# POLITEKNIK UNGKU OMAR

# E-MACHINERY INSPECTION CHECKLIST
# (E-MIC)


## NAQIBAH BINTI AB WAHID
## (01BCT21F3012)

## CIVIL ENGINEERING DEPARTMENT


## SESSION II 2023/2024

# POLITEKNIK UNGKU OMAR

# E-MACHINERY INSPECTION CHECKLIST (E-MIC)

**NAQIBAH BINTI AB WAHID**

**(01BCT21F3012)**

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

## CIVIL ENGINEERING DEPARTMENT

## SESSION II 2023/2024

## DECLARATION OF ORIGINAL AND OWNERSHIP

## E-MACHINERY INSPECTION CHECKLIST (E-MIC)

1.1 **NAQIBAH BINTI AB WAHID (NO.KP: 000910-10-0482)** am a student of **Bachelor of Civil Engineering Technology, in Politeknik Ungku Omar,** at the **address Jalan Raja Musa Mahadi, 31400 Ipoh, Perak**

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

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

**Prepared by;** )

NAQIBAH BINTI AB WAHID ) ----------

(Identification Number: 000910-10-0482) ) (NAQIBAH BINTI AB WAHID)

**Witnessed by;**

DR. MAZLINA BINTI ALANG OTHMAN )

(761015-08-6246) ) ----------

As the project supervisor, date: ) (DR.MAZLINA BINTI ALANG OTHMAN)

# ACKNOWLEDGEMENT

Firstly, I express gratitude to Allah for bestowing upon me the fortitude and capability to successfully accomplish my Final Year Project. Without His divine assistance, I would have been unable of its completion. The title of this final year project is " E-Machinery Inspection Checklist (E-MIC)." Indeed, there are numerous individuals to whom I extend my appreciation for their valuable contributions to the accomplished fulfilment of this dissertation. I would like to express my sincere appreciation and thanks to my supervisor for this final year project, Dr Mazlina binti Alang Othman. Their unwavering support, encouragement, assistance, and insightful notes greatly contributedto the improvement of my final year project report. Devoid of the support, incentive, andresources provided, it would be arduous for me to successfully complete this endeavor. I would like to extend my appreciation to the YTL Construction crew for their provisionof knowledge and willingness to share their expertise during the implementation process. I would want to express my heartfelt gratitude to my family for their steadfast support and comprehension, which significantly bolstered my mental resilience in doing this project successfully. Finally, I would want to convey my profound appreciation to any individual or organisation that helped, either directly or indirectly, in fulfilling my final year project. I really appreciate and appreciate your help. May Allah SWT reward them all for their services.

# ABSTRACT

The effective completion of a construction project is typically determined by its adherence to budgetary constraints, predetermined timeline, and compliance with established standards and specifications. Multiple organizations operating within the construction industry acknowledge that machinery constitutes a crucial resource for the successful completion of construction projects. Individuals who are engaged in the construction sector possess an understanding that any delays pertaining to the utilization of machinery would accidentally result in unwanted disruptions to the project's progress, thereby impacting the overall timeline for completion of building projects. Inspection of machinery conditions is a crucial aspect of safety inspection work, serving as a primary means of upholding safe conditions and monitoring hazardous practices within the workplace. The ALP Omega Bukit Raja Warehouse construction site analysis reveals regular machinery damage, increased project costs due to machinery repair, incidents caused by imbalanced machinery, and a lack of machinery checklist. Therefore, this study aims to identify machinery maintenance issues at ALP Omega Bukit Raja Warehouse, develop a website for the record of machinery checklists at the site, and analyze their effectiveness. The effectiveness of the E-Machinery Inspection Checklist is tested with safety and health officers and machinery operators using a survey questionnaire. The questionnaire is divided into five parts which is are ease of use, organisation of machinery inspection, effectiveness in task management, saving time and cost, environmental impact and intention to use. Based on the survey, almost 80% (strongly agree + agree) that the E-Machine Inspection Checklist (E-MIC) is a user-friendly tool that facilitates inspections, provides comprehensive data, and aids in identifying good machinery maintenance management companies. It improves organizational efficiency, data collection, work effectiveness, task completion, and operator alertness.

# ABSTRAK

Penyiapan berkesan projek pembinaan biasanya ditentukan oleh pematuhannya kepada kekangan belanjawan, garis masa yang telah ditetapkan, dan pematuhan dengan piawaian dan spesifikasi yang ditetapkan. Pelbagai organisasi yang beroperasi dalam industri pembinaan mengakui bahawa jentera merupakan sumber penting untuk menyiapkan projek pembinaan. Individu yang terlibat dalam sektor pembinaan mempunyai pemahaman bahawa sebarang kelewatan yang berkaitan dengan penggunaan jentera secara tidak sengaja akan mengakibatkan gangguan yang tidak diingini kepada kemajuan projek, sekali gus menjejaskan garis masa keseluruhan untuk menyiapkan projek bangunan. Pemeriksaan keadaan jentera adalah aspek penting dalam kerja pemeriksaan keselamatan, berfungsi sebagai cara utama untuk mengekalkan keadaan selamat dan memantau amalan berbahaya di tempat kerja. Analisis tapak pembinaan Gudang ALP Omega Bukit Raja mendedahkan kerosakan jentera yang kerap, peningkatan kos projek akibat pembaikan jentera, insiden yang disebabkan oleh mesin yang tidak seimbang, dan kekurangan senarai semak jentera. Oleh itu, kajian ini bertujuan untuk mengenal pasti isu penyelenggaraan jentera di Gudang ALP Omega Bukit Raja, membangunkan laman web untuk rekod senarai semak jentera di tapak, dan menganalisis keberkesanannya. Keberkesanan Senarai Semak Pemeriksaan (E-MIC) diuji dengan pegawai keselamatan dan kesihatan serta pengendali jentera menggunakan soal selidik tinjauan. Soal selidik terbahagi kepada lima bahagian iaitu kemudahan penggunaan, organisasi pemeriksaan jentera, keberkesanan dalam pengurusan tugas, penjimatan masa dan kos, kesan alam sekitar dan niat untuk digunakan. Berdasarkan tinjauan, Hampir 80% (sangat setuju + setuju) bahawa Senarai Semak Pemeriksaan E-Mesin (E-MIC) ialah alat mesra pengguna yang memudahkan pemeriksaan, menyediakan data yang komprehensif, dan membantu dalam mengenal pasti syarikat pengurusan penyelenggaraan jentera yang baik. Ia meningkatkan kecekapan organisasi, pengumpulan data, keberkesanan kerja, penyiapan tugas dan kewaspadaan pengendali.

## LIST OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# CHAPTER 1

# INTRODUCTION

## 1.1 INTRODUCTION

The construction sector encompasses a variety of maintenance, planning, and management responsibilities in addition to building and engineering constructions of every kind. Due to its interconnections with numerous other economic sectors, this particular sector serves as a significant and dependable gauge of the trajectory and developments within the overall national economy (Sweis, 2008). Nevertheless, construction projects are confronted with numerous hazards that pose a threat to their operations. The aforementioned risks primarily arise from inadequate project planning and management, which impede the project's advancement and occasionally lead to compromised construction quality, cost overruns, or delayed deliveries (Gajewska, 2011).

Effective machinery management practises should commence by establishing a precise definition of machinery and its associated management principles, since it distinctly deviates from the management of other resources within the construction domain. The effective administration of leased equipment is equally crucial as that of owned equipment, as it significantly contributes to fulfilling industrial requirements. Numerous construction companies heavily depend on leased equipment, necessitating the implementation of effective management practises at the construction site. This measure will guarantee that individuals are not rendered inactive on the premises as a result of material delivery delays or delays occurring in other project stages (Manaf.Z., 2007).

In recent years, the discussion around maintenance has become increasingly crucial. This is mostly due to the continuous evolution and rapid advancements in technology. As technology progresses, it necessitates a

corresponding development in maintenance practises to effectively address these changes. Many firms have come to recognise the need of proactively addressing machine breakdowns. Taking a little pause for maintenance is preferable than continuing production and risking unexpected stoppages, which can result in significant expenses and reduced productivity. The management of construction equipment is a crucial department responsible for overseeing the operational efficiency, cost reduction, increased mechanical availability, and extended lifespan of the existing equipment within the company (Teca.P.S, 2015).

Inspection of machinery conditions is a crucial aspect of safety inspection work, serving as a primary means of upholding safe conditions and monitoring hazardous practises within the workplace. In addition to this, safety management systems have necessitated the implementation of safety audits, which involve a comprehensive analysis and assessment of all elements within the system to verify their adherence to established criteria. Safety audits encompass many components such as safety inspections, examination of pertinent documents, and conducting interviews (Nikolaos, 2010)

## 1.2 PROBLEM STATEMENT

The effective completion of a construction project is typically determined by its adherence to budgetary constraints, adherence to the predetermined timeline, and compliance with established standards and specifications. The studies conducted by (Olawale, 2012), (Frimpong, 2003), and (Majid, 2006) are relevant to the topic at hand. In the realm of development and construction, it is common for contractors and engineers to strategically manage project timelines and optimise financial gains in order to enhance their market presence and contribute to the sector's overall growth and advancement. In order to achieve this inclination, it is imperative for project managers to conscientiously acknowledge the timetables and blueprints of a project and assess their ramifications prior to the execution phase (Gunduz, 2013).

Multiple organisations operating within the construction industry acknowledge that machinery constitutes a crucial resource for the successful completion of construction projects. Additionally, these limitations are inherent and require effective management in order to avoid impeding the overall progress of the project. Individuals who are engaged in the construction sector possess an understanding that any delays pertaining to the utilisation of machinery would accidentally result in unwanted disruptions to the project's progress, thereby impacting the overall timeline for completion of building projects (Manaf.Z., 2007).

Furthermore, the absence of regular inspection and maintenance of machinery poses a potential threat to the safety of users and the surrounding environment. This phenomenon is evident in a study conducted by Erwin (2011), which demonstrates that a significant number of accidents and near accidents (referred to as incidents) nevertheless occur in machines that have been designed and constructed in accordance with safety standards, such as European harmonised Standards, and equipped with advanced safety mechanisms. While the occurrence of accidents resulting from device failure may be deemed insignificant owing to their great reliability, a notable number of accidents do occur on equipment that are appropriately safeguarded. The majority of these events can be attributed to errors that have resulted in a significant reduction or impairment of the efficacy of the implemented preventive mechanisms, ultimately resulting in severe or deadly consequences.

The ALP Omega Bukit Raja warehouse constructing site has been the subject of study, which has identified machinery damage as a common problem at this location. The occurrence of such delays in work execution can result in increased project costs due to machinery repair expenses and extended completion timelines. Furthermore, based on the Alp Warehouse construction site, there are also accidents that occur as a result of the uneven surface area on the construction site which results in the machinery being unbalanced and causing accidents. According to the checklist provided by the Company, it is imperative for the operator to verify that the work placement area for the machinery is in a secure state. Moreover, in the event of any machinery damage, the safety officer will investigate by analysing the historical checklist records

associated with every component of machinery. Due to the manual nature of the checklist collection process, the safety officer is faced with a dearth of checklist history to carry out a thorough investigation into the root causes of machinery damage.

## 1.3 OBJECTIVE

The objective of this project are:

i. To identify the machineries inspection checklist at the site construction.
ii. To construct a website for the inspection of machinery at site.
iii. To analyze the effectiveness of the website.

## 1.4 SCOPE OF STUDY

**Figure 1.1:** ALP Omega Bukit Raja Warehouse

i. This study was conducted at ALP Omega Bukit Raja Warehouse site, as indicated in Figure 1.0.
ii. This research focuses on machinery inspection checklist at ALP Omega Bukit Raja Warehouse site.
iii. The Parties that involve in this study are Safety and Health Officer and Operator Machinery only.

## 1.4 SIGNIFICANT OF THE STUDY

Based on the research, the utilisation of manual checklist techniques for conducting machinery maintenance inspections and storing associated documentation has been found to be a time-consuming process in the realm of safety management. In order to address these issues, the implementation of this research will serve to enhance safety management and operators' understanding of machinery maintenance, as well as facilitate investigations and audits more efficiently. In the interim, abstaining from the use of paper can contribute to waste reduction.

The utilisation of this application has the potential to yield time and cost savings, as well as mitigate project delays and minimise the occurrence of accidents. In addition, it can help the safety department to manage the document of machinery checklist to assist in conducting investigations in the event of damage to the machinery. By enhancing safety management knowledge and operator vigilance, this technology facilitates the assurance of machinery safety. Furthermore, this application has the potential to be utilised by Company YTL in their upcoming construction project.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 INTRODUCTION

A literature review is a comprehensive and unbiased evaluation of the existing research and non-research literature pertaining to the subject under investigation (Hart, 1998). A literature review entails an examination of scholarly articles, books, and other pertinent materials that pertain to a specific subject, research area, or idea. Through this process, it offers a depiction, synopsis, and discerning assessment of these works. The objective of this is to acquaint the reader with the most recent scholarly works on a certain subject and serve as the foundation for another objective, such as providing a rationale for further investigations in the field. A comprehensive literature study compiles material pertaining to a certain topic from a multitude of sources. (Ramdhani, 2014).

Mobile devices are having an impact on construction management, as reported by Engineering News Record (ENR) in 2011. Construction personnel utilise tablets and smartphones to enhance job-site productivity. Both tablets and smartphones integrate mobile accessibility with mobile construction management apps. However, smartphones provide the additional benefit of being pocket-sized while yet offering the same advantages. The primary benefit derived from the utilisation of these mobile devices is the facilitation of interactive and dynamic work for construction professionals. Real-time sharing of data collected from the site, accompanied by visual attachments, allows for seamless collaboration among project participants. Additionally, site reports are generated with enhanced accuracy and currency, thanks to the availability of up-to-date information.

Presently, the exchange of construction information is conducted using conventional means of information and communication that are manual and reliant on paper. Utilising mobile computing technology to digitise construction information and automate information management tasks is highly desirable and perfect. Three strategies can be employed to enhance on-site information management from the current state to the desired level: utilising a commercially available mobile application that can be synchronised with the main information system, utilising a commercially available mobile application that can wirelessly transfer data to the main information system, and designing/developing a dedicated mobile application that wirelessly exchanges data with the main information system (Barbarosoglu, 2016).

## 2.2 CONSTRUCTION INDUSTRY

In the present era of globalisation and urbanisation, construction projects are being carried out in many locations across the globe. Each project will entail specific aspects of problems. Effective handling of these difficulties is crucial for achieving the objectives of the initiatives. The research paper focuses on the salient factors that impact the building project, namely quality, safety, and time management concerns. Delay, as referenced in construction, refers to the extension of the construction duration and the occurrence of interruptions that worsen the construction schedule. Construction management refers to the management activities that go beyond the typical architectural and engineering services performed during the planning, construction, and completion stages of a project. These activities aim to control costs and ensure timely completion. Quality, safety, and time management issues have a direct impact on the cost and duration of a project (Rajprasad, 2017).

Safety management is a hierarchical function that ensures the identification, assessment, and effective mitigation of all safety risks. The primary goal of safety management in the construction business is to prevent human injury or fatalities, as well as to prevent damage to the environment and property. The key determinants of safety performance are robust safety

regulations, comprehensive safety training, regular safety meetings, proper safety equipment, thorough safety inspections, effective safety incentives and penalties, workers' attitudes towards safety, and labour turnover rates. An effective method to avoid wastage and reduce expenses is by implementing thorough planning and coordination, both prior to and throughout the project (Rajprasad, 2017).

Proficiency in safety management is a crucial requirement in the field of project management, as acknowledged in The Guide to the Project Management Body of Knowledge (PMBOK Guide, as referenced by Cretu et al., 2011). Safety management is responsible for considering all potential hazards and incidents that could endanger project personnel. The health and safety (H&S) of a workplace is crucial for mitigating risks, both from a legal and ethical standpoint. However, in particularly hazardous environments like the construction sector, H&S assumes a paramount significance due to the inherently harmful nature of daily activities. Therefore, it is crucial to determine appropriate safety measures and tactics that can address potential significant health and safety issues (Twort, 2011).

## 2.3 MACHINERY IN SITE CONSTRUCTION

building projects are increasingly getting more challenging and intricate, and the usage of standard building methods would result in project delays. The expenses incurred due to building delays have compelled developers to adopt mechanisation. Construction machinery is utilised to enhance productivity, reduce costs, execute tasks that are impractical to be done manually, minimise physical exertion and weariness, sustain high output levels, and ensure timely completion of projects (Prochorov.S., 2018).

Several construction industry organisations acknowledge that equipment and machinery are crucial resources needed to successfully finish the building phase of a project. Additionally, these limitations are inherent and require efficient management to avoid impeding the overall project's advancement. Individuals in the construction business are aware that any delays in the

deployment of plant and machinery might unintentionally cause unneeded disruptions in the project's progress, ultimately impacting the completion time of construction projects (Zahara.M., 2007).

Effective management of plant and machinery necessitates a clear understanding and definition of these assets, as well as the associated management principles, as they distinctly vary from the administration of other construction resources. Both hired and owned equipment require effective administration due to their crucial roles in fulfilling business demands. A significant number of construction companies relied extensively on rented equipment, necessitating efficient supervision at work sites. This would guarantee that they are not remaining inactive on sites as a result of material supply delays or delays in other project phases (Zahara.M., 2007).

The whole productive output in contemporary industry relies on the use of equipment and machinery. Therefore, they constitute a highly significant component of the industrial sector. Consequently, the inactivity or lack of use of equipment and machinery incurs significant costs. Therefore, it is crucial to ensure adequate maintenance of the plant gear. The majority of maintenance expenditures are typically attributed to the operation of a certain item. Peurify and Schexnayder (2002) also describe it as the most significant proportion of expenses associated with the complete lifespan of the equipment. The allocation provided was as follows: 25% for depreciation, 15% for overhead, 23% for operational costs, and 37% for maintenance and repair (Phadatare D. C., 2016).

## 2.4 MAINTENANCE OF MACHINERY ON SITE CONSTRUCTION

During maintenance, it is crucial to preserve the original shape of individual components to maximise safety and production efficiency. The scope of work encompasses inspection, adjustment, and maintenance, as well as extensive repairs and overhauls conducted in the main workshop. Additionally, minor repairs are carried out on-site, and appropriate measures are taken for machines that are temporarily out of service (Phadatare D. C., 2016). Figure 2.0 depicts the maintenance process. During the process of work identification,

locate the specific equipment that requires maintenance and determine the specific sort of maintenance that is needed. In the process of work planning, it is essential to outline the specific procedures for conducting maintenance on the equipment, determine the necessary time for the maintenance work, and establish a timeline for its execution. Upon the completion of all planning and scheduling, the actual execution of work commences. Document the tasks carried out on the equipment and include them in the maintenance logbook. Conduct an analysis of the work to determine its level of performance. If it is not performing well, then begin the process again by identifying the work.

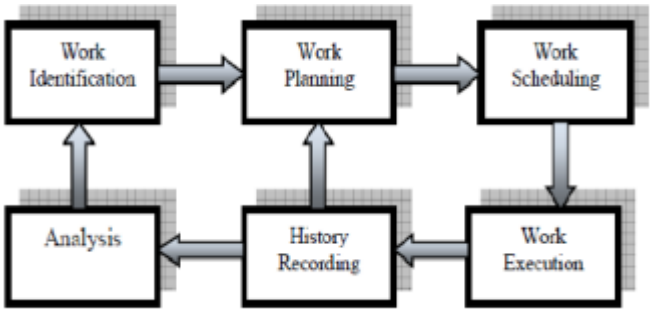



**Figure 2.1:** Maintenance Process

(Source: Construction Engineering and Management, Khanna Publication)

## 2.5 MAINTENANCE AND TEST PROCEDURES

Maintenance activities fall into three general categories (Pietersen, 2009):

### 2.5.1 Routine Maintenance

Activities conducted during the functioning of equipment and systems. These activities are predictable and can be scheduled and budgeted for. Usually, these tasks are scheduled either based on time or metre readings, as decided by preventative or predictive maintenance protocols. Some examples of maintenance duties comprise visual inspections, cleaning, functional tests,

measurement of operational quantities, lubrication, oil tests, and governor maintenance.

### 2.5.2 Maintenance Testing

Non-operational system evaluation activities that employ test equipment to assess the condition of a system. These activities are predictable and can be strategically scheduled and budgeted. They can be scheduled according to either time or distance, but they can also be intentionally coordinated to coincide with planned equipment maintenance periods. Due to the predictability of these activities, many offices classify them as either "routine maintenance" or "preventive maintenance." Illustrative instances encompass the synchronisation of governors and the examination of both balanced and unbalanced gates.

### 2.5.3 Diagnostic Testing

Activities involving the use of test equipment to assess the condition of equipment after anomalous events, such as equipment failure, repair, replacement, or when equipment deterioration is suspected. These procedures are fundamentally unpredictable and cannot be preplanned as they are necessitated by a forced outage. Each office must designate cash for these events. Illustrative instances encompass governor diagnosis, unit equilibrium, and vibration examination.

## 2.6 TYPE OF MACHINERY MAINTENANCE

Machinery Maintenance activities fall into four general categories (Phadatare D. C., 2016):

i. Reactive Maintenance – A maintenance system that repairs after breakdown occurs in equipment.

ii. Preventive Maintenance – A maintenance system that uses maintenance procedures to prevent breakdown by following a procedural approach with schedules and guidelines.

iii. Predictive Maintenance – In predictive maintenance, online condition monitoring helps identify when wear- out risk starts to increase and anticipate when failure is likely to occur. It is an equipment condition rather than time intervals which determine the need for service.

iv. Proactive Maintenance – Proactive maintenance based on data provided by predictive methods to identify problems and isolated the source of failure. To find out the root cause of the failure, proactive maintenance is use.

## 2.7 CHECKLIST FOR MACHINERY MAINTENANCE

A property maintenance checklist is a compilation of duties that an internal maintenance team must regularly fulfil in order to ensure the appropriate functioning and upkeep of a facility, machine, or system. Typically, it encompasses operations such as inspection, cleaning, lubrication, and repair. Implementing a maintenance checklist can effectively minimise employee downtime and the need for emergency repairs, while simultaneously enhancing the longevity of the equipment (Property Meld, 2023). Maintenance checklists are a crucial instrument for assuring the appropriate upkeep of equipment and timely completion of duties by maintenance crews. Checklists can enhance efficiency and cost-effectiveness by facilitating the prompt identification and resolution of potential challenges (Ework Orders, 2023).

Maintenance checklists are vital since they guarantee the safe and effective operation of a machine, equipment, or facility. They offer a thorough inventory of routine chores to frequently perform in order to guarantee the equipment's optimal functionality and eliminate any potential safety risks. Compiling a comprehensive list of routine maintenance obligations can assist in detecting potential issues that technicians must promptly resolve to prevent them from escalating into hazardous or expensive situations. Developing a

standardised maintenance checklist is essential for the management of a property maintenance crew and ensuring the satisfaction of residents (Property Meld, 2023).

A preventive maintenance checklist is a comprehensive inventory of jobs, tests, and inspections that must be carried out on equipment, systems, or machinery at predetermined time intervals. The primary objective of a preventive maintenance checklist is to provide maintenance professionals with a systematic guidance to proactively inspect for potential problems, mitigate breakdowns, and ensure that equipment is consistently maintained in its optimal state (Do forms, 2023).

Preventive maintenance is a common maintenance programme employed by enterprises, alongside corrective maintenance, risk-based maintenance, and condition-based maintenance. Although each of the four maintenance programmes has distinct advantages, the proactive strategy of preventative maintenance can significantly impact the timely resolution of potential downtime risks and the mitigation of unexpected downtime. Equipment malfunction might result in avoidable periods of inactivity and have an adverse impact on your company's productivity levels. Implementing a preventative maintenance checklist can effectively mitigate this issue and prolong the operational lifespan of your equipment (Field Eagle , 2022)

Maintenance checklists are uncomplicated yet highly efficient instruments that aid in maintaining organisation, guaranteeing routine inspections, and averting the oversight of crucial jobs. Implementing a checklist for machinery maintenance helps guarantee that duties are executed uniformly and in accordance with the prescribed criteria. The regularity of using checklists minimises the likelihood of unforeseen malfunctions and safety concerns. Additionally, the allocation of specific tasks to accountable team members is facilitated by checklists, guaranteeing that each individual is aware of their responsibilities in the maintenance procedure. In addition, checklists offer a concise documentation of maintenance tasks, facilitating the monitoring of equipment history, adherence to regulations, and performance trends throughout the duration. Technicians can enhance their efficiency and conserve time and

costs by adhering to a checklist. Furthermore, the implementation of routine inspections and maintenance, aided by the use of checklists, improves safety by promptly identifying and resolving possible dangers before they escalate into significant issues (Ework Orders, 2023).

Checklists are typically a list of action items or criteria arranged in a systematic manner, allowing the user to record the presence/ absence of the individual items listed to ensure that all are considered or completed. Additionally, a machine safety checklist functions as a reference record for overseeing inventories, machine components, injuries, and other significant facts. Thoroughly documenting all machine difficulties and associated injuries facilitates the management of budget allocation, enables risk assessments, and facilitates scheduling of maintenance checks (series, 1999).

## 2.8 MACHINERY CONDITION CHECKLIST

Checklists are necessary at ALP Omega Bukit Raja Warehouse for documenting the condition of every machine. Aside from assuring the machinery's proper functioning, a checklist is also completed to establish a comprehensive record for each piece of equipment. This record serves as a valuable resource in the event of any issues or accidents arising from the machinery, enabling a thorough investigation using the stored checklist data. At this construction site, every machine possesses its individual checklist form, yet there are also multiple machine kinds that use the same checklist form. This site contains a total of six checklist forms, specifically for excavators, backhoes, crane operators, cranes, boom lifts/ scissor lifts, and crawler cranes. All of these checklists must be completed comprehensively on an initial, weekly, or monthly basis.

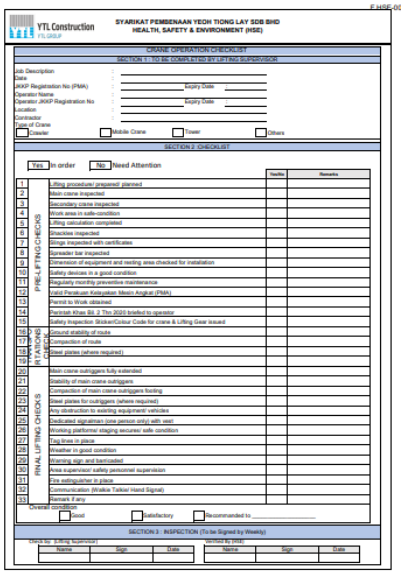

SYARIKAT PEMBENAAN YEOH TIONG LAY SDB BHD
HEALTH, SAFETY & ENVIRONMENT (HSE)
CRANE OPERATION CHECKLIST
SECTION 1 : TO BE COMPLETED BY LIFTING SUPERVISOR
SECTION 2 :CHECKLIST
SECTION 3 : INSPECTION (To be Signed by Weekly)

**Figure 2.2:** Example of checklist used in ALP Omega Bukit Raja Warehouse

## 2.9 TYPE OF MACHINERY ON SITE CONSTRUCTION

Construction equipment, sometimes known as heavy equipment, pertains to robust, self-propelled vehicles specifically engineered for carrying out construction operations. The utilisation of this technology plays a crucial role in the successful completion of civil projects, making it a substantial investment for the construction sector. In this study, the acronym CE denotes the equipment specifically designed for earth-moving tasks, such as excavators, dump trucks, loaders, compaction rollers, graders, scrapers, and others. The earthworks primarily involve four fundamental procedures: excavation, transportation, distribution, and compaction (Peurifoy, 1985). The common types of construction Machinery to be discussed in this chapter are:

### 2.9.1 Tower Crane

Tower cranes are a contemporary variation of balance cranes, with same fundamental components. Tower cranes are often anchored to a concrete slab and occasionally mounted to the sides of structures. They offer an optimal mix of height and lifting capacity, making them ideal for the construction of tall

buildings. Subsequently, the base is affixed to the mast, so providing the crane with its vertical dimension. Additionally, the mast is connected to the slewing unit, which consists of gears and a motor, enabling the crane to revolve. The slewing unit consists of three primary components: a lengthy horizontal jib (working arm), a shorter counter-jib, and the operator's cab.

The lengthy horizontal jib is the component of the crane responsible for bearing the weight. The counter-jib of a crane supports a counterweight, often made of concrete blocks, while the jib is responsible for suspending and moving the load towards and away from the crane's centre. The crane operator can either be situated in a cab located at the apex of the tower or operate the crane using a radio remote control device from the ground. Typically, in the initial scenario, the operator's cab is positioned at the highest point of the tower, connected to the turntable. However, it is also possible for the cab to be installed on the jib or at a midpoint along the tower. The crane operator utilises electric motors to control wire rope cables through a system of sheaves in order to operate the lifting hook. The hook is positioned on the elongated horizontal arm, serving the purpose of elevating the weight, and also housing its motor.

**Figure 2.3:** Tower Crane

### 2.9.2 Mobile Crane

Mobile cranes are affixed to wheeled vehicles, such as trucks, and possess great mobility on roadways. These vehicles have the capability to be transported to multiple areas, which enhances their adaptability for a wide range of work sites.Mobile cranes are renowned for their rapid installation and manoeuvrability, rendering them well-suited for tasks necessitating frequent repositioning. They are frequently employed for various lifting operations in

building, infrastructure, and maintenance endeavours. Mobile cranes are available in different variations, including truck-mounted cranes, rough terrain cranes, and all-terrain cranes. Each variety is specifically built to operate in particular situations and has its own lifting capacities.

**Figure 2.4:** Mobile Crane

### 2.9.3 Crawler Crane

A crawler refers to a type of crane that is equipped with an undercarriage and a series of tracks, also known as crawlers, which serve the purpose of ensuring both stability and mobility. Crawler cranes have a lifting capacity that varies from approximately 35.7 to 3,125.0 tonnes (Peurifoy, 1985). Crawler cranes has both benefits and drawbacks, contingent upon their use. The primary benefit of these cranes is their mobility and ability to execute lifts with minimal preparation. This is due to the crane's stability on its tracks, eliminating the need for outriggers. Furthermore, a crawler crane possesses the ability to transport a load while in motion. A primary drawback is their substantial weight, which hinders its portability and necessitates considerable expenditure for relocation between different work sites. Usually, a sizable crawler needs to be dismantled and transported by trucks, rail carriages, or ships to its subsequent destination.

**Figure 2.5:** Crawler Crane

### 2.9.4 Boom lift

A boom lift, alternatively referred to as a cherry picker or aerial work platform, is specifically engineered to raise workers in order to reach elevated regions. The device features a telescopic arm or boom that may be extended, with a platform located at its tip. Typically employed for activities such as maintenance, building, painting, and other duties that require personnel to reach elevated areas that are challenging to access using a ladder.

**Figure 2.6:** Boom Lift

### 2.9.5 Scissor Lift

A scissor lift is a platform that can be vertically elevated by means of a folding mechanism like crossed scissors. It offers a secure and steady surface for both people and equipment at different elevations. Employed for duties akin to boom lifts, encompassing maintenance, building, and installation operations. Scissor lifts are particularly advantageous in situations when a stable and spacious platform is needed.

**Figure 2.7:** Scissor Lift

### 2.9.6 Backhoe

A backhoe is a versatile piece of heavy equipment that combines a digging bucket on the back with a loader on the front. It is capable of doing duties such as digging, excavating, lifting, and loading. Frequently employed in building, excavation, landscaping, and other earthmoving endeavours. The backhoe's excavation and loading capabilities render it highly valuable for a multitude of jobs on building sites.


**Figure 2.8:** Backhoe

### 2.9.7 Forklift

Forklifts are specialised industrial vehicles that are equipped with fork-shaped prongs that have the capability to be elevated and lowered. These devices are specifically engineered for the purpose of elevating and transporting substantial loads across limited distances. Forklifts are extensively utilised in warehouses, manufacturing facilities and construction sites to perform duties such as pallet loading and unloading, material stacking and heavy item transportation.

**Figure 2.9:** Forklift

### 2.9.8 Excavator

An excavator is a robust construction apparatus equipped with a hydraulic arm that terminates in a bucket. This tool is employed for excavating, creating trenches, and performing various duties related to moving earth. Excavators play a vital role in several building endeavours, such as excavating foundations, digging trenches, and clearing away rubbish. They are available in various dimensions, ranging from miniature mini-excavators to massive, heavy-duty machines.

**Figure 2.10:** Excavator

## 2.10 MOBILE TECHNOLOGY ON SITE CONSTRUCTION INDUSTRY

The construction sector plays a significant role in our economy. It addresses the infrastructure needs of several sectors. However, the construction sector can't accomplish effective operations and proper administration without the coordination of professionals. In our current epoch, nearly every sector has embraced mobile technology to optimise their day-to-day operations. Currently, all construction-related tasks may be performed using smartphones and tablets. A smart mobile application is capable of both transmitting information and managing inventory.

The construction sector relies heavily on the transmission and transfer of important information throughout the duration of a project, making it highly information-intensive (Chen, 2011). The introduction of mobile devices to construction sites took place in the 1990s, with rudimentary functionalities. The utilisation of construction technologies has significantly surged with the advent

of the iPad and comparable gadgets. Several prominent construction firms in the United States equip their project managers and superintendents with mobile devices exclusively for construction operations (Sattineni.D.A., 2015).

The integration of mobile technologies is a significant recent advancement in building project management. The utilisation of mobile phones has been one of the many developments that have significantly influenced worldwide society (Eyong.C., 2013). The fundamental project management tools that aid in preventing or eliminating kickbacks throughout various stages of construction projects, such as planning, designing, and building, are being developed and implemented on tablets, smartphones, and other mobile devices. The construction sector has a primary goal of enhancing production and efficiency (M. Abdel-Wahab, 2011). Utilising intelligent and portable tools and technology in construction management and application can enhance the project's efficiency, quality, and production.

## 2.11 SURVEY QUESTIONNAIRE

A questionnaire is essentially a prearranged list of questions given to interviewees together with explicit guidelines outlining the format and requirements for selection. This instrument has notable adaptability in diverse research fields, including survey research and experimental design. It furnishes investigators with a methodical framework to methodically acquire insights for the purpose of data collecting and analysis (J & A, 2020) .

The researcher outlines the multidimensional role of questionnaires in research. They function as tools for obtaining and recording data on certain areas of interest, with an emphasis on matching the goal of the questionnaire with the goals of the study and guaranteeing clarity regarding the application of results. Primarily designed to fulfill quantitative research requirements, structured questionnaires allow numerical data to be gathered via a variety of survey forms, including postal, electronic, in-person, and telephone. These questionnaires are essential for gathering factual data, comprehending behaviors, assessing group attitudes, assessing customer satisfaction, and setting baseline data for

longitudinal research. They can be self-completed or given by interviewers (Albuam & Oppenheim, 1993) .

According (J & A, 2020) expound upon the four primary roles that questionnaires play in the research process. According to the, questionnaires help collect data by using standardized questions and they also help arrange interviews in a methodical manner that guarantees efficiency and uniformity. Additionally, the authors point out that questionnaires give structured information necessary for the evaluation of both quantitative and qualitative data, so making a substantial contribution to the research attempt. They also establish uniform ways for collecting replies, helping successful data analysis.

# CHAPTER 3

# METHODOLOGY

## 3.1 INTRODUCTION

The introduction to the methodology part of a research paper or thesis generally offers a concise summary of the research methodologies and approaches used in the study. The initial part of this section should provide a concise and explicit statement of the research question or hypothesis, followed by a justification for the appropriateness of the selected methodology in addressing the research topic. The research design provides a clear overview, specifying which is a qualitative approach. In addition, the data collection techniques employed, such as surveys and interview, and acknowledge any tools or devices utilised.

This chapter will presently provide a detailed explanation of the methodology employed. The content mostly covers elements such as the research design, methodology, and data gathering processes. Furthermore, it will address the process of choosing appropriate systems on the selected platform. The primary aim of this study is to investigate the current research, encompassing pertinent literature, references, interviews, interpersonal interactions, and other essential elements.

## 3.2 RESEARCH METHODOLOGY

Research methodology refers to a structured approach used to address a problem. It is the discipline that investigates the methodology of conducting research. Research methodology refers to the procedures that researchers use to describe, explain, and forecast events. It is also defined as the study of methods

by which knowledge is gained. Its aim is to give the work plan of research (Goundar, 2012).

Research methodology, within the realm of academic and scientific research, pertains to the methodical approach and collection of processes that govern the entirety of the research process. Research methodology refers to the systematic approach employed by researchers to examine and investigate their selected subjects, collect pertinent data, scrutinize the results, and derive significant conclusions. The research methodology serves as the fundamental basis for establishing trustworthy and dependable research. It encompasses critical choices on the design of research, methods for collecting data, procedures for sampling, and instruments for analyzing data. Research methodology offers a systematic framework for researchers to navigate the intricate process of inquiry and knowledge generation, ultimately contributing to the progress of science and our comprehension of the world.

Research methodology can be categorized as either quantitative, which involves the measurement of occurrences under specific conditions, or qualitative, which involves the collection of subjective opinions and feelings from individuals regarding a particular scenario. Optimally, thorough investigation should aim to integrate qualitative approaches. Research procedures are commonly employed in academic research to empirically examine hypotheses or theories. An effective design should guarantee the validity of the study, meaning that it accurately examines the hypothesis while minimizing the influence of extraneous variables. Additionally, it should assure the reliability of the research, producing consistent results with each repetition.

Qualitative research methods were created in the field of social sciences to facilitate the examination of social and cultural phenomena by researchers. Qualitative research approaches include action research, case study research, and ethnography. Qualitative data sources encompass many methods such as observation, participant observation (fieldwork), interviews, questionnaires, documents, texts, as well as the researcher's impressions and reactions (Myers 2009).

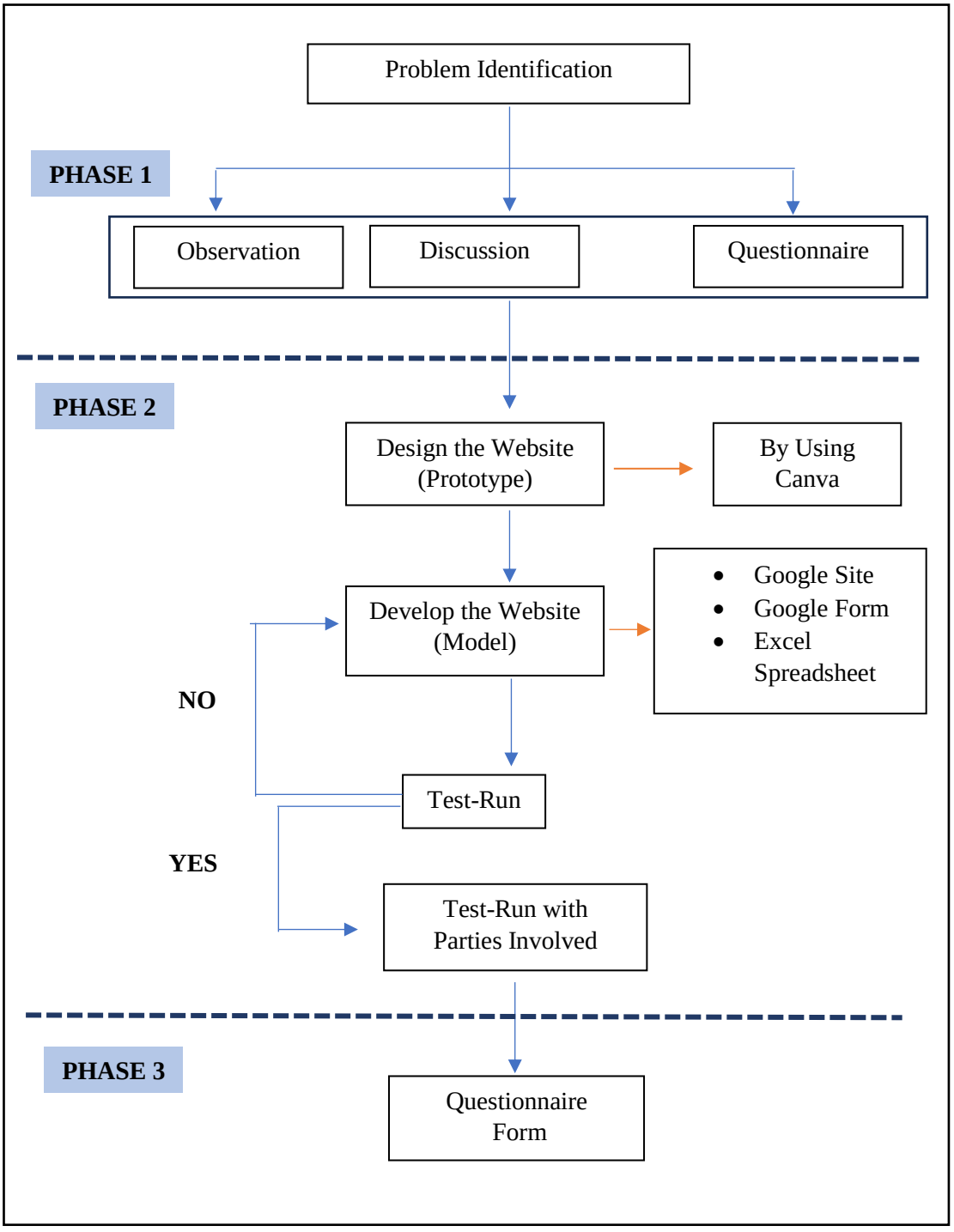



**Figure 3.1:** Flow Chart Methodology of E-Machinery Inspection Checklist

Figure 3.1 depicts the E-Machinery Inspection Checklist procedure using a flow chart. The objective of this approach is to achieve the project's goals and generate optimal outcomes in terms of profitability. This study will provide an in-depth explanation of the precise research procedures that were implemented. The objective of this chapter is to examine the different elements related to the implementation of research, such as the target population, the framework for studying this population, and the sampling technique employed for conducting interviews.

The flow chart outlines a series of consecutive stages that must be followed in order to carry out this study. The first phase is utilising a qualitative methodology, wherein data is gathered by monitoring activities in the building site environment to assess any observed concerns on the site. Subsequently, initiate a dialogue with the relevant parties to get information and viewpoints pertaining to the settlement of the matter. Subsequently, provide a questionnaire to elicit the user's perspectives on the proposed implementation of the programme. In the second stage, the task at hand is to create the application by identifying and specifying the essential components and information required for the intended user. Afterwards, continue with the development of the application to guarantee its usability. To evaluate the effectiveness of the application, it is important to carry out research with experts and run the questionnaire for the third phase to get confirmation for the effectiveness of the application.

## 3.3 DEVELOPMENT OF RESEARCH

The initial phase elucidates the process of gathering information and defines the essential components necessary for implementation in the website.

### 3.3.1 Observation

Observation is the process of collecting data or information by carefully observing and recording certain phenomena, events, or objects. The main purpose of observation is to understand a situation or phenomenon by involving direct observation. Finding out about the incident and information at the ALP Omega Bukit Raja warehouse location begins with observation. While research is seen in many departments, the safety department is given precedence for this particular study. Besides, the observation also refer on several journal and article for obtain more information about the problem occur on site construction.

### 3.3.2 Interview

Design thinking can be a viable approach when gathering information. Its initial phase focuses on obtaining information sources from the individuals in one's vicinity through observation, engagement (interviews), and attentive listening. Conducting interviews with users and observing their behaviour in their natural environments are essential components of the Empathise stage of design thinking (Siang, 2020). Hence, information pertaining to this study was acquired through an interview with the Safety and Health department about the machinery maintenance management at site, also involved a brief discussion and expression of opinion regarding the research. Furthermore, several machinery operators were interviewed regarding the difficulties they encountered while completing the checklist.

### 3.3.3 Questionnaire

A questionnaire is a research instrument used to collect data from respondents in the form of written responses to a series of questions. Questionnaires are usually designed to obtain quantitative information, although there are also questionnaires that can be used to collect qualitative data.

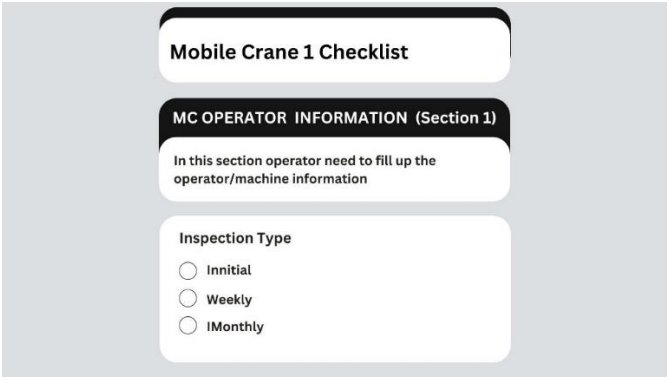
Questionnaire is done at the first stage to ensure that issues related to machinery maintenance are a problem faced at the construction site. These questions are specifically to be answered by the safety and health officer and the machinery operator. The question for first phase are attached in Appendix 1.

## 3.4 PROTOTYPE (SYSTEM DESIGN)

A prototype is an initial iteration or model of a product that is utilised for the purposes of testing, assessment, and showcasing prior to the complete manufacturing or launch of the ultimate product. A prototype is a physical or virtual model that enables designers, engineers, and stakeholders to visually and analytically evaluate the essential characteristics, functionality, and design components of a product. Prototyping is an essential stage in the product development process, as it enables the identification of potential problems, collection of user input. The data required for this application is based on the checklist by safety and health department and manual machinery maintenance as specified by the machinery brand.

**Table 3.1:** Prototype for the E-Machinery Inspection Checklist

| | |
|---|---|
|  | **The first page of Website:**<br>- Title of project<br>- The machinery Checklist History in Excel<br>- Navigation bar |

| | |
|---|---|
|  | **From Navigation Bar (Any Machinery Checklist):**<br>- Operator Information<br>- checklist (Google Form) |
|  | **Checklist Form:**<br>- Operator can fill up the checklist by section depends on types of machinery |

## 3.5 SYSTEM DEVELOPMENT

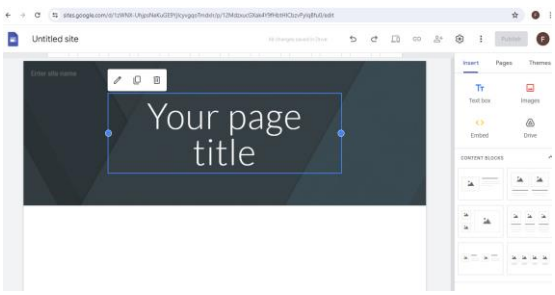
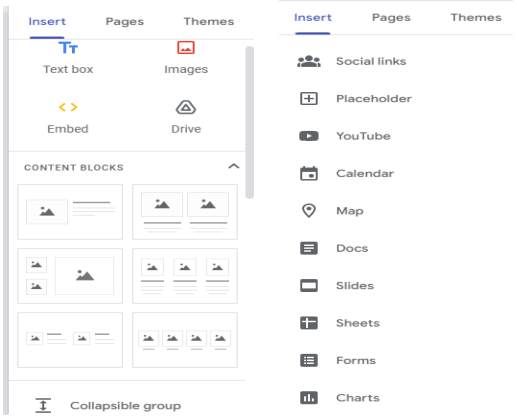
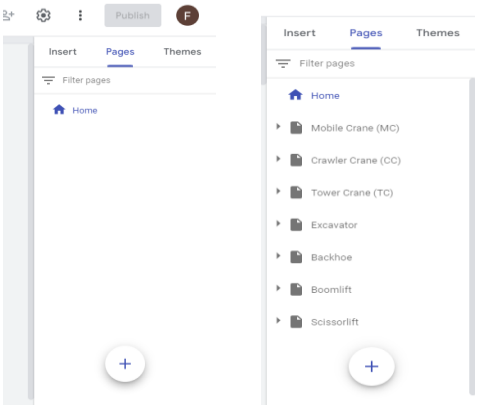
This application paradigm is made up of three fundamental elements, namely the computer, the networks, and the mobile applications. For the purpose of constructing this application, the technique that is proposed entails making use of an Excel spreadsheet as the database management system, utilise google site as the website builder, and google form for the purpose of data resource.

### 3.5.1 Google Site

Google site is used as a website builder for the collection of information about machinery management at the construction site within a platform. This website stores information about the machinery used on the site as well as

operator information, it also has a google form for the convenience of operators to check the condition of their machinery and there is an excel spreadsheet where all data about the condition of machinery is stored.

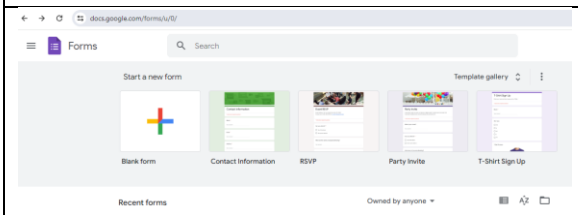
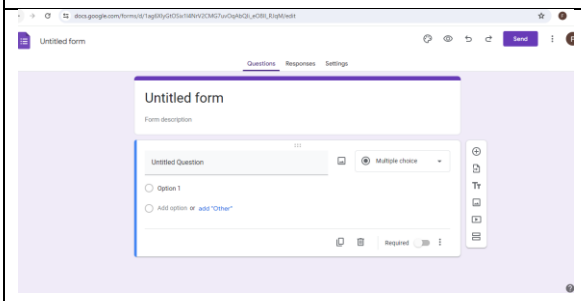
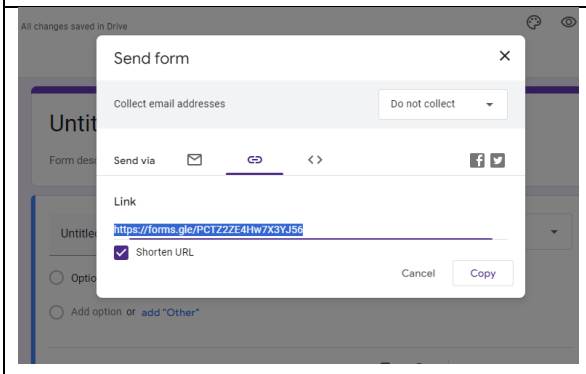
**Table 3.2:** Website Development

| Development | Description |
|---|---|
|  | First step is open the google site, then customize the site by editing the text, adding images and insert all the necessary things. |
|  | Customize the design and layout of site using the built-in tools. Also can change fonts, colors, backgrounds, and layouts to create a unique look and feel for the site. From the side bar can attach file from checklist data spreadsheet. |
|  | Organize site by adding multiple pages. Click on the "Pages" option in the sidebar to add new pages, rename existing ones, or rearrange the page order. Form the sub title, also link the google form of checklist machinery condition. |

### 3.5.2 Google Form

Google Forms is a user-friendly tool that allows users to create customizable surveys, quizzes, and questionnaires. Its intuitive interface allows users to add questions, images, videos, themes, and templates. Forms can be shared, collected, and organized in Google Sheets, providing real-time data access and analysis. It integrates with other Google Workspace applications for collaboration and efficient data management. Google form is used as a retrieval of information related to the condition of the machinery used on the construction site, also known as a checklist for inspecting the condition of the machinery.

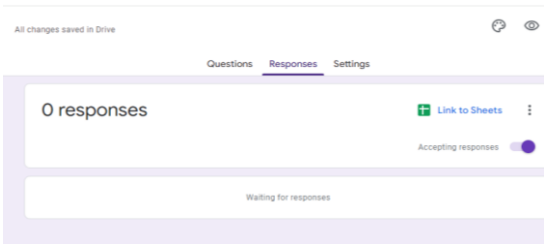
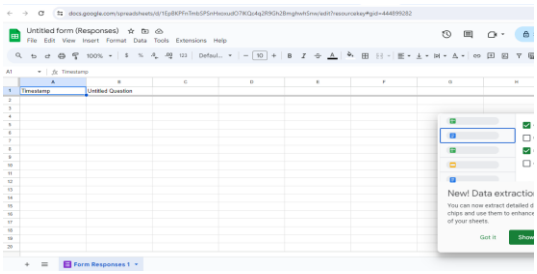
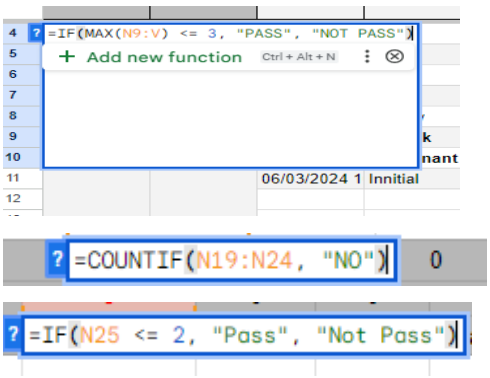
**Table 3.3:** Inspection Checklist Development

| Development | Description |
|---|---|
|  | sign in to google form, then click on the "Blank" template to start creating a new form. |
|  | adding questions to the form by clicking on the "+ Add question" button. All the question are refer from the old checklist form. |
|  | After done develop the questionnaire, copy the link to insert in the google site. |

### 3.5.3 Excel Spreadsheet

Excel is a versatile tool for organizing, analyzing, and storing data in a tabular format. It offers formatting options, charts, graphs, sorting, pivot tables, and macros. Excel's versatility extends beyond basic data manipulation, enabling complex financial calculations, statistical analysis, and data modelling. It integrates with other Microsoft Office applications, making it a crucial tool for data-driven decision-making. Excel spreadsheet is used as a place to store data from the use of google forms, as well as it can be used as decision making for the status of machinery on site.

**Table 3.4:** Data storing Development

| Development | Description |
|---|---|
|  | on the "Responses" tab. can see the response summaries, analyze data, and export responses to Google Sheets for further analysis. |
|  | All the checklist data will automatic appear in this excel. To change the appearance, format the data cell such as color, and alignment. |
|  | After the data appear and completed custom the table in the excel, insert the formula to continue analysis the data.<br>The formula that used in the excel:<br>• =COUNTIF(R1:R8, "NO")<br>• =IF(R9 <= 2, "Pass", "Not Pass")<br>• =IF(MAX(N9:CW9) <= 2, "PASS", "NOT PASS")<br>• =COUNTIF(A1:A29, "NOT PASS")<br>• 'MC1'!D31 |

## 3.6 TESTING THE PRODUCT

A "test run" is the process of testing the product after it has been developed in order to find and address any problems, faults, or difficulties before it is made available to users. To guarantee the application's dependability, quality, and operation, this stage is essential. Only the person who produced the application is participating in this test run. If there are any issues, the programme will be rectified once again. However, if this application can run properly, the effectiveness of this web site will be tested with the parties involved in the management of machinery maintenance, namely the safety and health officer and the machinery operator.

## 3.7 DATA COLLECTION AND ANALYSIS

This stage is the final phase of the flowchart methodology that has been implemented. Regarding the evaluation of the effectiveness and suitability for usage in the construction industry of this application, this phase is an essential stage.

Following the completion of this study, a questionnaire will be sent to the safety and health department and machinery operators. The questionnaire is divided into five parts which is term of ease to use, organization of machinery inspection, effectiveness in task management, efficiency and environmental impact also intention to use. The five section in questionnaire are important to ensure the effectiveness of this google site, the questionnaire as attached in appendix B.

## 3.8 CONCLUSION

This chapter provides a detailed explanation of the research methodology employed in a study, covering elements such as research design,

methodology, and data gathering processes. Research methodology is a structured approach used to address a problem, focusing on the procedures used to describe, explain, and forecast events. It serves as the foundation for establishing trustworthy and dependable research. Qualitative research methods, such as action research, case study research, and ethnography, are used to examine social and cultural phenomena. A conceptual framework guides the design process, guiding the evaluation and improvement of goals, formulation of research questions, selection of appropriate methodologies, and identification of potential risks to the validity of results. The e-machinery condition checklist is used to accomplish the project's goals and produce the best possible results in terms of profitability

# CHAPTER 4

# RESULT

## 4.1 INTRODUCTION

The researcher should have a general understanding of the project's anticipated results from this chapter. As part of the pre-project planning duties, researchers carefully assessed what data will be created throughout the project's execution. Thirty respondents were given a questionnaire utilizing the quantitative approach. Excel was used to process the respondents' feedback, and a paired t-test was used to analyze the data and determine the two-dependent means. The following goals are anticipated to be accomplished by the E-Machinery Condition Checklist.

i. To identify the machineries maintenance at the site construction.
ii. To construct a website for the inspection of machinery at site.
iii. To analyze the effectiveness of the website.

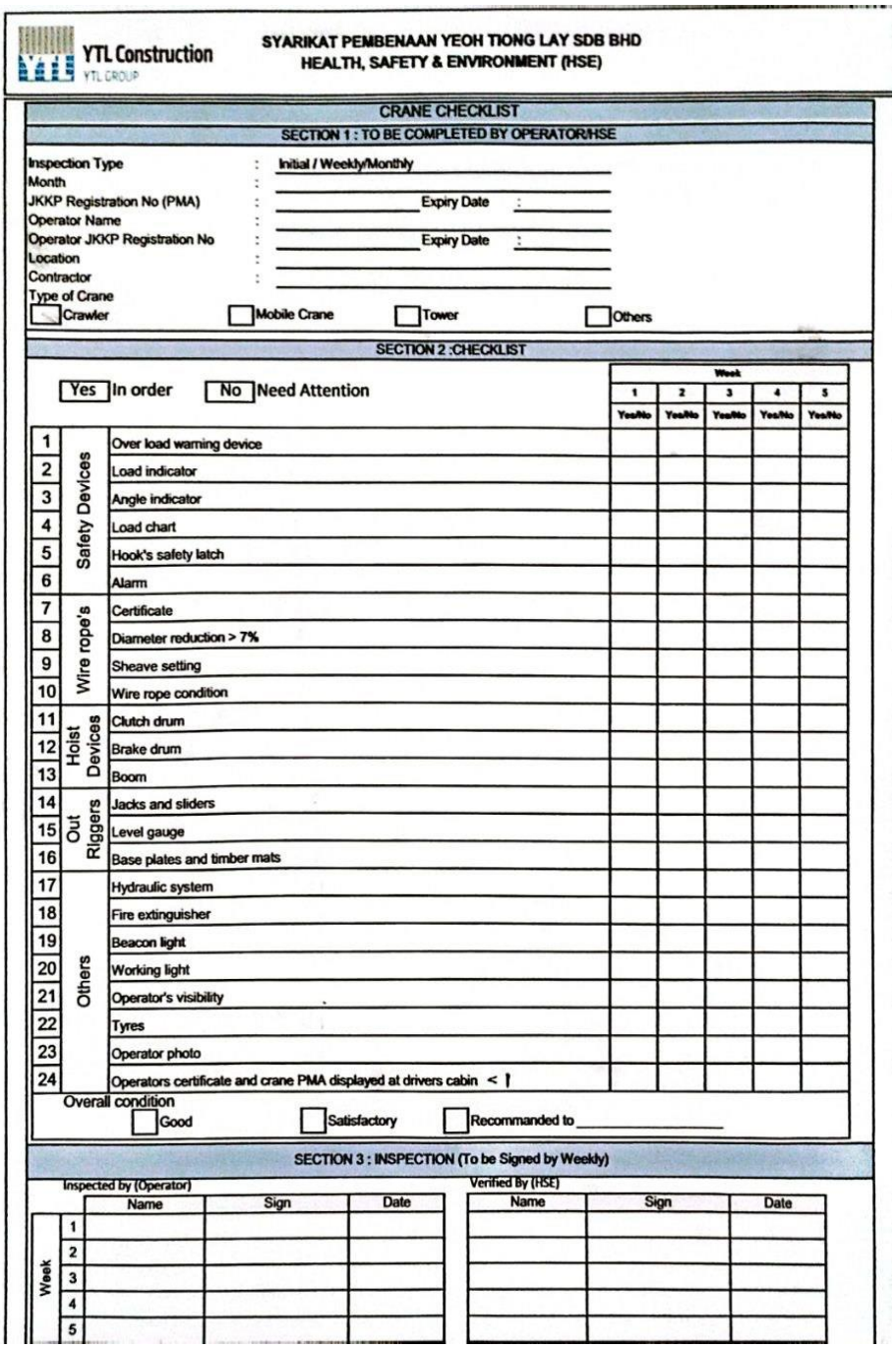
## 4.2 THE MACHINERIES INSPECTION AT SITE CONSTRUCTION

The use of machinery at the construction site is very important to complete a project according to the set time and date. The types of machinery used are according to the work conditions at the site such as lifting, excavators, bulldozers and digging. In addition, every machine that enters the site needs to check the state of their machine whether it passes the criteria set by the safety officer, which is through the state of the machine checklist. This checklist is categorized according to its type or function.

**i. Lifting (Mobile Crane, Crawler Crane & Tower Crane)**

A crane is a machine used to move materials both vertically and horizontally, utilizing a system of a boom, hoist, wire ropes or

chains, and sheaves for lifting and relocating heavy objects within the swing of its boom. As for the inspection of this machinery, it is divided into several sections, which is the inspection of machinery body components and the inspection of lifting equipment. Figure 4.1, 4.2 and 4.3 shows the Catheter required of excavation checklist.



YTL Construction
YTL GROUP

SYARIKAT PEMBENAAN YEOH TIONG LAY SDB BHD
HEALTH, SAFETY & ENVIRONMENT (HSE)

**CRANE CHECKLIST**

**SECTION 1 : TO BE COMPLETED BY OPERATOR/HSE**

Inspection Type : Initial / Weekly/Monthly
Month :
JKKP Registration No (PMA) : Expiry Date :
Operator Name :
Operator JKKP Registration No : Expiry Date :
Location :
Contractor :
Type of Crane
☐ Crawler ☐ Mobile Crane ☐ Tower ☐ Others

**SECTION 2 :CHECKLIST**

Yes In order No Need Attention

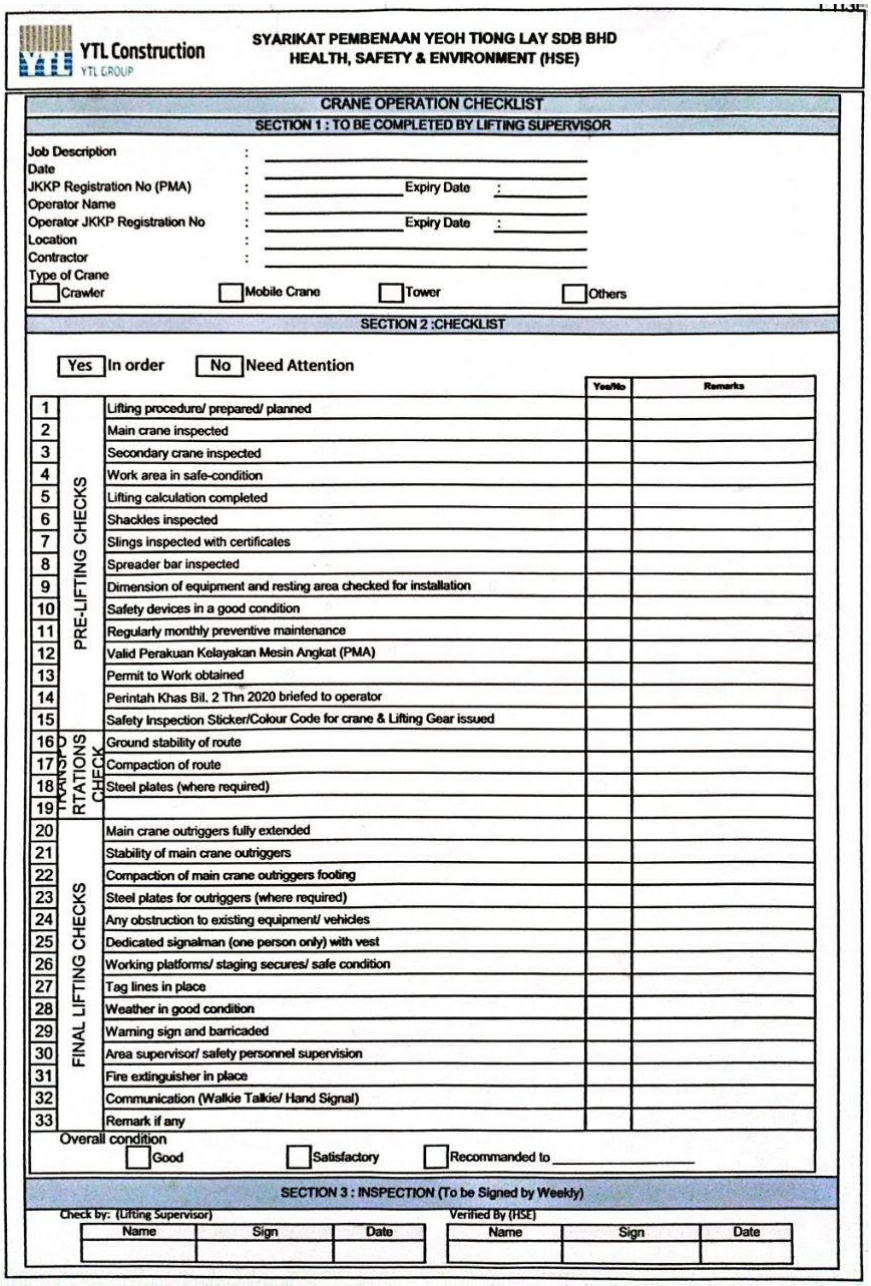
| | | | Week 1 Yes/No | 2 Yes/No | 3 Yes/No | 4 Yes/No | 5 Yes/No |
|---|---|---|---|---|---|---|---|
| 1 | Safety Devices | Over load warning device | | | | | |
| 2 | | Load indicator | | | | | |
| 3 | | Angle indicator | | | | | |
| 4 | | Load chart | | | | | |
| 5 | | Hook's safety latch | | | | | |
| 6 | | Alarm | | | | | |
| 7 | Wire rope's | Certificate | | | | | |
| 8 | | Diameter reduction > 7% | | | | | |
| 9 | | Sheave setting | | | | | |
| 10 | | Wire rope condition | | | | | |
| 11 | Hoist Devices | Clutch drum | | | | | |
| 12 | | Brake drum | | | | | |
| 13 | | Boom | | | | | |
| 14 | Out Riggers | Jacks and sliders | | | | | |
| 15 | | Level gauge | | | | | |
| 16 | | Base plates and timber mats | | | | | |
| 17 | Others | Hydraulic system | | | | | |
| 18 | | Fire extinguisher | | | | | |
| 19 | | Beacon light | | | | | |
| 20 | | Working light | | | | | |
| 21 | | Operator's visibility | | | | | |
| 22 | | Tyres | | | | | |
| 23 | | Operator photo | | | | | |
| 24 | | Operators certificate and crane PMA displayed at drivers cabin < 1 | | | | | |

Overall condition
☐ Good ☐ Satisfactory ☐ Recommanded to _____

**SECTION 3 : INSPECTION (To be Signed by Weekly)**

| Week | Inspected by (Operator) Name | Sign | Date | Verified By (HSE) Name | Sign | Date |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |

**Figure 4.1:** First Section of Crane Checklist



YTL Construction
YTL GROUP

SYARIKAT PEMBENAAN YEOH TIONG LAY SDB BHD
HEALTH, SAFETY & ENVIRONMENT (HSE)

**CRANE OPERATION CHECKLIST**

**SECTION 1 : TO BE COMPLETED BY LIFTING SUPERVISOR**

Job Description :
Date :
JKKP Registration No (PMA) : Expiry Date :
Operator Name :
Operator JKKP Registration No : Expiry Date :
Location :
Contractor :
Type of Crane
☐ Crawler ☐ Mobile Crane ☐ Tower ☐ Others

**SECTION 2 :CHECKLIST**

☐ Yes In order ☐ No Need Attention

| | | | Yes/No | Remarks |
|---|---|---|---|---|
| 1 | PRE-LIFTING CHECKS | Lifting procedure/ prepared/ planned | | |
| 2 | | Main crane inspected | | |
| 3 | | Secondary crane inspected | | |
| 4 | | Work area in safe-condition | | |
| 5 | | Lifting calculation completed | | |
| 6 | | Shackles inspected | | |
| 7 | | Slings inspected with certificates | | |
| 8 | | Spreader bar inspected | | |
| 9 | | Dimension of equipment and resting area checked for installation | | |
| 10 | | Safety devices in a good condition | | |
| 11 | | Regularly monthly preventive maintenance | | |
| 12 | | Valid Perakuan Kelayakan Mesin Angkat (PMA) | | |
| 13 | | Permit to Work obtained | | |
| 14 | | Perintah Khas Bil. 2 Thn 2020 briefed to operator | | |
| 15 | | Safety Inspection Sticker/Colour Code for crane & Lifting Gear issued | | |
| 16 | TRANSPORTATIONS CHECK | Ground stability of route | | |
| 17 | | Compaction of route | | |
| 18 | | Steel plates (where required) | | |
| 19 | | | | |
| 20 | FINAL LIFTING CHECKS | Main crane outriggers fully extended | | |
| 21 | | Stability of main crane outriggers | | |
| 22 | | Compaction of main crane outriggers footing | | |
| 23 | | Steel plates for outriggers (where required) | | |
| 24 | | Any obstruction to existing equipment/ vehicles | | |
| 25 | | Dedicated signalman (one person only) with vest | | |
| 26 | | Working platforms/ staging secures/ safe condition | | |
| 27 | | Tag lines in place | | |
| 28 | | Weather in good condition | | |
| 29 | | Warning sign and barricaded | | |
| 30 | | Area supervisor/ safety personnel supervision | | |
| 31 | | Fire extinguisher in place | | |
| 32 | | Communication (Walkie Talkie/ Hand Signal) | | |
| 33 | | Remark if any | | |

Overall condition
☐ Good ☐ Satisfactory ☐ Recommanded to _____

**SECTION 3 : INSPECTION (To be Signed by Weekly)**

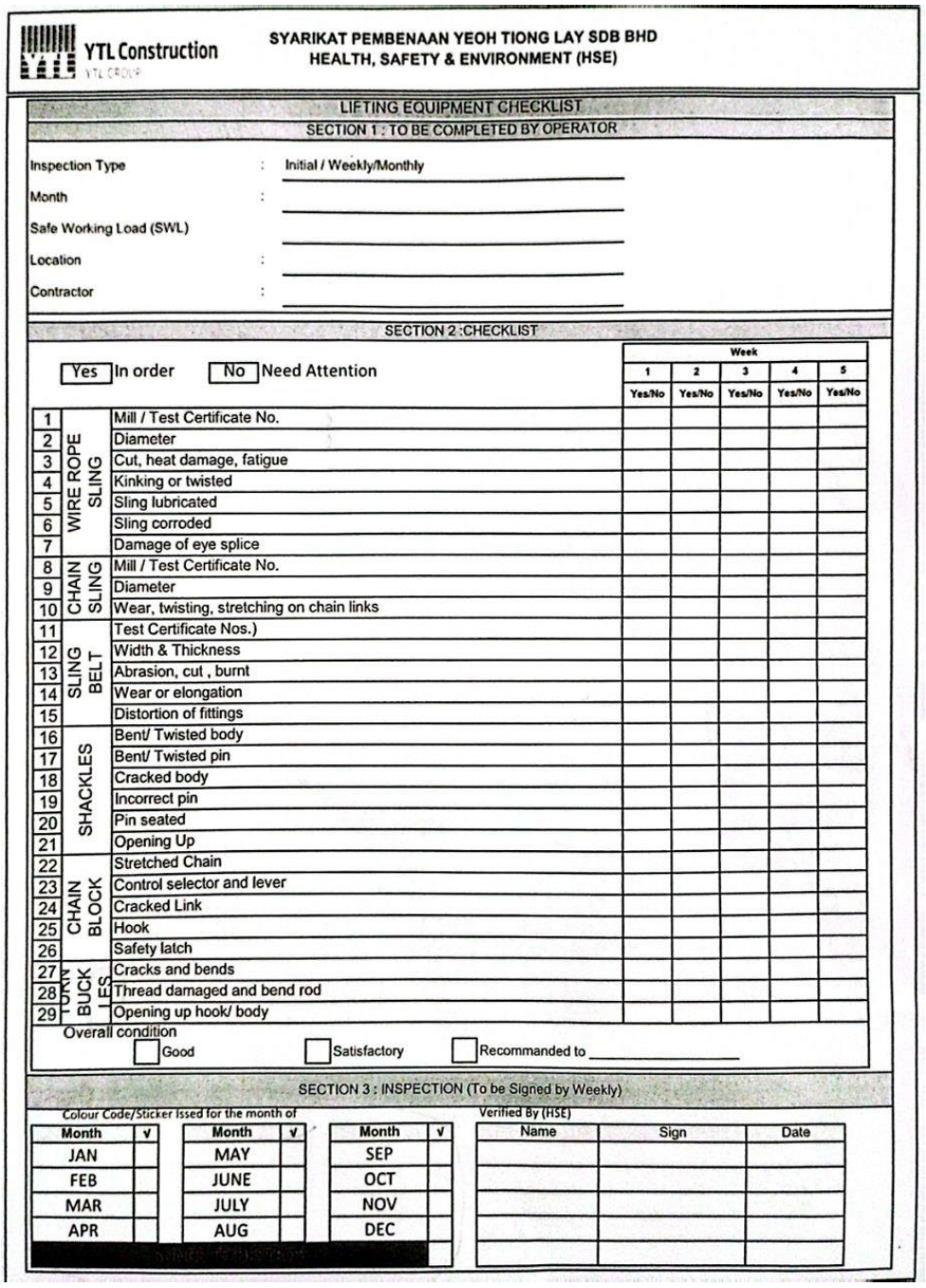
Check by: (Lifting Supervisor)

| Name | Sign | Date |
|---|---|---|
| | | |

Verified By (HSE)

| Name | Sign | Date |
|---|---|---|
| | | |

**Figure 4.2:** Second Section of Crane Checklist



YTL Construction
YTL GROUP

SYARIKAT PEMBENAAN YEOH TIONG LAY SDB BHD
HEALTH, SAFETY & ENVIRONMENT (HSE)

LIFTING EQUIPMENT CHECKLIST

SECTION 1 : TO BE COMPLETED BY OPERATOR

Inspection Type : Initial / Weekly/Monthly
Month :
Safe Working Load (SWL)
Location :
Contractor :

SECTION 2 :CHECKLIST

Yes In order  No Need Attention

| | | | Week 1 Yes/No | 2 Yes/No | 3 Yes/No | 4 Yes/No | 5 Yes/No |
|---|---|---|---|---|---|---|---|
| 1 | WIRE ROPE SLING | Mill / Test Certificate No. | | | | | |
| 2 | | Diameter | | | | | |
| 3 | | Cut, heat damage, fatigue | | | | | |
| 4 | | Kinking or twisted | | | | | |
| 5 | | Sling lubricated | | | | | |
| 6 | | Sling corroded | | | | | |
| 7 | | Damage of eye splice | | | | | |
| 8 | CHAIN SLING | Mill / Test Certificate No. | | | | | |
| 9 | | Diameter | | | | | |
| 10 | | Wear, twisting, stretching on chain links | | | | | |
| 11 | SLING BELT | Test Certificate Nos.) | | | | | |
| 12 | | Width & Thickness | | | | | |
| 13 | | Abrasion, cut , burnt | | | | | |
| 14 | | Wear or elongation | | | | | |
| 15 | | Distortion of fittings | | | | | |
| 16 | SHACKLES | Bent/ Twisted body | | | | | |
| 17 | | Bent/ Twisted pin | | | | | |
| 18 | | Cracked body | | | | | |
| 19 | | Incorrect pin | | | | | |
| 20 | | Pin seated | | | | | |
| 21 | | Opening Up | | | | | |
| 22 | CHAIN BLOCK | Stretched Chain | | | | | |
| 23 | | Control selector and lever | | | | | |
| 24 | | Cracked Link | | | | | |
| 25 | | Hook | | | | | |
| 26 | | Safety latch | | | | | |
| 27 | TURN BUCKLES | Cracks and bends | | | | | |
| 28 | | Thread damaged and bend rod | | | | | |
| 29 | | Opening up hook/ body | | | | | |

Overall condition
Good  Satisfactory  Recommanded to _____

SECTION 3 : INSPECTION (To be Signed by Weekly)

Colour Code/Sticker Issed for the month of

| Month | √ | Month | √ | Month | √ |
|---|---|---|---|---|---|
| JAN | | MAY | | SEP | |
| FEB | | JUNE | | OCT | |
| MAR | | JULY | | NOV | |
| APR | | AUG | | DEC | |

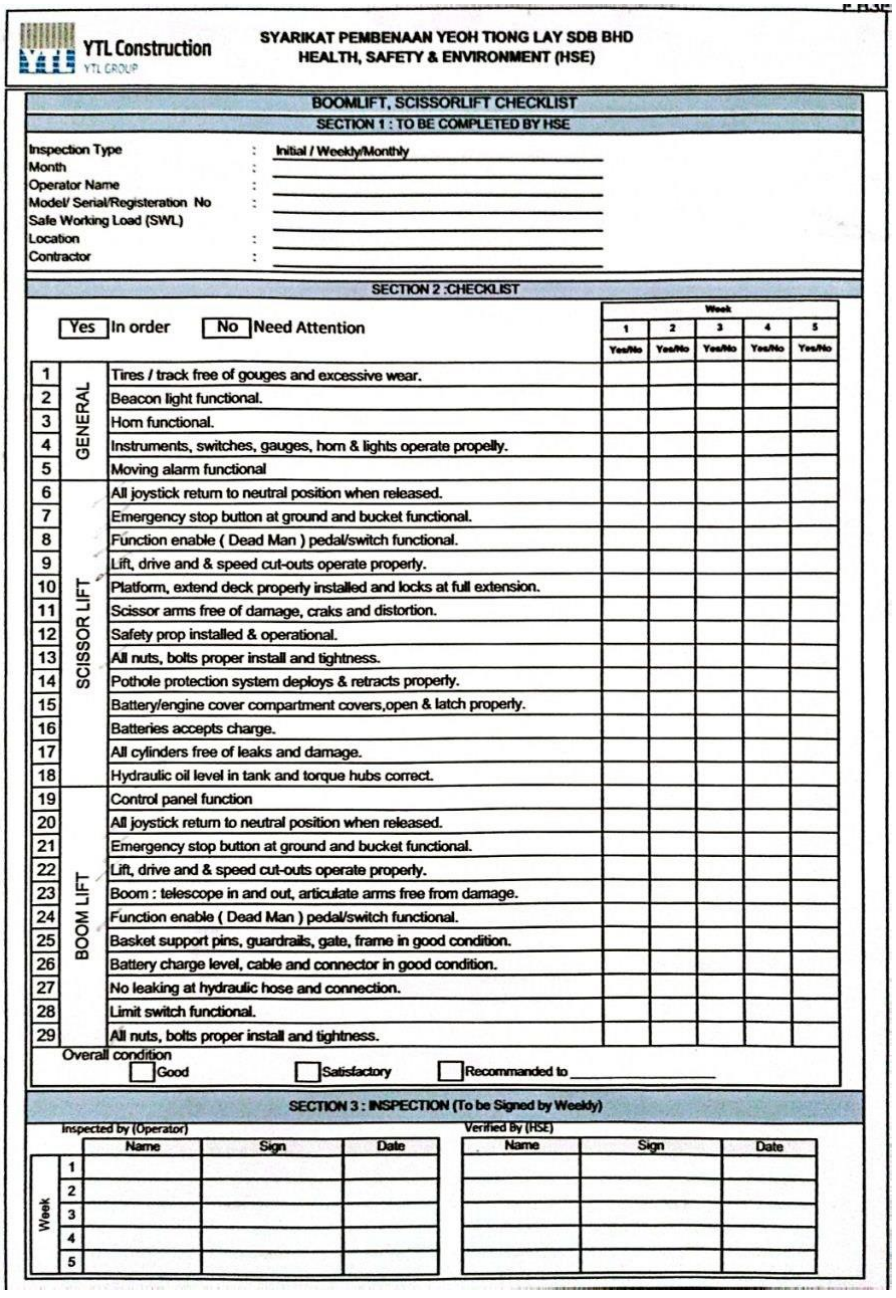
Verified By (HSE)

| Name | Sign | Date |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**Figure 4.3:** Third section of Crane Lifting Checklist

### ii. Lifter (Boom Lift)

A boom lift is a piece of lift equipment that elevates a worker in a small bucket or on a compact elevating work platform. This type of aerial lift features a grounded base and hydraulic lift system. For the inspection of the condition of this machinery, it inspects the general the boom lift part.



YTL Construction
YTL GROUP

SYARIKAT PEMBENAAN YEOH TIONG LAY SDB BHD
HEALTH, SAFETY & ENVIRONMENT (HSE)

**BOOMLIFT, SCISSORLIFT CHECKLIST**

**SECTION 1 : TO BE COMPLETED BY HSE**

Inspection Type : Initial / Weekly/Monthly
Month :
Operator Name :
Model/ Serial/Registeration No :
Safe Working Load (SWL)
Location :
Contractor :

**SECTION 2 :CHECKLIST**

Yes In order  No Need Attention

| | | | Week 1 Yes/No | 2 Yes/No | 3 Yes/No | 4 Yes/No | 5 Yes/No |
|---|---|---|---|---|---|---|---|
| 1 | GENERAL | Tires / track free of gouges and excessive wear. | | | | | |
| 2 | | Beacon light functional. | | | | | |
| 3 | | Horn functional. | | | | | |
| 4 | | Instruments, switches, gauges, horn & lights operate propelly. | | | | | |
| 5 | | Moving alarm functional | | | | | |
| 6 | SCISSOR LIFT | All joystick return to neutral position when released. | | | | | |
| 7 | | Emergency stop button at ground and bucket functional. | | | | | |
| 8 | | Function enable ( Dead Man ) pedal/switch functional. | | | | | |
| 9 | | Lift, drive and & speed cut-outs operate properly. | | | | | |
| 10 | | Platform, extend deck properly installed and locks at full extension. | | | | | |
| 11 | | Scissor arms free of damage, craks and distortion. | | | | | |
| 12 | | Safety prop installed & operational. | | | | | |
| 13 | | All nuts, bolts proper install and tightness. | | | | | |
| 14 | | Pothole protection system deploys & retracts properly. | | | | | |
| 15 | | Battery/engine cover compartment covers,open & latch properly. | | | | | |
| 16 | | Batteries accepts charge. | | | | | |
| 17 | | All cylinders free of leaks and damage. | | | | | |
| 18 | | Hydraulic oil level in tank and torque hubs correct. | | | | | |
| 19 | BOOM LIFT | Control panel function | | | | | |
| 20 | | All joystick return to neutral position when released. | | | | | |
| 21 | | Emergency stop button at ground and bucket functional. | | | | | |
| 22 | | Lift, drive and & speed cut-outs operate properly. | | | | | |
| 23 | | Boom : telescope in and out, articulate arms free from damage. | | | | | |
| 24 | | Function enable ( Dead Man ) pedal/switch functional. | | | | | |
| 25 | | Basket support pins, guardrails, gate, frame in good condition. | | | | | |
| 26 | | Battery charge level, cable and connector in good condition. | | | | | |
| 27 | | No leaking at hydraulic hose and connection. | | | | | |
| 28 | | Limit switch functional. | | | | | |
| 29 | | All nuts, bolts proper install and tightness. | | | | | |

Overall condition
Good  Satisfactory  Recommanded to _____

**SECTION 3 : INSPECTION (To be Signed by Weekly)**

| Week | Inspected by (Operator) Name | Sign | Date | Verified By (HSE) Name | Sign | Date |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |

**Figure 4.4:** Boom Lift Checklist

### iii. Lifter (Scissor Lift)

A scissor lift is a piece of equipment with a large, flat aerial work platform supported by a series of crisscrossed braces. These braces squeeze together to push the platform upward. The base of the scissor lift needs to sit on flat, stable ground directly beside the workspace for the project to be accessible to those on the lift. For the inspection of the condition of this machinery, it inspects the general and the scissor lift part.

YTL Construction
YTL GROUP

**SYARIKAT PEMBENAAN YEOH TIONG LAY SDB BHD**
**HEALTH, SAFETY & ENVIRONMENT (HSE)**

**BOOMLIFT, SCISSORLIFT CHECKLIST**

**SECTION 1 : TO BE COMPLETED BY HSE**

Inspection Type : Initial / Weekly/Monthly
Month :
Operator Name :
Model/ Serial/Registeration No :
Safe Working Load (SWL)
Location :
Contractor :

**SECTION 2 :CHECKLIST**

Yes In order  No Need Attention

| | | | Week 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| | | | Yes/No | Yes/No | Yes/No | Yes/No | Yes/No |
| 1 | GENERAL | Tires / track free of gouges and excessive wear. | | | | | |
| 2 | | Beacon light functional. | | | | | |
| 3 | | Horn functional. | | | | | |
| 4 | | Instruments, switches, gauges, horn & lights operate propelly. | | | | | |
| 5 | | Moving alarm functional | | | | | |
| 6 | SCISSOR LIFT | All joystick return to neutral position when released. | | | | | |
| 7 | | Emergency stop button at ground and bucket functional. | | | | | |
| 8 | | Function enable ( Dead Man ) pedal/switch functional. | | | | | |
| 9 | | Lift, drive and & speed cut-outs operate properly. | | | | | |
| 10 | | Platform, extend deck properly installed and locks at full extension. | | | | | |
| 11 | | Scissor arms free of damage, craks and distortion. | | | | | |
| 12 | | Safety prop installed & operational. | | | | | |
| 13 | | All nuts, bolts proper install and tightness. | | | | | |
| 14 | | Pothole protection system deploys & retracts properly. | | | | | |
| 15 | | Battery/engine cover compartment covers,open & latch properly. | | | | | |
| 16 | | Batteries accepts charge. | | | | | |
| 17 | | All cylinders free of leaks and damage. | | | | | |
| 18 | | Hydraulic oil level in tank and torque hubs correct. | | | | | |
| 19 | BOOM LIFT | Control panel function | | | | | |
| 20 | | All joystick return to neutral position when released. | | | | | |
| 21 | | Emergency stop button at ground and bucket functional. | | | | | |
| 22 | | Lift, drive and & speed cut-outs operate properly. | | | | | |
| 23 | | Boom : telescope in and out, articulate arms free from damage. | | | | | |
| 24 | | Function enable ( Dead Man ) pedal/switch functional. | | | | | |
| 25 | | Basket support pins, guardrails, gate, frame in good condition. | | | | | |
| 26 | | Battery charge level, cable and connector in good condition. | | | | | |
| 27 | | No leaking at hydraulic hose and connection. | | | | | |
| 28 | | Limit switch functional. | | | | | |
| 29 | | All nuts, bolts proper install and tightness. | | | | | |

Overall condition
Good  Satisfactory  Recommanded to _____

**SECTION 3 : INSPECTION (To be Signed by Weekly)**

| | | Inspected by (Operator) Name | Sign | Date | Verified By (HSE) Name | Sign | Date |
|---|---|---|---|---|---|---|---|
| Week | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |

**Figure 4.5:** Scissor Lift Checklist

### iv. Excavations (Excavator)

A crawler excavator is a tracked machine designed for digging, loading, earthmoving, grading, lifting and carrying jobs and is classified by its mode of locomotion. Figure 4.6 shows the Catheter required of excavation checklist.

F HSE-

YTL Construction
YTL GROUP

**SYARIKAT PEMBENAAN YEOH TIONG LAY SDB BHD**
**HEALTH, SAFETY & ENVIRONMENT (HSE)**

**EXCAVATOR CHECKLIST**

**SECTION 1 : TO BE COMPLETED BY OPERATOR**

Inspection Type : Initial / Weekly/Monthly
Month :
Vehicle Identification No :
Operator Name :
Operator CIDB Registration No : Expiry Date :
Location :
Contractor :

**SECTION 2 :CHECKLIST**

Yes In order  No Need Attention

| | | Week 1 Yes/No | 2 Yes/No | 3 Yes/No | 4 Yes/No | 5 Yes/No |
|---|---|---|---|---|---|---|
| 1 | Crawler Chain | | | | | |
| 2 | No leakage | | | | | |
| 3 | Indicator & Gauge | | | | | |
| 4 | Working Lights | | | | | |
| 5 | Beacon Lights | | | | | |
| 6 | Fire Extinguisher | | | | | |
| 7 | Brakes | | | | | |
| 8 | Horn | | | | | |
| 9 | Bucket Linkage Lubrication | | | | | |
| 10 | Cabin Cleanliness | | | | | |
| 11 | Hoisting & Boom Limit Switch | | | | | |
| 12 | Side View Mirror | | | | | |
| 13 | Coolant Level | | | | | |
| 14 | Engine Oil Level | | | | | |
| 15 | Hydraulic Oil Level | | | | | |
| 16 | Fuel Level | | | | | |
| 17 | Swing Bearing Lubrication | | | | | |
| 18 | Boom & Stick Linkage Lubrication | | | | | |

Overall condition
Good  Satisfactory  Recommanded to _____

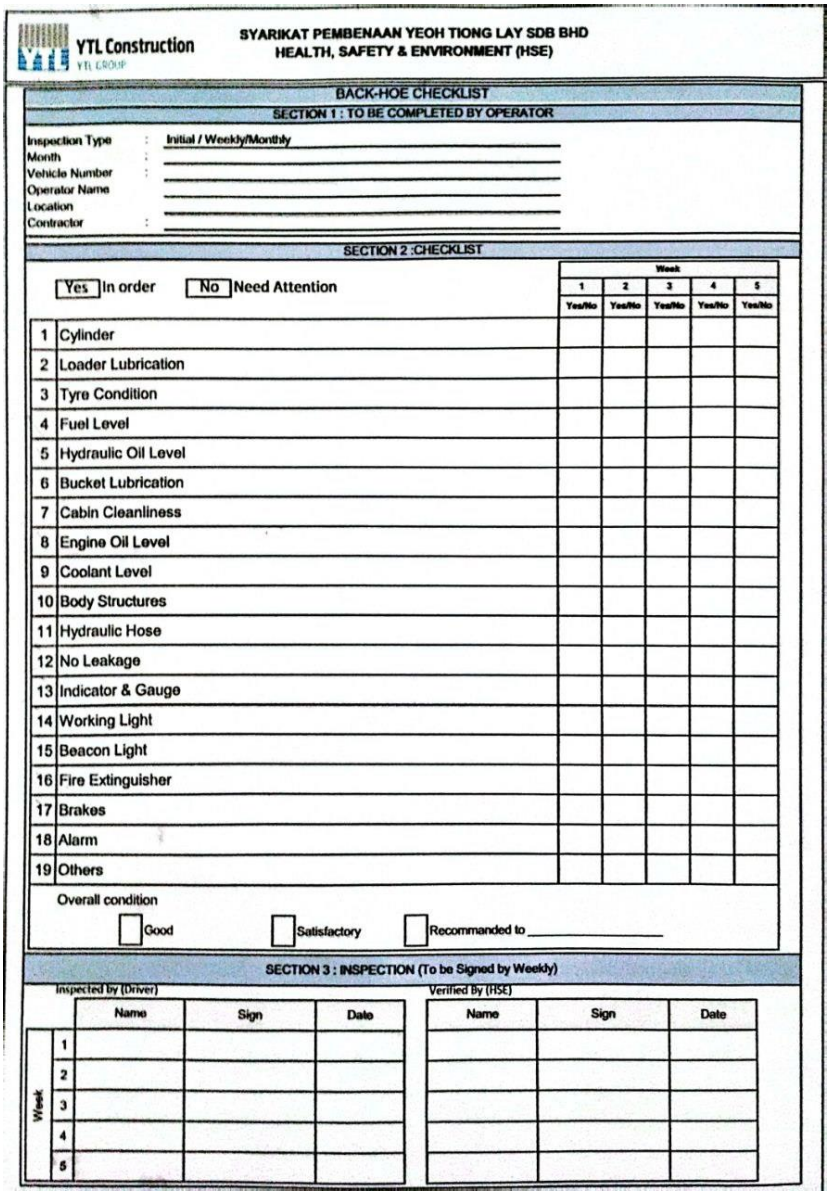
**SECTION 3 : INSPECTION (To be Signed by Weekly)**

| | Inspected by (Driver) Name | Sign | Date | Verified By (HSE) Name | Sign | Date |
|---|---|---|---|---|---|---|
| Week 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |

**Figure 4.6:** Excavator Checklist

### v. Excavations (Back Hoe)

They can tackle both flat surfaces and inclines. Backhoes are versatile. They come with a bucket and digging arm that can perform many different tasks, such as digging, small demolitions, moving materials, landscaping, breaking asphalt, and paving roads. Figure 4.7 shows the Catheter required of back hoe checklist.



YTL Construction
YTL GROUP

SYARIKAT PEMBENAAN YEOH TIONG LAY SDB BHD
HEALTH, SAFETY & ENVIRONMENT (HSE)

**BACK-HOE CHECKLIST**

**SECTION 1 : TO BE COMPLETED BY OPERATOR**

Inspection Type : Initial / Weekly/Monthly
Month :
Vehicle Number :
Operator Name
Location
Contractor :

**SECTION 2 :CHECKLIST**

Yes In order  No Need Attention

| | | Week 1 Yes/No | 2 Yes/No | 3 Yes/No | 4 Yes/No | 5 Yes/No |
|---|---|---|---|---|---|---|
| 1 | Cylinder | | | | | |
| 2 | Loader Lubrication | | | | | |
| 3 | Tyre Condition | | | | | |
| 4 | Fuel Level | | | | | |
| 5 | Hydraulic Oil Level | | | | | |
| 6 | Bucket Lubrication | | | | | |
| 7 | Cabin Cleanliness | | | | | |
| 8 | Engine Oil Level | | | | | |
| 9 | Coolant Level | | | | | |
| 10 | Body Structures | | | | | |
| 11 | Hydraulic Hose | | | | | |
| 12 | No Leakage | | | | | |
| 13 | Indicator & Gauge | | | | | |
| 14 | Working Light | | | | | |
| 15 | Beacon Light | | | | | |
| 16 | Fire Extinguisher | | | | | |
| 17 | Brakes | | | | | |
| 18 | Alarm | | | | | |
| 19 | Others | | | | | |

Overall condition
Good  Satisfactory  Recommanded to _____

**SECTION 3 : INSPECTION (To be Signed by Weekly)**

| Week | Inspected by (Driver) Name | Sign | Date | Verified By (HSE) Name | Sign | Date |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |

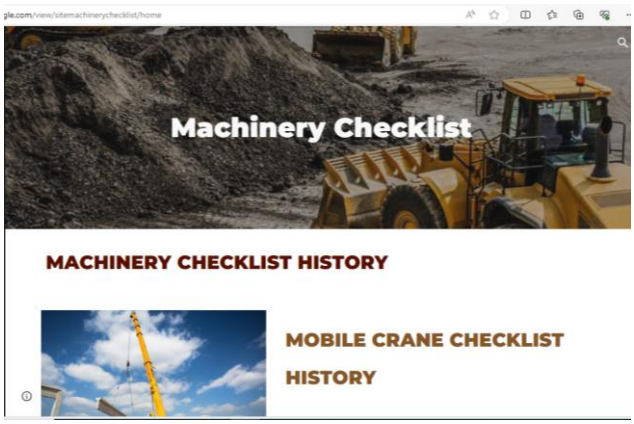
**Figure 4.7:** Backhoe Checklist

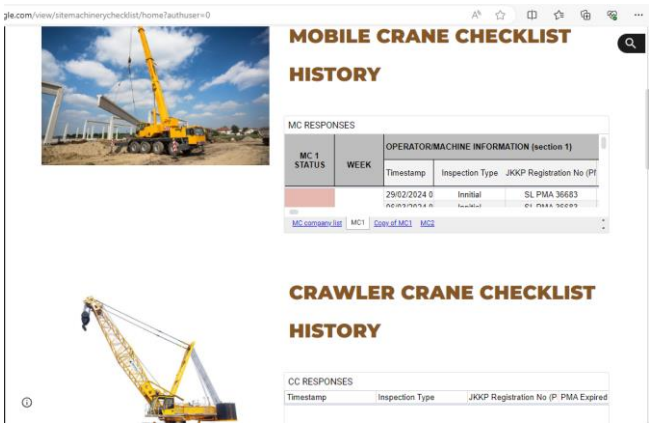
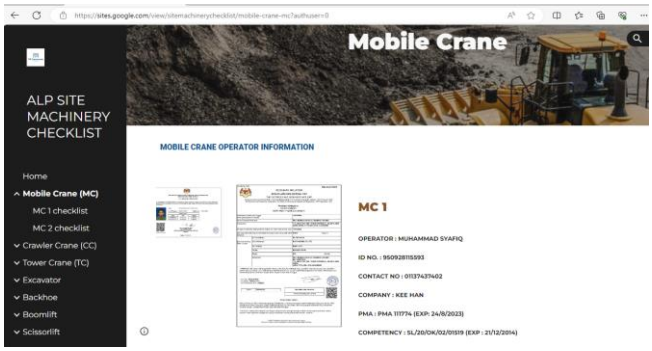
## 4.3 E-MACHINERY INSPECTION CHECKLIST

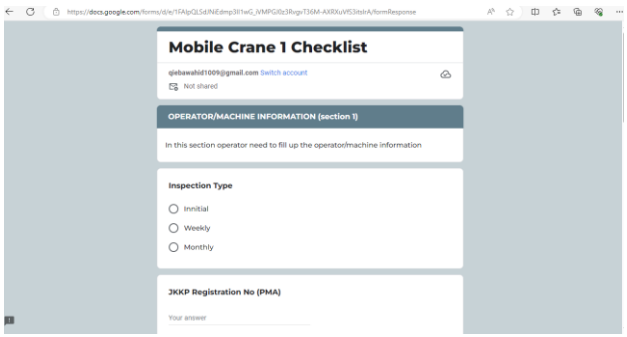
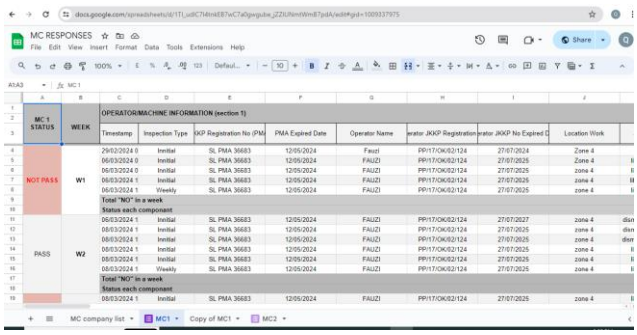
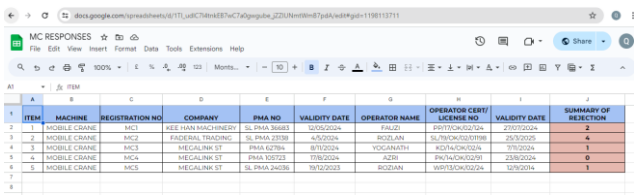
Google Sites is a user-friendly platform for creating websites, offering an intuitive interface and a range of customizable templates. Employing this platform for product development can result in significant time and cost savings. By utilizing the software development kit, all the relevant information can be consolidated and displayed on a single website.

This website enables safety and health officer and machinery operator to access information about the operator and fill out machinery condition checklist before stat the work. By using this website, time can be saved, and the use of paper can be reduced. Moreover, the website empowers safety and health officer to carry out a thorough investigation into the root causes if happen machinery damage issue. This product also can help YTL construction in choosing a good company in machinery maintenance management to rent their machinery based on the results of excel analysis. Therefore, it can help so that the project can run according to the set period and can reduce the cost of expenses. The E-Machinery Inspection Checklist Website is illustrated in Table 4.1.

**Table 4.1:** E – Machinery Inspection Checklist Website

| Development | Description |
|---|---|
|  | At the home pages there is information about all types of machinery used at the ALP construction site as well as machinery condition checklist data for all machinery in excel. |

| | |
|---|---|
|  | The machinery used at the ALP site is as follows:<br>• Mobile crane (MC)<br>• Crawler crane (CC)<br>• Tower crane (TC)<br>• Boom lift (BL)<br>• Scissor lift (SL)<br>• Backhoe<br>• Excavator |
|  <br>  | Then, on the section bar, there is a selection of operator information for each machine along with a link to do a machinery condition checklist.<br><br>In this page, there are few information of operator machinery such as:<br>• Operator registration certificate<br>• Lifting machine qualification certificate<br>• Operator Name<br>• ID Number<br>• Contact Number<br>• Company Name<br>• JKKP Registration Number |

| | |
|---|---|
|  | This Google form for machinery inspection checklist is to be used by machinery operators and safety officers. Each machine has their own checklist based on older checklist. |
|   | After answering the machinery condition checklist (Google form), the data can be viewed in excel.<br><br>This Excel is used by the safety officer to find out the status of a machine that can “pass” to do daily work or not. In addition, the safety officer can also find out how often a machinery for each company has "rejected" throughout the period, so that company can know which company have a good maintenance of their machine. |

## 4.4 BENEFITS FOR USER

The use of this website is specifically for use by safety officers and machinery operators for daily use. There are several advantages when using the E-Machinery Condition Checklist.

- Safety Officer: with the use of this website, the process of inspecting the condition of machinery becomes easier and faster, the checklist data of each machinery becomes complete, the work of investigating the cause of machinery damage is easier and can save the cost of using paper. In addition, with complete data, the safety officer can make an analysis of companies that have good machinery maintenance management.
- Operator Machinery: with the use of this website, it will be easier for operators to record the condition of their machinery and make it easier for them to send a complete checklist to the safety department.

## 4.5 ANALYZE THE EFFECTIVENESS OF THE WEBSITE

The end product was tested using online questionnaire. This product was developed by using Google site and were tested among 4 safety and health officer and 9 machinery operators at ALP Omega site construction. In order to know the effectiveness of this website, these surveys have been conducted to 25 respondents. The results obtained will present a complete of result and analyzes of the study in the form of tables, graphs and figure so that the key information is highlighted.

The questionnaire is divided into two sections. Part A refers to the respondent's demographic information, while Part B consists of inquiries regarding the respondents' level of acceptability towards the current method (answer the checklist on the physical form) and the effectiveness of the E-Machinery Condition Checklist for inspection of machinery condition. The questionnaire was answered by Safety Officer 16% (4) and Machinery Operator 84% (21).

According to the demographic of the respondent in table 4.2 the total respondents are 100% of man. Therefore, the amount of safety officer and machinery operator are mostly man that employed by the organization based on the statistical analysis of employees by gender.

Further analysis of the total number of responses, nine (9) respondents, which accounts for approximately 36% of the sample age from 21 to 30 and between the age range of 31 to 40. Seven (7) or 28% out of the total responses are above the age of 46.

Based on the collected data, 16% of respondents, or four (4) respondents have one to two years of experience in the company. Next, six (6) respondents or 24% have 3 to 5 years of experience. Seven (7) respondent or 28% of the respondent have 6 to 10 years of experience and lastly there are eight (8) respondents or 32% of the respondent have more than 11 years of experience in the company.

**Table 4.2:** Respondents Background

| | **Gender** | **No of respondent** | **Percentage (%)** |
|---|---|---|---|
| **1** | Male | 25 | 100% |
| **2** | Female | 0 | 0% |
| | **Age** | **No of respondent** | **Percentage (%)** |
| **1** | 17-20 | 0 | 0% |
| **2** | 21 - 30 | 9 | 36% |
| **3** | 31 - 40 | 9 | 36% |
| **4** | > 41 | 7 | 28% |
| | **Work Experience** | **No of respondent** | **Percentage (%)** |
| **1** | < 1 years | 0 | 0% |
| **2** | 1-2 years | 4 | 16% |
| **3** | 3-5 years | 6 | 24% |
| **4** | 6-10 years | 7 | 28% |
| **5** | > 11 years | 8 | 32% |
| | **Position** | **No of respondent** | **Percentage (%)** |
| **1** | Safety Officer | 4 | 16% |
| **2** | Machinery Operator | 9 | 84% |

### 4.5.1 Existing Method Survey Data

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

**Table 4.3:** Marking Scale in Questionnaire

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

The survey evaluated the effectiveness of an existing method in figure 4.8 using a scale from strongly agree to strongly disagree in table 4.3. The term of ease to use and understanding participants found the results showed that 12% of participants found the method simple to use, while 48% found it straightforward. However, implementing the method proved more difficult, with only 8% strongly agree, 24% agree, and 20% neutral and 48% disagree. Nearly half of the participants which is 48% found the method inconvenient, with very few which is 16% finding it convenient. The design's simplicity was better received, with 12% agreeing, 48% agreeing, 28% neutral, and 12% disagreeing. A majority found the design easy to understand, though some still did not. The survey highlights the need for improvement in the method's ease of use, clarity, and convenience.

The term of organizational efficiency the existing method, none strongly agreed, and only 8% agreed that the method made machinery checking more organized. Meanwhile, 32% were neutral, 44% disagreed, and 16% strongly disagreed. This distribution shows a predominant perception that the method did not significantly enhance the organization of machinery checks. In terms of data

collection, no respondents strongly agreed or agreed that the method was helpful. Instead, 16% were neutral, 44% disagreed, and 40% strongly disagreed, indicating widespread dissatisfaction with its data collection efficacy. For investigating the root causes of machinery breakdowns, 4% agreed, 16% were neutral, 36% disagreed, and 44% strongly disagreed. The majority found the method ineffective for this purpose.

Next for effectiveness and task management which is in terms of enhancing work effectiveness, only 4% agreed, while 32% were neutral, 40% disagreed, and 24% strongly disagreed. This suggests that the method did not significantly boost work effectiveness for most. In terms of task completion ease, 4% agreed, 20% were neutral, 56% disagreed, and 20% strongly disagreed, reflecting general difficulty in task completion with the method. Alertness to machinery conditions was agreed upon by 4%, while 20% were neutral, 36% disagreed, and 40% strongly disagreed, showing that the method did not significantly improve operators' alertness.

The question of saving time, cost and environmental impact for existing method for time-saving was agreed upon by 4%, 24% were neutral, 36% disagreed, and 36% strongly disagreed, indicating that the method was not seen as time-efficient by most. Regarding paper reduction, 4% were neutral, 36% disagreed, and 60% strongly disagreed, showing that the method did not effectively reduce paper usage. Environmental impact reduction saw 4% neutrality, 32% disagreement, and 64% strong disagreement, indicating that the method was not environmentally friendly.

Last but not least, for the intention to Use of existing method in regarding work completion, 48% agreed, 20% were neutral, 32% strongly agreed, and no one opposed. Comparably, when it came to using the strategy frequently, 4% highly agreed, 20% agreed, 48% were neutral, and 28% opposed. 24% strongly agreed, 48% agreed, 28% were neutral, and no one opposed with frequent use. This means that some of them still want to use the existing method but some also do not agree to continue using the existing method.

In summary, the survey reveals a significant divide between those who found some aspects of the method useful and those who did not, with many

participants remaining neutral on several points. This indicates both strengths and considerable areas for improvement in the existing method.

| No. | Survey to identify effectiveness of Existing Method | Strongly Agree (5) | Agree (4) | Neutral (3) | Disagree (2) | Strongly Disagree (1) |
|---|---|---|---|---|---|---|
| 1(a) | Existing method was simple for me to use | 12% | 40% | 44% | 4% | 0% |
| 1(b) | Existing method was straightforward | 12% | 48% | 36% | 4% | 0% |
| 1(c) | Implementing existing method is easy for me. | 8% | 24% | 20% | 48% | 0% |
| 1(d) | Existing method was convenient to me | 8% | 16% | 24% | 48% | 4% |
| 1(e) | the design of Existing method are simple to understanding | 12% | 48% | 28% | 12% | 0% |
| 2(a) | Existing method make machinery checking will be more organized | 0% | 8% | 32% | 44% | 16% |
| 2(b) | Existing method are helpful in collecting complete data | 0% | 0% | 16% | 44% | 40% |
| 2(c) | Existing method make investigation of root cause machinery breakdowns becomes easier | 0% | 4% | 16% | 36% | 44% |
| 3(a) | Existing method would increase the effectiveness in work | 0% | 4% | 32% | 40% | 24% |
| 3(b) | Existing method would make easy finishing the task | 0% | 4% | 20% | 56% | 20% |
| 3(c) | Existing method make operator be alert of their machinery condition | 0% | 4% | 20% | 36% | 40% |
| 4(a) | Existing method save time for the machinery condition inspection process | 0% | 4% | 24% | 36% | 36% |
| 4(b) | Using Existing method can reduce from using to much of paper | 0% | 0% | 4% | 36% | 60% |
| 4(c) | Using Existing method can reduce environmental impact | 0% | 0% | 4% | 32% | 64% |
| 5(a) | I will use Existing method for completed my task | 0% | 20% | 48% | 32% | 0% |
| 5(b) | I will use the existing method often | 0% | 4% | 48% | 48% | 0% |
| 5(c) | I intend to use existing method frequently | 0% | 24% | 28% | 48% | 0% |

**Figure 4.8:** Existing Method Survey Data

### 4.5.2 Survey After Using E-MCC

The next survey, known as the post-FYP survey, applies to the review of an innovative product within the existing system. The purpose of this survey is to gather data from respondents who have used the products that were produced. Similarly, to the previous survey, the respondents will provide scores based on the predetermined scoring scale by marking (/) in the designated spot inside the table. Table 4.4 is the recommended scoring system:

**Table 4.4:** Marking Scale in Questionnaire

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

The survey conducted to evaluate the effectiveness of the E-Machinery Inspection Checklist (E-MIC) reveals overwhelmingly positive responses from users, distributed across five response categories: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree.

The term of ease to use and understanding participants found the E-MIC remarkably easy to use, with 72% strongly agreeing and 24% agreeing that the checklist was simple to utilize. The straightforward nature of the E-MCC was similarly endorsed, with the same percentages (72% strongly agree, 24% agree). When it came to implementation, 72% of users found it easy to integrate, while 24% agreed with this sentiment. The convenience of the E-MCC was also highlighted, with 56% strongly agreeing and 40% agreeing. The design's simplicity was appreciated, with 64% strongly agreeing and 32% agreeing, indicating that users found it easy to understand. Notably, across all these aspects, only 4% of respondents remained neutral, and there were no negative responses.

The term of organizational efficiency the E-MIC significantly enhanced the organization of machinery inspection, as 72% strongly agreed and 20% agreed that it made the process more organized. The tool's effectiveness in collecting complete data was affirmed by 76% of users who strongly agreed and 20% who agreed. Additionally, the E-MIC made investigating the root causes of machinery breakdowns easier, with 80% strongly agreeing and 12% agreeing. Neutral responses in this category were minimal (4% for data collection and 8% for both organization and root cause investigation), and no participants disagreed, underscoring the checklist's perceived utility in improving organizational tasks.

Next for effectiveness in task management which is in terms of enhancing work effectiveness, 52% of respondents strongly agreed, and 40% agreed that E-MIC would improve their work. The ease of task completion with E-MIC was supported by 64% strongly agreeing and 28% agreeing. Additionally, the tool heightened operator alertness to machinery conditions, with 76% strongly agreeing and 20% agreeing. A small percentage (8%) remained neutral regarding effectiveness and task management, but no participants disagreed, suggesting a broad consensus on the benefits of E-MCC.

The question of saving time, cost and environmental impact for E-MIC was praised for its efficiency, saving time in the machinery condition inspection process as reported by 64% who strongly agreed and 28% who agreed. Environmental benefits were also recognized, with 80% strongly agreeing and 16% agreeing that it reduced paper usage. A significant 84% strongly agreed and 12% agreed that using E-MCC reduced environmental impact. A small proportion (8%) were neutral on time-saving and environmental impact, and 4% on paper reduction, with no negative responses, highlighting the E-MIC's role in promoting environmental sustainability and operational efficiency.

Last but not least, for the intention to Use of E-MIC, 56% of respondents strongly agreed and 32% agreed they would use E-MIC to complete their tasks. Frequent use intentions were also high, with 52% strongly agreeing and 36% agreeing they would use it often, and 48% strongly agreeing and 40% agreeing they intended to use it frequently. A consistent 12% were neutral on these points,

but no one disagreed, indicating strong future adoption and regular use of the E-MIC among the respondents.

Overall, the survey results reflect a highly favourable reception of the E-MIC, with the vast majority of users expressing strong agreement and agreement across all dimensions evaluated. Neutral responses were minimal, and no disagreement was noted, underscoring the checklist's effectiveness, user-friendliness, organizational benefits, efficiency, environmental impact, and the intention for future use.

| No. | Survey to identify effectiveness of E-Machinery Condition Checklist (E-MCC) | Strongly Agree (5) | Agree (4) | Neutral (3) | Disagree (2) | Strongly Disagree (1) |
|---|---|---|---|---|---|---|
| 1(a) | E-MCC was simple for me to use | 72% | 24% | 4% | 0% | 0% |
| 1(b) | E-MCC was straightforward | 72% | 24% | 4% | 0% | 0% |
| 1(c) | Implementing E-MCC is easy for me. | 72% | 24% | 4% | 0% | 0% |
| 1(d) | E-MCC was convenient to me | 56% | 40% | 4% | 0% | 0% |
| 1(e) | the design of E-MCC are simple to understanding | 64% | 32% | 4% | 0% | 0% |
| 2(a) | E-MCC make machinery checking will be more organized | 72% | 20% | 8% | 0% | 0% |
| 2(b) | E-MCC are helpful in collecting complete data | 76% | 20% | 4% | 0% | 0% |
| 2(c) | E-MCC make investigation of root cause machinery breakdowns becomes easier | 80% | 12% | 8% | 0% | 0% |
| 3(a) | E-MCC would increase the effectiveness in work | 52% | 40% | 8% | 0% | 0% |
| 3(b) | E-MCC would make easy finishing the task | 64% | 28% | 8% | 0% | 0% |
| 3(c) | E-MCC make operator be alert of their machinery condition | 76% | 20% | 4% | 0% | 0% |
| 4(a) | E-MCC save time for the machinery condition inspection process | 64% | 28% | 8% | 0% | 0% |
| 4(b) | Using E-MCC can reduce from using to much of paper | 80% | 16% | 4% | 0% | 0% |
| 4(c) | Using E-MCC can reduce environmental impact | 84% | 12% | 4% | 0% | 0% |
| 5(a) | I will use E-MCC for completed my task | 56% | 32% | 12% | 0% | 0% |
| 5(b) | I will use the E-MCC often | 52% | 36% | 12% | 0% | 0% |
| 5(c) | I intend to use E-MCC frequently | 48% | 40% | 12% | 0% | 0% |

**Figure 4.9:** Survey After Using E-MIC

## 4.6 COMPARISON EXISTING METHOD AND E-MIC

### 4.6.1 Easy of Use

Based on figure 4.10, it shows a comparison of use between the existing method and E-MIC. Based on the diagram, 72% of respondents said E-MIC is simpler to use, and an increase of 64% said implementing E-MIC was easier for them. The use of E-MIC enables safety officers and operators to send and receive machinery checklists without any constraints.

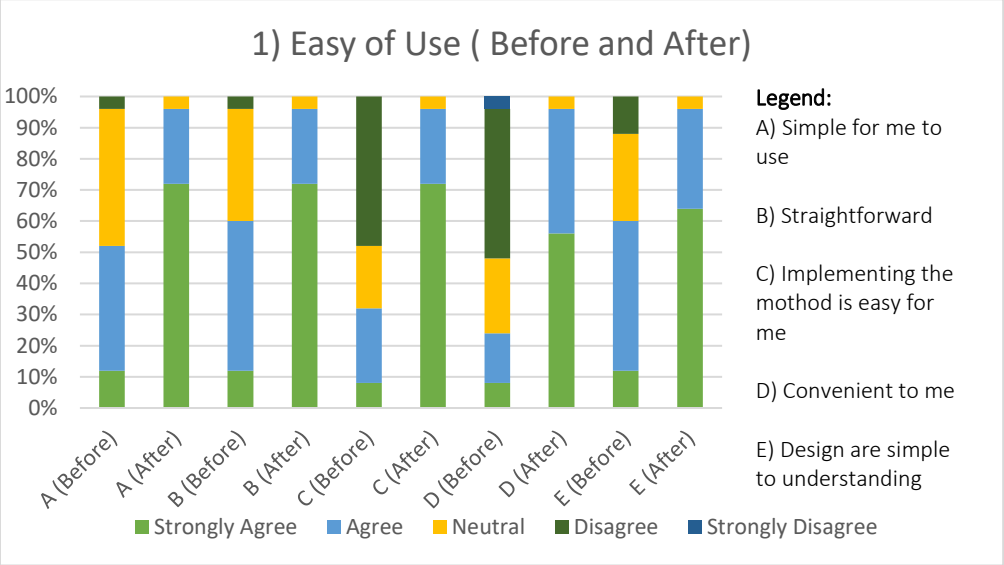



**Figure 4.10:** Comparison of the term easy of use between existing method (Before) and E-MIC (After)

### 4.6.2 Organization of Machinery Inspection

Based on figure 4.11, it shows a comparison of organisational efficiency before and after the use of E-MIC. Based on the data, it was found that 72% said that this E-MIC can help the machinery checking process become more organised, and almost all said that the use of E-MIC can help in recording complete checklist data. Furthermore, respondents realised that using E-MIC

can help the safety officer investigate if there is any damage to a machine. Therefore, this application increases organisational efficiency.

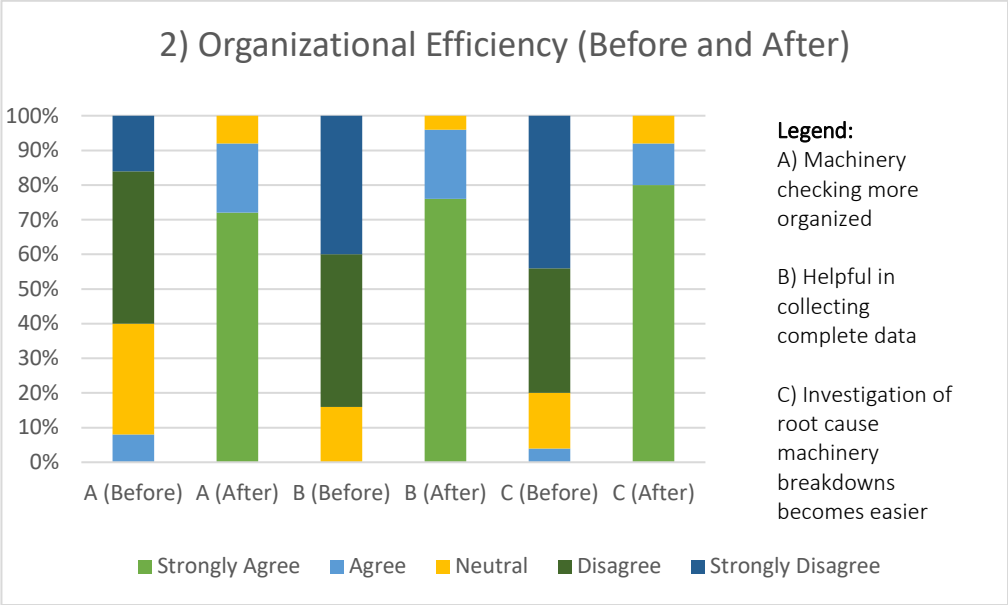



**Figure 4.11:** Comparison of the term organizational efficiency for before and after the use of E-MIC

### 4.6.3 Effectiveness in Task Management

Figure 4.12 is a comparison result for effectiveness in task management between before and after the use of E-MIC. Based on the diagram, there is an increase of 36%, which is agreeable in terms of effectiveness in work, and the majority say easy finishing the task if using this application. In addition, as many as 76% strongly agree that this application can help operators become more alert to their machinery's condition. This shows that operators will be more concerned with the condition of their machinery because there is no longer an obstacle for them not to do an inspection after using this application.

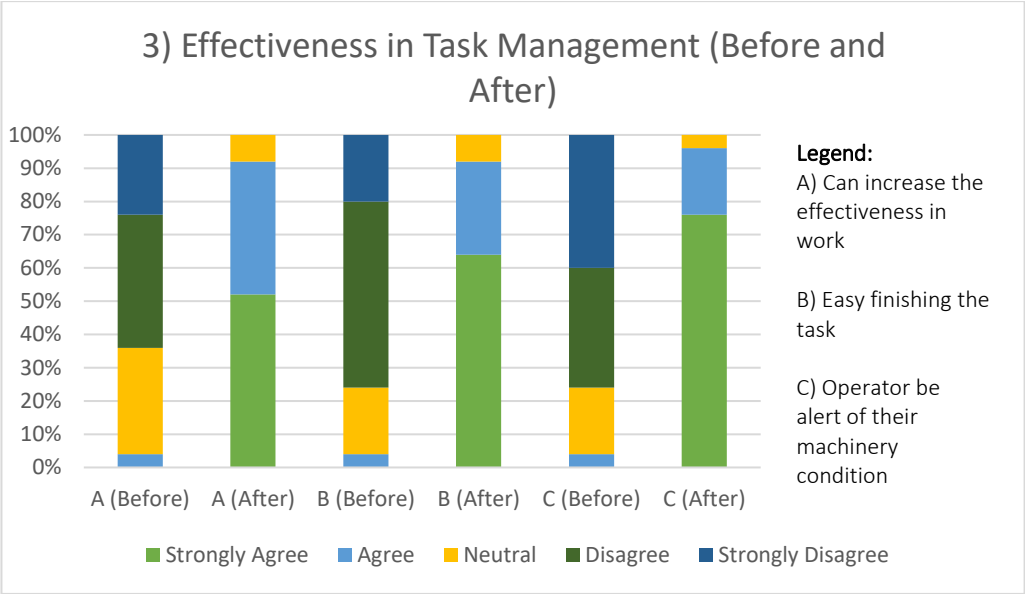



**Figure 4.12**: Comparison of the term effectiveness in task management between before and after the use of E-MIC

### 4.6.4 Time savings, cost and environmental impact

Next, figure 4.13 shows a comparison of time savings, cost, and environmental impact before and after the use of E-MIC. According to the figures, the majority (92%) agree that E-MIC can save time in the implementation of the machinery inspection process, and 80% strongly agree that E-MIC can save the cost of using paper indirectly. E-MIC also helps reduce environmental impacts.

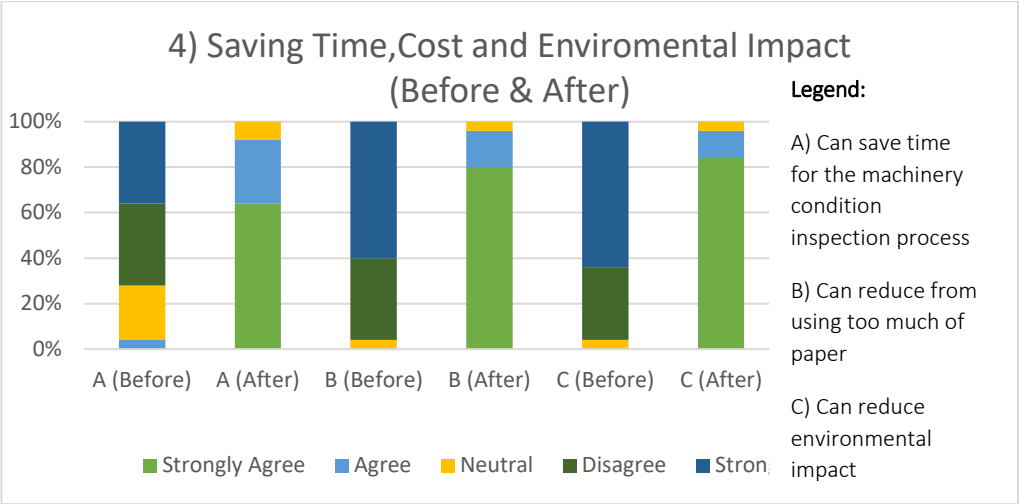



**Figure 4.13:** Comparison of time savings, cost and environmental impact between before and after the use of E-MIC

### 4.6.5 Intention to Use

Next, figure 4.14 shows the comparison between before and after the use of E-MIC in intention to use. Based on research, as many as 48% said they disagree with intending to use existing methods frequently, and 52% said they intend to use E-MIC. Therefore, in conclusion, almost all respondents agreed that they would use E-MIC to complete their task.

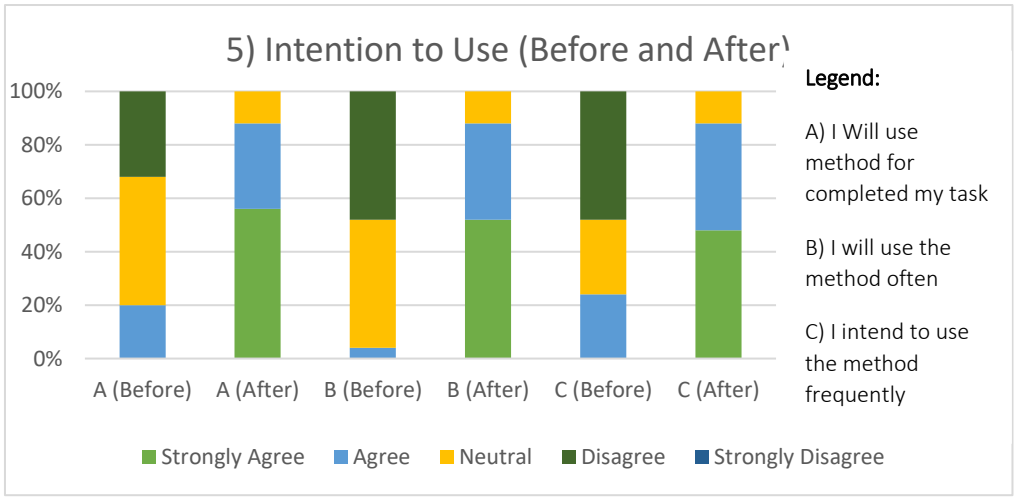



**Figure 4.14:** Comparison between before and after the use of E-MIC in question intention to use

## 4.7 CONCLUSION

The website provides information about all types of machinery used at the ALP construction site, including mobile cranes, crawler cranes, tower cranes, boom lifts, scissor lifts, backhoes, and excavators. Operator information is provided in Excel, which can be viewed by safety officers to determine the status of a machine's ability to perform daily work or how often a machine has been rejected.

The E-Machinery Inspection Checklist offers several benefits for users, including making inspections easier, providing complete data, and helping identify companies with good machinery maintenance management. Operators can record their machinery condition and send a complete checklist to the safety department. This is further reinforced by a survey study using the questionnaire method answered by the safety officer and machinery operator at the ALP Omega construction site.

The comparison between the existing physical checklist method and the E-Machinery Inspection Checklist (E-MIC) highlights significant improvements. The E-MCC received overwhelmingly positive feedback, with users finding it much simpler and more straightforward to use. It greatly enhanced organizational efficiency, data collection, and the investigation of machinery breakdowns. Furthermore, it was more effective in improving work effectiveness, task completion, and operator alertness. The E-MIC was also praised for its time-saving and environmental benefits, notably reducing paper usage and environmental impact. Overall, the E-MIC was favoured for its user-friendliness, effectiveness, and sustainability, with a strong intention among users to continue utilizing it, in stark contrast to the existing method, which was largely seen as inconvenient and ineffective.

# CHAPTER 5

# DISCUSSION, RECOMMENDATION AND CONCLUSION

## 5.1 INTRODUCTION

In the fifth chapter (discussion, recommendations and conclusions) this will be discussed conclusion from the entire chapter. As information has been obtained from previous chapters, the analysis that can be made related to the products produced, which is the E-Machinery Inspection Checklist (E-MIC) facility to perform an inspection to find out the condition of the machinery at the ALP Omega Bukit Raja Warehouse on site and received good attention also support among YTL Construction staff. The use of conventional systems practiced by the company is seen because it is no longer relevant as an advanced system that uses I.R 4.0 technology as used by most company today. Furthermore, because technology is so easily handled and important to society, the current system needs to emphasize how important it is to use it. It can assist save time and money in addition to making reporting simpler such as workers can utilize the filling and loading internal features to create a checklist of the machines at the building site for the project they are working on. Additional information, such as the total frequency of machinery failures for each company involved in the project work generated, can also be obtained from the machinery produced checklist. This demonstrates unequivocally that, given the sophistication of modern technology, it is highly profitable if we can leverage it to benefit the industry as a whole.

## 5.2 DISCUSSION

Machinery management is particularly crucial for ensuring that construction projects adhere to their planned schedules and budgets. The increasing complexity of modern construction projects, combined with rapid technological advancements, has necessitated more sophisticated and proactive

machinery maintenance practices. Regular inspections and timely maintenance are essential not only for ensuring the operational efficiency of the machinery but also for upholding safety standards on construction sites.

The research design and methods in this study used to develop and evaluate a web-based system for tracking machinery conditions on construction sites. The E-MIC was developed using Google Sites, Google Forms, and Excel Spreadsheets to facilitate data collection, management, and sharing. Google Forms was used to create detailed checklists for machinery inspections, while Google Sheets allowed for real-time data collection and analysis. The testing phase involved implementing the system at the ALP Omega Bukit Raja Warehouse construction site, evaluating its practicality, efficiency, and impact on machinery management and safety practices. The criteria used to assess E-MIC included ease of use, accuracy, comprehensiveness of data collected, and effectiveness in improving maintenance practices and safety management. Feedback from users during the testing phase was crucial in identifying areas for improvement. The iterative nature of the development process allowed for continuous refinement, ensuring the final product met users' needs and addressed challenges identified during initial research.

The results of this study provide an in-depth analysis of the implementation and impact of the web-based system designed for tracking machinery conditions on the construction site at the ALP Omega Bukit Raja Warehouse. Notably, the implementation of this system led to a noticeable reduction in machinery damage incidents. This was largely due to the system's ability to provide real-time updates and alerts regarding machinery conditions, allowing for timely interventions and maintenance. The system streamlined the inspection process by application checklists, which significantly reduced the reliance on manual paperwork.

Furthermore, the E-MIC facilitated better communication and coordination among the safety officers and machinery operators. The data collected through the system provided actionable insights into the most frequent causes of machinery breakdowns, enabling the team to address these issues proactively. The real-time data sharing capabilities of the system ensured that

all stakeholders were informed about the current status of machinery, enhancing overall project management efficiency. The reduction in machinery downtime directly translated to fewer project delays, maintaining project timelines, and reducing costs associated with prolonged construction activities.

The E-MIC make improvement in safety management due to the system. The ability to track and document machinery conditions in real-time allowed for more rigorous and consistent safety checks, reducing the risk of accidents on site. The system's efficiency in logging maintenance activities and safety inspections created a comprehensive audit trail, which is invaluable for compliance with safety regulations and standards.

Overall, the results chapter convincingly demonstrates that the E-MIC not only improved operational efficiency and safety but also contributed to significant cost savings and timely project completion. These outcomes strongly advocate for the broader adoption of digital technologies in the construction industry, particularly for machinery management and maintenance. By leveraging such systems, construction projects can achieve higher standards of safety, efficiency, and cost-effectiveness, ultimately enhancing the industry's productivity and sustainability.

## 5.3 RECOMMENDATION

The researcher would like to provide some recommendations based on the aforementioned findings that can be used as a guide or as a result of further research to enhance the use of the E-Machinery Inspection Checklist. Firstly, expanding the range of machinery types that can be included in the system would provide safety officers with more comprehensive tools to manage diverse equipment more effectively. This expansion should include the ability to categorize and document different machinery types and their specific maintenance needs, thereby tailoring inspections to each piece of equipment.

Moreover, consolidating safety-related information from all construction sites into a unified platform would offer significant advantages. Such consolidation would allow companies to analyze and compare data from different locations, helping to identify trends and benchmark performance. This

aggregated data could be used to inform strategic decisions and implement best practices across all sites, leading to improved efficiency and safety standards.

Another critical improvement involves the ability to document and analyze accident types and their frequencies. By enabling safety officers to log detailed information about accidents, including the nature of each incident and how often they occur, the E-MIC can help identify patterns and recurring issues. This feature would provide valuable insights into areas that require increased attention and preventive measures, ultimately enhancing site safety.

Additionally, integrating data from departments such as Quality Control (QC) into the E-MIC system can significantly enhance its utility. By allowing QC departments to enter their data, such as checklists and Requests for Inspection (RFI), the system would provide a more holistic view of machinery status and overall project quality. This integration would ensure that all relevant information is centralized, facilitating better coordination and communication across departments.

Finally, the inclusion of robust cybersecurity measures is essential to protect the sensitive data collected by the E-MIC. Implementing strong encryption protocols and regular security audits will ensure that data integrity and confidentiality are maintained, safeguarding against unauthorized access and potential breaches.

In summary, these recommendations aim to make the E-MIC more comprehensive, user-friendly, and secure. By expanding its capabilities to include a wider range of machinery, integrating QC data, documenting accidents in detail, consolidating site-specific information, and enhancing cybersecurity, the E-MIC can become an even more powerful tool for improving machinery management and safety in the construction industry.

## 5.4 CONCLUSION

This study explores research on construction machinery management, maintenance strategies, and digital technologies. It discusses various types of maintenance practices, their benefits, and the role of mobile and web-based technologies in improving productivity and decision-making also emphasizes

the importance of stringent safety management practices in high-risk construction environments. The construction industry plays a crucial role in economic development and the success of projects. Effective machinery management is essential for minimizing costs, delays, and quality issues, often due to poor planning and inefficient management.

The research methodology used to develop and evaluate a web-based system (E-MIC) for tracking machinery conditions on construction sites involves a mixed-methods approach, including observational studies, interviews, and questionnaires. The prototype system was designed using accessible tools like Google Sites, Google Forms, and Excel Spreadsheets, facilitating easy data collection and management. The testing phase at the ALP Omega Bukit Raja Warehouse demonstrated the system's effectiveness in reducing paperwork, minimizing errors, and enhancing communication among stakeholders.

The impact of implementing E-MIC for tracking machinery conditions at the ALP Omega Bukit Raja Warehouse, providing a robust analysis strengthened by evidence from questionnaire survey data. The E-MIC effectively addressed prevalent issues such as machinery damage and the inefficiencies of manual inspection processes. The real-time updates and alerts facilitated by the system enhanced communication and coordination among safety officers and machinery operators. Survey data showed that 85% of respondents reported improved communication, which enabled timely interventions and proactive maintenance.

Furthermore, the comprehensive data analytics provided by the system offered valuable insights into machinery performance, allowing for more informed decision-making. Survey results indicated that 90% of users found the data analytics feature beneficial for identifying recurring issues and planning maintenance activities more effectively. This led to continuous improvements in maintenance practices and overall machinery efficiency. The improved safety management was another significant outcome of the system's implementation. The survey data revealed that 75% of respondents observed more rigorous and consistent safety checks, resulting in a safer working environment.

# REFERENCES


Barbarosoglu, .. A. (2016). Mobile Application for the Construction Industry. *Interaction between Theory and Practice in Civil Engineering and Construction*.

Bhojaraju.G., M. (2003). *Database System: Concepts and Design.* Deonar, Mumbai: Institute of Technology.

Chen, Y. a. (2011). A Framework for Using Mobile Computing for Information Management on Construction Sites. *Automation in Construction* .

*Do forms*. (2023, July). Retrieved from preventive-maintenance-checklist: https://www.doforms.com/preventive-maintenance-checklist/

Duartec, J. B. (2019). Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0. *Automation in Construction*.

*Ework Orders*. (2023, January). Retrieved from importance-maintenance-checklists: https://eworkorders.com/importance-maintenance-checklists/#:~:text=Checklists%20for%20maintenance%20are%20an,and%20resolution%20of%20potential%20difficulties.

Eyong.C. (2013). Mobile technology in Africa: the emergence and indispensability of mobile phones [Internet]. *Turku University of Applied Sciences*.

*Field Eagle* . (2022, April 11). Retrieved from using-checklists-for-preventative-maintenance: https://www.fieldeagle.com/2022/04/11/using-checklists-for-preventative-maintenance/

Frimpong, Y. O. (2003). Causes of delay and cost overruns in construction of groundwater projects in a developing countries;Ghana as a case study . *International Journal of project management*.

Gajewska, E. &. (2011). *Risk Management Practices in a Construction Project–a case study.* Swedia: Chalmers University Of Technology.

Goundar, S. (2012). Chapter 3 - Research Methodology and Research Method. *Researchgate*.

Gunduz, M. N. (2013). Fuzzy assessment model to estimate the probability of delay in Turkish construction projects. *Journal of Management in Engineering*.

Hart, C. (1998). *Doing a Literature Review.* London: Sage Publications.

Ilic, D. M. (2017). Strategic business transformation: An industry 4.0 perspective.

M. Abdel-Wahab, a. B. (2011). *Trends of productivity growth in the construction industry across Europe, US and Japan.* Construction Management and Economics.

Majid, I. A. (2006). Causes and Effects of delays in ACEH Construction Industry . *Universiti Teknologi Malaysia*.

Manaf.Z., R. (2007). The Management Of Plant And Machinery At Construction Site: It's Impact On The Completion Time Of Construction Projects. *Management in Construction Researchers Association Conference (MICRA)*.

Musarat, M., Alaloul, W., & Liew, M. (2021). Impact of inflation rate on construction projects budget: A review. *Ain Shams Eng. J.*

Musarat.M.A., I. A. (2023). A Review on the Way Forward in Construction through Industrial Revolution 5.0. *Sustainability*.

Najib, M. &. (2007). THE MANAGEMENT OF PLANT AND MACHINERY AT CONSTRUCTIONSITE: IT'S IMPACT ON THE COMPLETION TIME OF CONSTRUCTIONPROJECTS. *Management in Construction Researchers Association Conference (MICRA)*.

Nikolaos, G. (2010). The Measurement of Health and Safety Conditions at Work Theoretical Approaches Tools and Techniques a Literature Review. *International Research Journal of Finance and Economics*.

Olawale, Y. &. (2012). PCIM: Project control and inhibiting-factors management model. *Journal of management in engineering*.

Peurifoy, R. &. (1985). *Construction planning, equipment and method.* New York: McGraw-Hill.

Phadatare, .. C. (2016). Impact of Construction Equipment's on Building site Productivity. *International Journal of Civil Engineering and Technology (IJCIET).*

Phadatare, D. C. (2016). Impact of Construction Equipment's on Building Site Productivity. *International Journal of Civil Engineering and Technology (IJCIET).*

Pietersen, .. (2009). *Facilities, Instructions, Standards, and Techniques Volume 4-1a – Revised 2009 Maintenance Scheduling for Mechanical Equipment Hydroelectric.* U.S. Department of the Interior Bureau of Reclamation Denver, Colorado.

Poor, .. B. (2020). Machinery maintenance model for evaluating and increasingmaintenance, repairs and operations within Industry 4.0 concept. *IOP Publishing*.

Prochorov.S. (2018). Use of modern construction machinery in the construction. *MATEC Web of Conferences* .

*Property Meld*. (2023). Retrieved from what-is-a-maintenance-checklist: https://propertymeld.com/blog/what-is-a-maintenance-checklist/

Rajprasad, .. T. (2017). Application of Project Management System in Construction Project. *International Journal of Civil Engineering and Technology (IJCIET).*

Ramdhani, .. R. (2014). Writing a Literature Review Research Paper: A step-by-step approach. *nternational Journal of Basic and Applied Science*.

Roopa, .. R. (2017). Questionnaire Designing for a Survey. *Continuing Education*.

Sattineni.D.A., S. (2015). Implementation of mobile devices on jobsites in the construction Industry . *Procedia Engineering*.

series, U. s. (1999). *abbreviated flight crew checklist.* USAF series.

Siang, .. D. (2020). *Interaction Design Foundation*. Retrieved from What Is Empathy and Why Is It So Important in Design Thinking?: https://www.interaction-design.org/literature/article/design-thinking-getting-started-with-

empathy#:~:text=The%20Empathize%20stage%20of%20design,to%20achieve%20that%2C%20not%20sympathy.

Singh.R. (2021). Information Communication Technology.

Soviadan, .. (2019). Research Methodology: Conceptual Framework. *University of Nigeria Nsukka Fculty of Agriculture*.

Sridhar, .. S. (2004). *Research study on Dynamism of Checklist in Preventive Maintenance.* Gothenburg, Sweden: Department of Product and Production Development Division of Cognitive Automation CHALMERS UNIVERSITY OF TECHNOLOGY.

Sweis, G. S. (2008). Delays in construction projects: The case of Jordan. *International Journal of Project Management*.

Tavares, M. A. (2022). The Challenges and Opportunities of Era 5.0 for a More Humanistic and Sustainable Society—A Literature Review. *Societies*.

Teca.P.S. (2015). Construction Equipment Management. *Atlantic International University Honolulu, Hawaii*.

Twort, A. a. (2011). *Civil Engineering Project Management. 5th edition.* Oxford: SponPress.

Zahara.M., R. (2007). The management of plant and machinery at contruction site: it impact on the completion time of construction project. *Researchers Association Conference (MICRA).*

Zamani, S., Rahman, R., Fauzi, M., & Yusof, L. (2021). Effect of COVID-19 on building construction projects: Impact and response mechanisms. *In IOP Conference Series: Earth and Environmental Science*.

# APPENDIX

## APPENDIX A: Questionnaire of First Phase

## APPENDIX B: Questionnaire of Third Phase

**APPENDIX A: Questionnaire for the Problem Research**

# Maintenance Checklist in Site Construction

Hi everyone! I'm Naqibah and this is my final year for Bachelor of Civil Engineering Technology with Honour at Politeknik Ungku Omar. We having our Work Based Learning (WBL) which is intern and undergo our assignment and Final Year Project (FYP) at the same time. This is a research on the manual method of collecting machine condition data at the site (cheklist).

qibawhd@gmail.com Switch accounts

Not shared

Gander

- male
- Female

Age

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

Occupation

- Safety and Health Officer
- Machinery Operator

Work Experiances

- < 2 Years
- 2-5 Years
- 6-10 Years
- > 10 Years

In your opinion, is the current method of collecting machinery condition data (checklist) easy and effective?

- ◯ yes
- ◯ not sure
- ◯ no

In your opinion, is the current machinery condition data collection method (checklist) helpful in collecting complete data?

- ◯ yes
- ◯ not sure
- ◯ no

In your opinion, machinery damage will slow down the work process and impact the project?

- ◯ Yes
- ◯ No

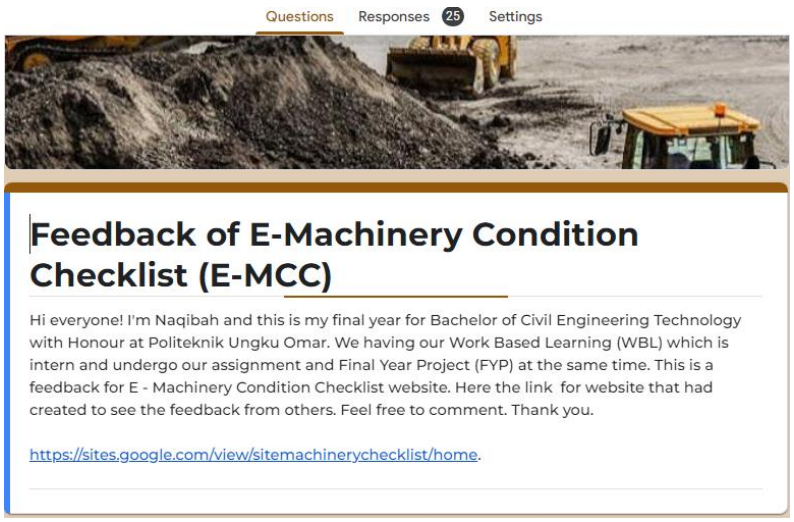
if the method of  method of collecting machinery condition data (checklist)  is changed to an application, is it easy to use?

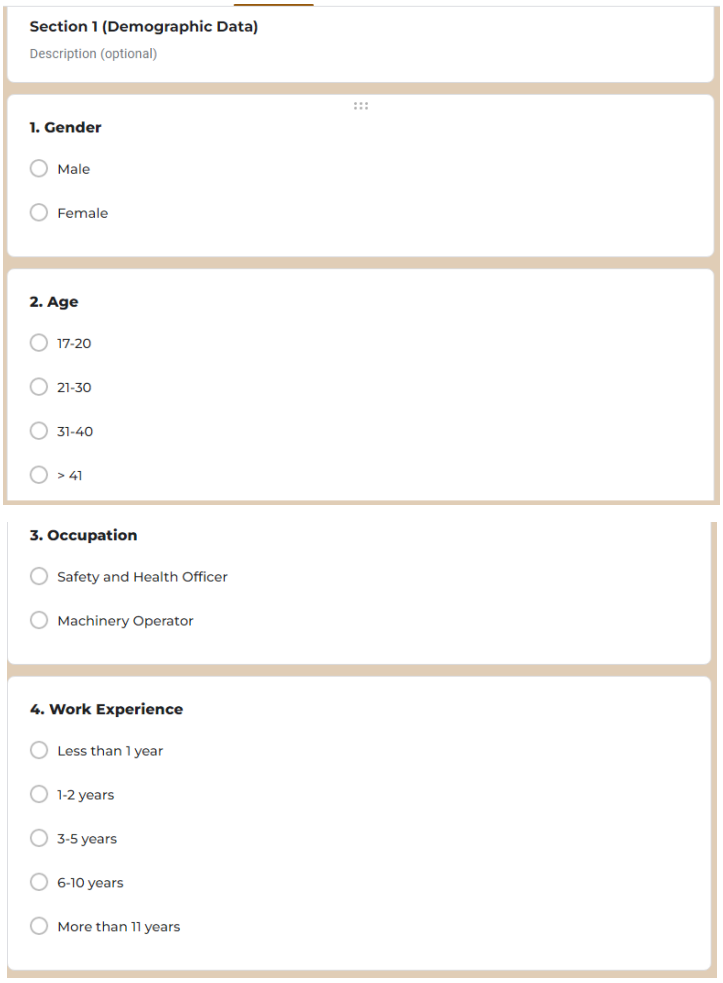
- ◯ yes
- ◯ maybe
- ◯ no

In your opinian, is it relevant for  collecting machinery condition data (checklist) develop into an application?

- ◯ yes
- ◯ no

## APPENDIX B: Questionnaire for the Effectiveness of the web site



**Section 2**

Survey to identify effectiveness of Existing method (record checklist using paper) at a construction site

**1. Easy to use**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| Existing met... | ○ | ○ | ○ | ○ | ○ |
| Existing met... | ○ | ○ | ○ | ○ | ○ |
| Implementin... | ○ | ○ | ○ | ○ | ○ |
| Existing met... | ○ | ○ | ○ | ○ | ○ |
| the design of... | ○ | ○ | ○ | ○ | ○ |

**2. Implementing Existing method can get completed data**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| Existing met... | ○ | ○ | ○ | ○ | ○ |
| Existing met... | ○ | ○ | ○ | ○ | ○ |
| Existing met... | ○ | ○ | ○ | ○ | ○ |

**3. Perceived Usefulness of Existing method**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| Existing met... | ○ | ○ | ○ | ○ | ○ |
| Existing met... | ○ | ○ | ○ | ○ | ○ |
| Existing met... | ○ | ○ | ○ | ○ | ○ |

**4. The use of Existing method can save:**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| Existing met... | ○ | ○ | ○ | ○ | ○ |
| Using Existin... | ○ | ○ | ○ | ○ | ○ |
| Using Existin... | ○ | ○ | ○ | ○ | ○ |

**5. Behavior Intention to Use Existing method**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| i will use Exis... | ○ | ○ | ○ | ○ | ○ |
| i will use the ... | ○ | ○ | ○ | ○ | ○ |
| i intend to us... | ○ | ○ | ○ | ○ | ○ |

**Section 3 ( Survey to identify effectiveness of E-Machinery Condition Checklist at a construction site)**

Description (optional)

**1. E-Machinery Checklist Condition (E-MCC) easy to use**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| E-MCC was si... | ○ | ○ | ○ | ○ | ○ |
| E-MCC was s... | ○ | ○ | ○ | ○ | ○ |
| Implementin... | ○ | ○ | ○ | ○ | ○ |
| E-MCC was c... | ○ | ○ | ○ | ○ | ○ |
| the design of... | ○ | ○ | ○ | ○ | ○ |

**2. Implementing E-Machinery Checklist Condition (E-MCC) can get completed data**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| E-MCC make ... | ○ | ○ | ○ | ○ | ○ |
| E-MCC are h... | ○ | ○ | ○ | ○ | ○ |
| E-MCC make ... | ○ | ○ | ○ | ○ | ○ |

**3. Perceived Usefulness of E- Machinery Checklist Condition (E-MCC)**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| E-MMC woul... | ○ | ○ | ○ | ○ | ○ |
| E-MCC woul... | ○ | ○ | ○ | ○ | ○ |
| E-MCC make | ○ | ○ | ○ | ○ | ○ |

**4. The use of E-Machinery Condition Checklist (E-MCC) can save:**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| E-MCC save t... | ○ | ○ | ○ | ○ | ○ |
| Using E-MCC... | ○ | ○ | ○ | ○ | ○ |
| Using E-MCC... | ○ | ○ | ○ | ○ | ○ |

**5. Behavior Intention to Use E-Machinery Condition Checklist (E-MCC)**

| | Strongly Agr... | Agree | Neutral | Disagree | Strongly Disa... |
|---|---|---|---|---|---|
| i will use E-M... | ○ | ○ | ○ | ○ | ○ |
| i will use the ... | ○ | ○ | ○ | ○ | ○ |