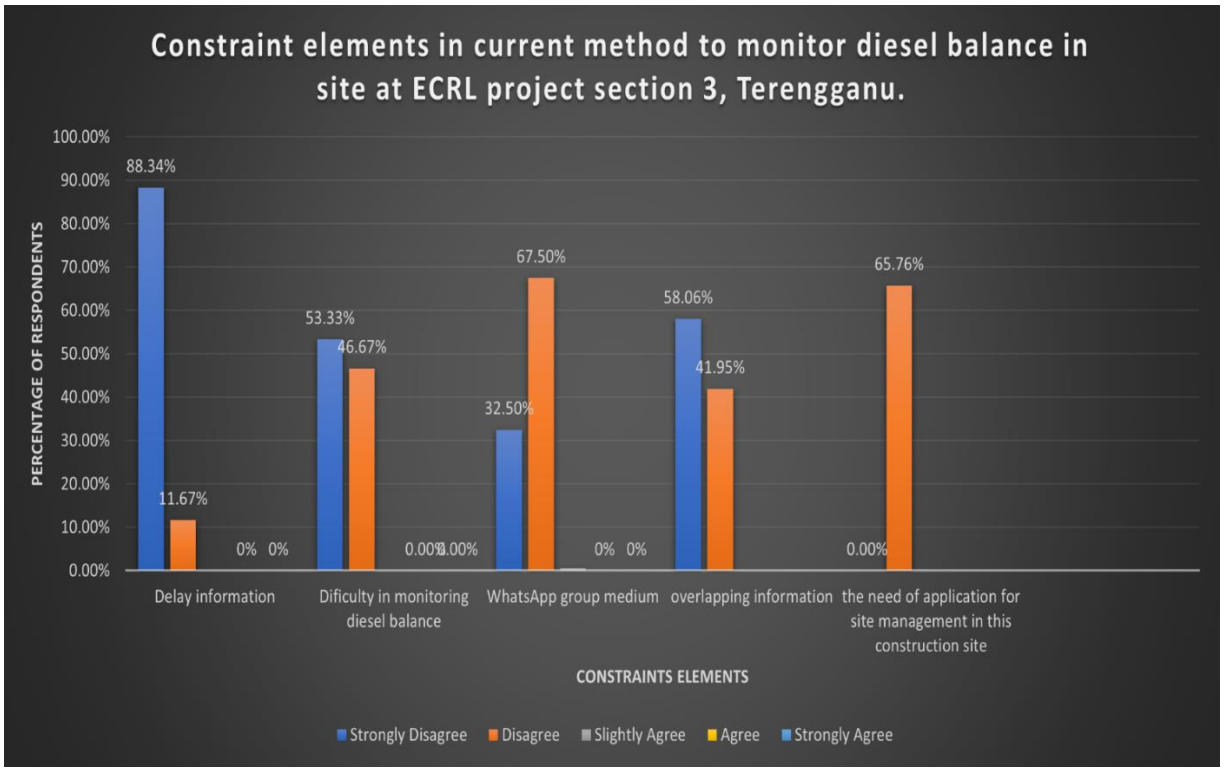


Figure 4.1 Issues related to existing method

From figure 4.1, it shows the respondents feedback regarding the issues related to existing method on handling diesel storage for construction management. The data are visualize using bar charts so that it will provides much understandable data to the readers since it is commonly in presentation. Bar charts, which are popular chart types on the Internet, are commonly used to visually present quantitative information. (Zhou et al.2020) Majority respondent indicates on scale 2 (Disagree) and scale 1(Strongly Disagree) above which visualize that new method are needed in managing diesel balance on site much effective. The are 5 issues that are been highlighted in this questionnaire and the data collected are as below:

i. Delay Information

From the number of 30 respondents, the highest total score is for item strongly disagree which are 88.34%. for the lowest score is for item disagree which are 11.67%.

ii. **Difficulty In Monitoring Diesel Balance**

From the number of 30 respondents, the highest total score is for item strongly disagree which are 53.33%. for the lowest score is for item disagree which are 46.67%

iii. **Whatsapp Group Medium**

From the number of 30 respondents, the highest total score is for item Disagree which are 67.50%. for the lowest score is for item Strongly disagree which are 32.50%

iv. **Overlapping Information**

From the number of 30 respondents, the highest total score is for item strongly disagree which are 58.06%. for the lowest score is for item disagree which are 41.95%

v. **The need of Application For Site Management In This Construction Site**

From the number of 30 respondents, the highest total score is for item Disagree which are 65.76. for the lowest score is for item Strongly disagree which are 33.34%%

4.4.5 Issues related to new method to monitor Diesel Balance In ECRL Project Section 3, Terengganu

Second part of the questionnaire which is the post-test questionnaire of the DBM application effectiveness from the respondent perspective. Respondent indicates level agreement or disagreement with the following statement by tick on the appropriate response. The respondent's perspective of the DBM application in managing diesel balance on site is presented in Section B post-test questionnaire. Respondents are obliged to rate their level of agreement on a scale of 1 to 5. The results from the respondents answer are shown clearly in table 4.7. The data are shown in form of percentage and being organized by their level of agreement.

Table 4.7: Issues related to new method

No	Constraint elements in current method to monitor diesel balance in site at ECRL project section 3, Terengganu.	Level of agreement (%)				
		1	2	3	4	5
1	Provide updated information	(0%)	(0%)	(7%)	(10%)	(83.33%)
2	Efficient to monitor	(0%)	(0%)	(7%)	(16.67%)	(76.67%)
3	Official medium	(0%)	(0%)	(9%)	(41.67%)	(52.67%)
4	Systematic Information	(0%)	(0%)	(7%)	(307%)	(63.33%)
5	The need of application for site management in this construction site	(0%)	(0%)	(1%)	(41.67%)	(57.76%)

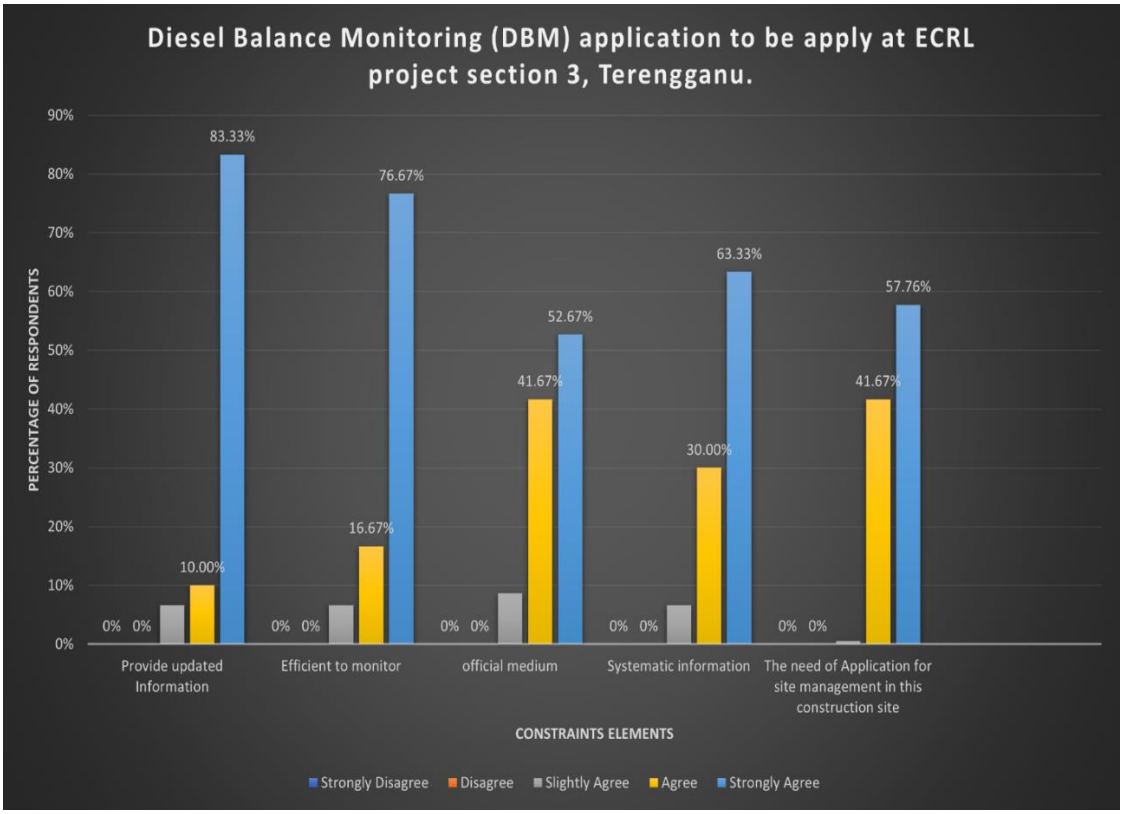


Figure 4.2 The data of Diesel Balance Monitoring Application (DBM) survey

From figure 4.2, it shows that the respondent feedback regarding Diesel Balance Monitoring (DBM) application to be apply at ECRL project Section 3, Terengganu. Majority of the respondent indicate on scale 3 (Slightly agree) until scale 5(Strongly agree) above. The data are visualize using bar charts so that it will provides much understandable data to the readers since it is commonly in presentation. The feedback and percentage of respondents respond are as below.

i. Provide Updated Information

From the number of 30 respondents, the highest total score is for item strongly agree which are 88.33%. while for the item agree, shows intermediate score which are 10%. for the lowest score is for item slightly agree which are 7%

ii. Efficient To Monitor

From the number of 30 respondents, the highest total score is for item strongly agree which are 76.67%. while for the item agree, shows

intermediate score which are 16.67%. for the lowest score is for item slightly agree which are 7%

iii. Official Medium

From the number of 30 respondents, the highest total score is for item strongly agree which are 52.67%. while for the item agree, shows intermediate score which are 41.67%. for the lowest score is for item slightly agree which are 9%

iv. Systematic Information

From the number of 30 respondents, the highest total score is for item strongly agree which are 63.33%. while for the item agree, shows intermediate score which are 30%. for the lowest score is for item slightly agree which are 7%

v. The Need Of Application For Site Management In This Construction Site.

From the number of 30 respondents, the highest total score is for item strongly agree which are 57.76%. while for the item agree, shows intermediate score which are 41.67%. for the lowest score is for item slightly agree which are 1%

4.4.6 Reliability Test For Current Method

Reliability analysis may be used to investigate the properties of measuring scales and the item that forms the scale. The reliability analysis procedure computes several commonly used scale reliability metrics as well as information on the correlation between scales item. Intraclass correlation coefficients can be used to calculate inter-rater reliability estimates.

Tables 4.8 reliability test

Cronbach's Alpha	Cronbach's Alpha based on standardized item	N of items
.622	.609	10

4.4.6 Descriptive Test Of Average Mean Pre-test

Descriptive statistics are used to summarize data in an organized manner by describing the relationship between variables in a sample or population. Calculating descriptive statistics represents a vital first step when conducting research and should always occur before making inferential statistical comparisons. Descriptive statistics include types of variables (nominal, ordinal, interval, and ratio) as well as measures of frequency, central tendency, dispersion/variation, and position. (Kaur et al. 2018). Table 4.9 and 4.13 shows the result of descriptive test for average mean for both post-test and pre-test.

Table 4.9 pre-test descriptive statistics

	N	Mean		Std. Deviation	Variance
	Statistic	Statistic	Std. Error	Statistic	Statistic
a) Existing method gives delay information	30	1.13	.063	.346	.120
b) Existing method is inconvenient to planning for further delivery	30	1.10	.056	.305	.093
Existing method is difficult to follow up status with person in site	30	1.30	.085	.466	.217

Table 4.9 (Continuation)

a) Existing method are difficult for PIC to update diesel balance on site using WhatsApp group	30	1.43	.092	.504	.254
b) Existing method is inconvenient to update diesel balance in Microsoft Excel refer to WhatsApp medium	30	1.47	.093	.507	.257
c) Existing method staff missing important information in WhatsApp group might causes paperwork to be delayed	30	1.53	.093	.507	.257
d) Existing method can result in diesel order to be delayed due to overlook information in WhatsApp group	30	1.47	.093	.507	.257
e) Existing method lead to balance not being recorded due to overlook information in WhatsApp group	30	1.40	.091	.498	.248

Table 4.9 (Continuation)

f) Existing method may causes refuelling schedule delayed as a result of missing information in WhatsApp groups.	30	1.43	.092	.504	.254
Existing method may lead to overlapping information due to no specific PIC to update the diesel balance	30	1.37	.089	.490	.240

Table 4.9 shows the results of respondents about the issues related to the current method in monitoring diesel balance at ECRL site project section 3, Terengganu. From the questionnaire researcher has classified the constraint into five elements. The data are generated by using SPSS software, version 26. Table 4.10 shows the detail of elements constraints and the mean and average for existing method.

Table 4.10 Mean and average mean of the constraint elements for existing method.

No	Constraint elements of the current method in ECRL	Mean	Average Mean	Average Mean (%)
1	Delay information	1.19	1.17	16.34
		1.14		
2	Difficulty in monitoring diesel balance	1.43	1.43	19.97
3	WhatsApp group medium	1.57	1.63	22.77
		1.67		
		1.67		
		1.73		
		1.47		
		1.67		
4	overlapping information	1.57	1.57	21.93
5	the need of application for site management in this construction site	1.36	1.36	18.99
Total Average		1.50	7.16	100

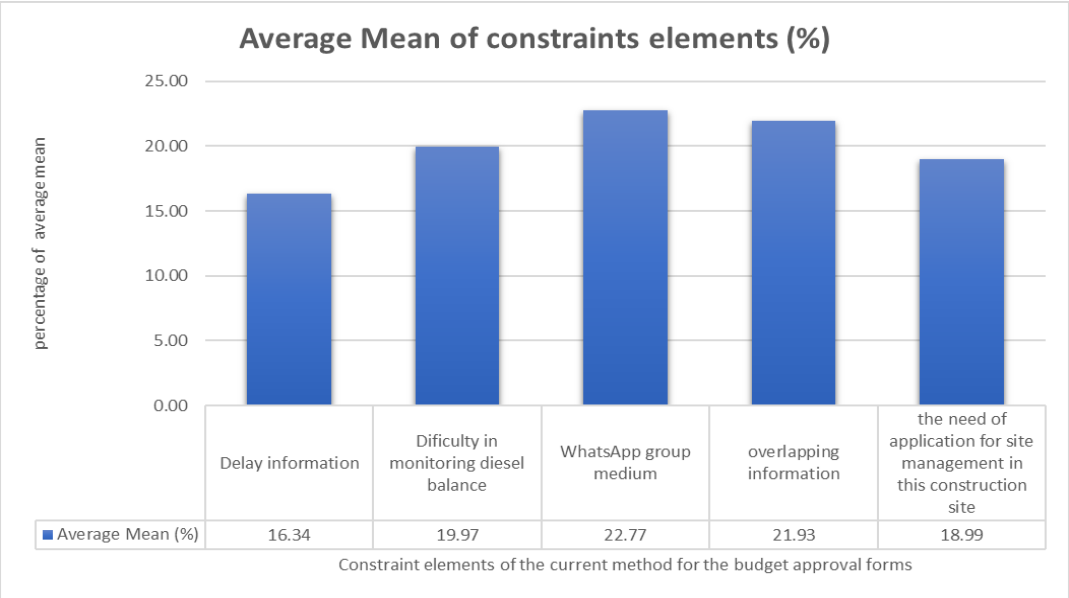


Figure 4.3 Percentage of average mean

According to the statistics in table 4.10 and figure 4.3, it shows that the average mean for item Delay information is 16.34%. second the difficulty in monitoring diesel balance is 19.97%, while the items number 3 and 4 are which is WhatsApp group medium and overlapping information are both shown to have collected the percentage value of 22.7% and 21.93%. Finally, the value of the need of application for site management is 18.99%

Table 4.11 Usability of current method

Variables	Mean	Interpretation
Delay Information	1.17	Very Low
Difficulty In Monitoring Diesel Balance	1.43	Very Low
WhatsApp Group	1.64	Low
Overlapping Information	1.57	Low
The Need Of Application For Site Management	1.36	Very Low

Table 4.11 shows respondent level of usability towards current method whereby analysis shows for all variables tested the mean score were less than 2.50 meaning that the usability level of existing method was very low. Therefore the Application Of Diesel Balance Monitoring (DBM) For Construction Site Management is needed to be developed to solve this issues of the related issues of Constraint elements in current method to monitor diesel balance in site at ECRL project section 3, Terengganu.

4.4.7 Reliability Test for Diesel Balance Monitoring Application (DBM)

Researcher has developed 5 categories in the questionnaire to evaluate the effectiveness of using Diesel Balance Monitoring (DBM). Beside that, the question is developed on the 5 point of Likert Scale. The questionnaire consists responses ranging from "Strongly Disagree" to "Strongly Agree". To determine either if the questionnaire could "reliably" measure the latest variable like the effectiveness of Diesel Balance Monitoring (DBM) mobile application, Cronbach alpha test was conducted. The acceptable reliability value is 0.6. Therefore, if the questionnaire's reliability is more than 0.59 then the questionnaire is consider "reliable".

Table 4.12 Reliability test for Diesel Balance Monitoring (DBM)

Cronbach's Alpha	Cronbach's Alpha based on standardized item	N of items
.656	.649	10

4.4.8 Descriptive Test Of Average Mean Post-test

Descriptive statistics are used to summarize data in an organized manner by describing the relationship between variables in a sample or population. Calculating descriptive statistics represents a vital first step when conducting research and should always occur before making inferential statistical comparisons. Descriptive statistics include types of variables (nominal, ordinal, interval, and ratio) as well as measures of

frequency, central tendency, dispersion/variation, and position. Since descriptive statistics condense data into a simpler summary, they enable health-care decision-makers to assess specific populations in a more manageable form (Kaur et al. 2018). Table 4.9 and 4.13 shows the result of descriptive test for average mean for both post-test and pre-test.

Table 4.13 Post-Test Descriptive Statistics

	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
New method provide well updated information	30	4.90	.056	.305
New method is easy to follow up status with person in site	30	4.77	.092	.504
New method are easy for PIC to update diesel balance	30	4.47	.104	.571
New method is convenient to update diesel balance in Microsoft Excel	30	4.43	.104	.568

Table 4.13 (Continuation)

New method prevent staff missing important information and won't cause paperwork to be delay	30	4.53	.115	.629
New method won't cause diesel order to be delay	30	4.57	.114	.626
New method will be recorded systematically	30	4.53	.124	.681
New method won't cause delayed refuelling schedule	30	4.57	.133	.728
New method will not lead to overlapping information due to there are specific information to update the diesel balance	30	4.57	.114	.626

Table 4.9 shows the results of respondents about the usage of Diesel Balance Monitoring (DBM)in monitoring diesel balance at ECRL site project section 3, Terengganu. From the questionnaire researcher has classified the effectiveness into five elements. The data are generated by using SPSS software, version 26. Table 4.10 shows the detail of elements constraints and the mean and average for existing method.

Table 4.14 Total Average Mean

No	Constraint elements of the current method in ECRL	Mean	Average Mean	Average Mean (%)
1	Delay Information	4.91	4.91	21.49
2	Difficulty In Monitoring Diesel Balance	4.78	4.78	18.51
3	WhatsApp Group Medium	4.47	4.53	19.82
		4.44		
		4.56		
		4.56		
		4.56		
		4.59		
4	Overlapping Information	4.59	4.59	20.09
5	The Need Of Application For Site management In This Construction Site.	4.59	4.59	20.09
Total Average		4.61	22.85	100

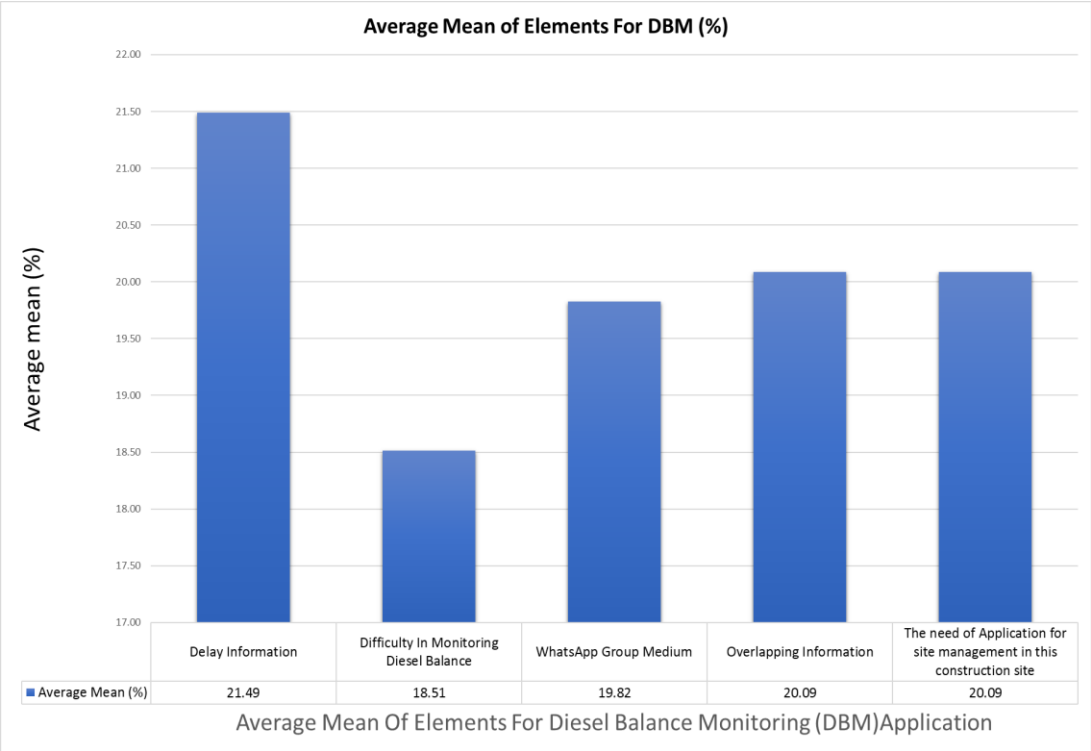


Figure 4.4 Average Mean of Effectiveness of Diesel Balance Monitoring Application

Table 4.15 Usability of current method

Variables	Mean	Interpretation
Delay Information	4.91	Very High
Difficulty In Monitoring Diesel Balance	4.78	Very High
WhatsApp Group Medium	4.53	Very High
Overlapping Information	4.59	Very High
The Need Of Application For Site Management In This Construction Project	4.59	Very High

4.4.9 Paired Sample Statistics

Paired sample statistics is the test to compare the effectiveness of current method of monitoring diesel balance in site and the usage of the Application of Diesel Balance Monitoring (DBM) for site management. The test are listed and shown in the table 4.12

Table 4.16 Paired Sample Statistics

Effectiveness Category	**Paired sample statistics**	
	Mean	
	Current Method	**DBM**
Delay Information	1.17	4.91
Difficulty In Monitoring Diesel Balance	1.43	4.23
WhatsApp group medium	1.63	4.53
Overlapping information	1.57	4.59
The need of Application for site management in this construction site	1.36	4.59

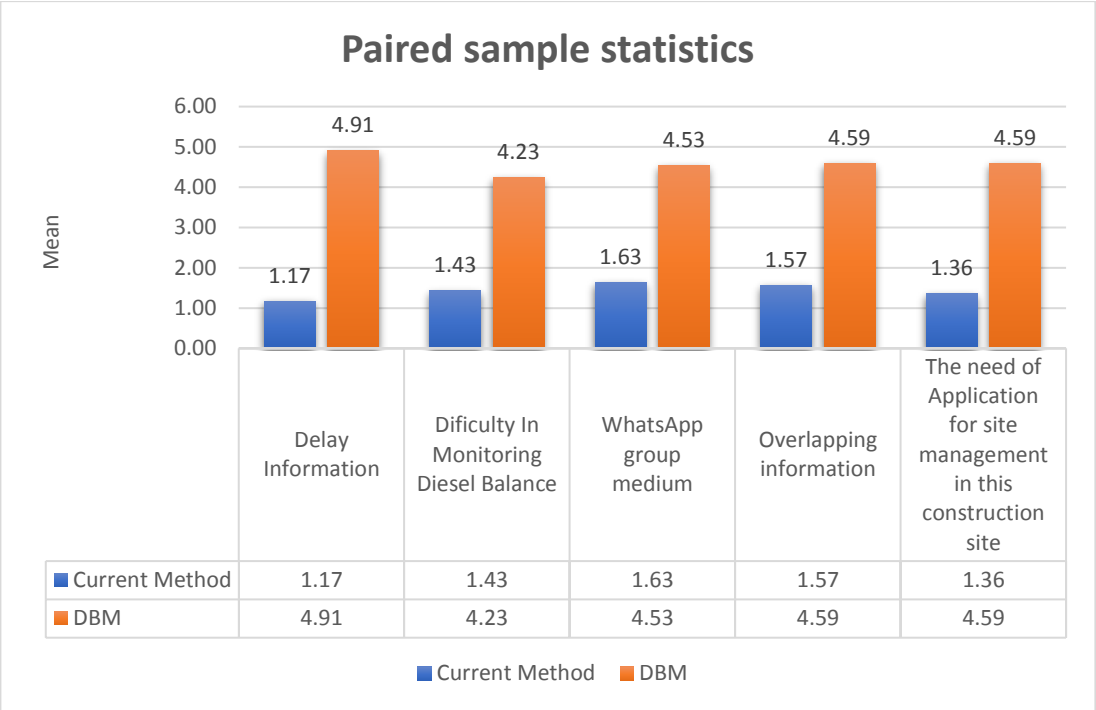


Figure 4.5 Paired Sample Statistics

4.5 CONCLUSION

In leading the day-to-day technology system that can make everyday life easier, so it can assist any person to spend time developing something. Furthermore, with this technology can be used in all areas, particularly in construction. Indeed, in this area requires technology in terms of work which can save time and get accurate information.

In advance, to manage the fuel storage in site ECRL section 3 Terengganu, is best to initiate the usage of the application to solve the problem. Therefore, the development of system to assist in this process designing and develop the objective of identifying problem related such as misunderstanding between employee, unorganized process, and the management system are not in systematic order. Adopting a systematic approach in project management mitigates the risks of issues during construction (Mahmoud Ershad,2023). The developed Diesel Balance Monitoring (DBM) application can be evaluated the efficiency and applied into this site.

From the testing that have been made, the results have shown the differences between the current method and the new method to be used in the ECRL Project Section

3, Terengganu. It shown that the effectiveness of each categories have a big gap of differences which visualizes that the new method using the Application Of Diesel Monitoring (DBM) to monitor Diesel balance in site is much more effective that using the current method at ECRL Project Section 3, Terengganu.

As the results that have been shows, this application can be used by all construction participants. By using this application, their cost and time can be managed well. The systems that had been illustrates in the Diesel Balance Monitoring Application are developed by using bubble software can be used as digital information on site. This application are developed in accordance with the country to achieve the level of industrial revolution 4 in the future

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

Based on the data analysis in the previous chapter. This section summarizes the finding, conclusions and suggestion. The efficiency of using the Diesel Balance Monitoring application (DBM) for site management at the ECRL Project section 3, Terengganu. It is assessed by determining how well the study objectives are met. In this chapter, the researcher should have the recommendation to upgrade the developed product to be much better and advanced functionality from the product that have been carried out. Researcher must thought this through carefully so that the recommendation idea for this project will be much better and convincing.

Diesel Balance Monitoring Application (DBM) for site management are developed as a centralize information application. The application contains the detail and specific detail and information regarding the diesel balance in site. DBM aim to help employee to make their daily duty much easier and simple. Besides, this application also function as site diary for fuel consumption in which employee can update fuel balance in site according their work hours and workload on each day. this action help person in charge to track fuel consumption and manage fuel balance in each site even they are geographically distance.

Last but not least, Diesel Balance Monitoring application (DBM) are developed to be an friendly user application that are easy to understand and used by any ages as long as they have their smartphones in which can be accessed anywhere anytime. This application also aim to be an one of alternative toward green environment as this application will reduce the amount usage of paper. This application are proven by the data result from user that Diesel balance monitoring application (DBM) is a better way to manager the diesel balance in site compare to the existing method that they have been

using all this time which is paper-based information as their main organization management. DBM also train the employee toward the technology Innovation Revolution 4.0 in construction sector.

5.2 DISCUSSION

The result show that user agree Diesel Balance Monitoring Application (DBM) is more effective compare the existing method. The current method that has been used on site are paper base information are used as their reference and submission. Everything is depends on paper which is involve a lot of trees. Besides that, using paper is impractical since most of the workers are working on site which are geographically distance and hard to get hand on office appliances to update information and other working that require updated information from time to time.

From the questionnaire given, it shows that more than 50% respondents are agreed with this application development which are more easy to comprehend then the existing method that giving them a hard time to completing their work task. Based on this problem, The Diesel Balance Monitoring application (DBM) has been design as a friendly user mobile application that can be easily use by all workers. This application help them to gain information online so that they can save time and cost to make proper planning for further work progress. From the questionnaire above also shows that more than 50% respondents are agreed to use this application for their project.

5.3 CONCLUSION

The conclusion of the project, it is possible to conclude that workers have faces constants problem to handle the diesel amount in site. The respondents have agreed that all of the issues that arise on the site project had impact on their work. The Diesel balance monitoring application (DBM) is proposed for the use at ECRL project section 3, Terengganu since the respondents are pleased and satisfied of the application usage to handle the diesel amount in site. Researcher has achieved the objective of this project. The specifications objectives of this projects are, To design diesel tracking application in construction site which is researcher has gather all the information based on site and

interview with Person in charge. Second, To develop Diesel Balance Monitoring Application using Bubble software. Bubble is a visual programming language, an easy code development platform and an construction application platform as a service, developed by Bubble Group, that enables non-technical people to build web or applications without needing to type complex code. Finally, To evaluate the effectiveness of the Diesel Balance Monitoring (DBM) application. The effectiveness of this product has been carried out by social science statistic by using method paired t-test.

5.4 RECOMMENDATION

As a results of above findings, the researcher would like to suggest a few recommendation that can be used as a furthers extensions or follow up actions for the improvement of the diesel balance monitoring application (DBM). Researcher only scope the usage of this application to be used for tracking the amount of diesel in site. So, below are some recommendations that may result in improving the application so that it will contain various functionality to help more user that uses them.

First, this application can be developed not only to track diesel balance in site. It can also be used to track machinery which are geographically distance. For example, the ECRL project section 3, Terengganu involve a huge amount of machinery. And it is almost impossible to track all of them. By combining this application feature and a Global Positioning System (GPS), it will create a room of opportunity for the application to improve.

Next, the Diesel balance monitoring application can also be convert in to online website which can also ease the user that are spending most of their working time in office. The website can help them to extract the data directly and use the information to make order, report etc. It depends on the company itself in which way they prefer to use the systems.

As a conclusion, the usage of technology in construction sector is very important and practical in producing the best quality of work. The diesel balance monitoring

application (DBM) can help to cut cost of paper usage, save time and create a systematic organization. Hence, the usage of technology systems can attract more clients to choose the company service. By applied the technology in company may also help to bring Malaysia parallel with other success countries in the world. Technology in construction sector is important to boost of a nation's economy.

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APPENDIX

APPENDIX A

COST FOR DEVELOPMENT OF THE PROJECT			
No	**Item**	**Quantity**	**Price(RM)**
1	Bubble developer account Registration	1	200.00
2	Interface module	1	150.00
3	Notification module	1	150.00
4	Source Code export from Bubble software	1	300.00
Total			800.00

APPENDIX B

THE EXAMPLE OF QUESTIONAIRE FORM

FINAL YEAR PROJECT

Title:

THE APPLICATION OF DIESEL BALANCE MONITORING (DBM) FOR CONSTRUCTION SITE MANAGEMENT

The Respondents Point Of View Regarding The Issues Related To Diesel quantity information on Site

1. **A part of my study of Final Year Project for Bachelor of Civil Engineering Technology (BCT) at Politeknik Ungku Omar (PUO), Ipoh, Perak. I am MUHAMMAD ASY SYIBLI BIN HASSAN (01BCT30F3009) conducting a survey to evaluate THE APPLICATION OF DIESEL BALANCE MONITORING (DBM) FOR CONSTRUCTION SITE MANAGEMENT**

SECTION A: thick (√)

DEMOGRAPHY

a) **Gender**

Male	
female	

b) **Age**

≤ 25	
26-35	
36-45	
≥ 46	

c) **Work experience**

< 2 years	
2 – 5 years	

6 – 10 years	
> 10 years	

d) Education level

SPM	
Diploma	
Bachelor Degree	
Master	
PhD	

e) Position

Project manager	
Construction manager	
Engineer	
Site supervisor/ Assistant engineer	
others	

SECTION B: Thick (√)

PRE-TEST

Question 1 to 5 are shown in table below:-

No	The Need of systematic centralized information application	Issues Related to monitoring diesel balance in site	Level of Agreement				
			1	2	3	4	5
1	Delay information	a) Existing method gives delay information					
		b) Existing method is inconvenient to planning for further delivery					
2	Difficult to monitor balance	a) Existing method is difficult to follow up status with person in site					
3	WhatsApp Group Medium	a) Existing method are difficult for PIC to update diesel balance on site using WhatsApp group					
		b) Existing method is inconvenient to update diesel balance in Microsoft Excel refer to WhatsApp medium					
		c) Existing method staff missing important information in WhatsApp group might causes paperwork to be delayed					

		d) Existing method can result in diesel order to be delayed due to overlook information in WhatsApp group					
		e) Existing method lead to balance not being recorded due to overlook information in WhatsApp group					
		f) Existing method may causes refuelling schedule delayed as a result of missing information in WhatsApp groups.					
4	**Overlapping information**	**a) Existing method may lead to overlapping information due to no specific PIC to update the diesel balance**					
5	**The need of Application for site management in this construction site**	**Do you need a systematic centralized information application?**					
		Question 1: delay information **a) Do you need a systematic monitoring application to solve diesel issues in site?**					
		b) Do you think a systematic centralized information application can avoid run out of diesel in site issues from happening?					

		Question 2: Difficult to monitor balance **a) Do you agree a systematic centralized information application can help to monitor the diesel balance in each site much easier?**					
		Question 3: WhatsApp Group Medium **a) Do you agree a systematic centralized information application can help PIC to update diesel balance in site much easier?**					
		b) Do you agree systematic centralized information application are convenient to update in Microsoft excel?					
		c) Do you agree systematic centralized information application can prevent missing information in WhatsApp group that might cause paperwork to be delayed?					
		d) Do you agree systematic centralized information application can prevent diesel order to be delayed due to overlook information in WhatsApp group?					
		e) Do you agree a systematic centralized information application can prevent diesel balance not being recorded due to					

		overlook information in WhatsApp group?					
		g) Do you agree a systematic centralized information application can prevent refuelling schedule to be delayed as a result of missing information in WhatsApp groups?					
		Question 4: overlapping information **a) Do you agree a systematic centralized information application can prevent overlapping information due to no specific PIC to update the diesel balance?**					

SECTION C: Thick (√)

POST-TEST

Question 1 to 5 are shown in table below :-

No	The Need of systematic centralized information application	Effectiveness of Using Diesel Balance Monitoring (DBM) application in site	Level of Agreement				
			1	2	3	4	5
1	Delay information	a) New method provide well updated information					
2	Difficult to monitor	a) New method is easy to follow up status with person in site					
3	WhatsApp Group Medium	a) New method are easy for PIC to update diesel balance					
		b) New method is convenient to update diesel balance in Microsoft Excel					
		c) New method prevent staff					

		missing important information and won't cause paperwork to be delay					
		d) New method won't cause diesel order to be delay					
		e) New method will be recorded systematically					
		f) New method won't cause delayed refuelling schedule					
4	**Overlapping information**	**a) New method will not lead to overlapping information due to there are specific information to update the diesel balance**					
5	**The Effectiveness Of Diesel Balance**	**a) Do you agree that this systematic centralized information**					

	Monitoring (DBM) application for project management	**application is effective?**					
		b) Do you agree that this systematic centralized information application can solve delay update issue?					
		c) Do you agree that this systematic centralized information application can prevent delay update and will help in planning further work progress?					
		d) Do you agree that this systematic centralized information application can provide real-time information to user?					
		e) Do you agree that this systematic centralized information application can					

		update the diesel balance left on site?					
		f) Do you agree that this systematic centralized information application can prevent user overlook important information?					

If there any comment/improvement regarding Diesel Balance Monitoring application (DBM) for site management, please write it down below:

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APPENDIX C

NO.	WORK DESCRIPTION	FEB					MAC				APR				MAY				JUNE		
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20
		30/1/2023 - 04/2/2023	6/2/2023 - 11/2/203	13/2/2023 - 18/2/2023	20/2/2023 - 25/2/2023	27/2/2023 - 4/3/2023	6/3/2023 - 11/3/2023	13/3/2023 - 18/3/2023	20/3/2023 - 25/3/2023	27/3/2023 - 1/4/2023	3/4/2023 - 8/4/2023	10/4/2023 - 15/4/2023	17/4/2023 - 22/4/2023	24/4/2023 - 29/4/2023	1/5/2023 - 6/5/2023	8/5/2023 - 13/5/2023	15/5/2023 - 20/5/2023	22/5/2023 - 27/5/2023	29/5/2023 - 3/6/2023	5/6/2023 - 10/6/2023	12/6/2023 - 17/6/2023
1	REGISTRATION AT WORKPLACE FOR NEW SEMESTE																				
2	DATA COLLECTION (PRE -TEST)																				
	Build questionnaire (Pre-Test and Post-Test)																				
	Distribute questionnaire among respondents																				
	Counting data using IBM SPSS																				
3	PROJECT IMPLEMENTATION AND DEVELOPMENT																				
	Product development																				
	Test run the project																				
4	RESULTS AND ANALYSIS																				
	Counting data using IBM SPSS																				
	State and summarize all the data / results																				
5	DATA COLLECTION (POST-TEST)																				
	Distribute questionnaire among respondents																				
	Counting data using IBM SPSS																				
6	REPORT WRITING																				
	Proposal of Chapter 4 (Data and Analysis)																				
	Proposal of Chapter 5 (Discussion, Conclusion and Recommendation)																				
7	RESEARCH PROPOSAL																				
	Completing of final report / thesis and slide presentation																				
	Technical Paper																				
8	FINAL YEAR PROJECT DISSERTATION AND PRESENTATION																				
9	OBSERVATION																				
10	FINAL REPORT / THESIS																				
	Editing of Final Report / Thesis																				
	Final editing of Final Report / Thesis																				
11	SUBMISSION OF FINAL REPORT / THESIS																				
12	FINAL EVALUATION & KEY-IN PROCESS OF MARKS																				