



Faculty of Computer Science and Information Technology

**E-PERMIT TO WORK: SMART PERMIT TO WORK APPLICATION AND
MONITORING WEB APPLICATION**

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Bachelor of Software Engineering with Honours

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MONITORING WEB APPLICATION**

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This project is submitted in partial fulfilment of
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ABSTRACT

The Permit to Work: Smart Permit to Work Application and Monitoring Web Application is a project aimed at addressing the limitations of traditional, paper-based permit-to-work (PTW) systems. These systems are often prone to inefficiencies, errors, and delays, which can hinder workplace safety and operational productivity. By leveraging a web-based platform, this project seeks to digitalise and automate the entire PTW process, making it more efficient, transparent, and user friendly. The proposed system is developed using the Rapid Application Development (RAD) methodology, which emphasises iterative design and continuous feedback from users. This approach ensures that the system aligns closely with user needs and evolves effectively throughout the development process. The web application includes features such as staff registration, automated notifications, application tracking, role based access for security, and a comprehensive dashboard for real-time monitoring and reporting. One of the key benefits of this system is its ability to reduce the time required for the application and approval process by automating tasks that were previously done manually. It also minimizes human errors by introducing validation checks and centralised data management. Furthermore, the system enhances workplace safety by ensuring that permits are approved only after thorough checks and compliance with safety standards. This project aims to contribute to the digital transformation efforts of organizations by introducing a solution that integrates advanced technologies to streamline operations. The digital PTW system not only ensures better compliance with workplace safety regulations but also supports the organisation's goals of increasing operational efficiency and sustainability. To validate the effectiveness of the system, a User Acceptance Testing (UAT) was conducted involving users from various roles. A total of 72 test cases were executed, with a pass rate of 96% and only 4% minor failures. Users expressed high satisfaction with the system usefulness, and responsiveness. Feedback collected during testing confirmed that the digital PTW system is reliable, user friendly, and effective in supporting permit workflows. Through this project, I hope to demonstrate how technology can be used to solve real world problems and create a meaningful impact on workplace processes.

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Chapter 1: Introduction

1.1 Introduction/Project Background

Permit to work applications are an example of authorization document that guarantee a sufficient level of risk has been assessed before any worker or staff permitted to construction site (Jusoh, 2021). The purpose of this permit is to have control and safety implemented to lessen the possibility of accident happening. PTW system serves as formal communication mechanisms that document all necessary safety precautions, roles, and responsibilities before, during, and after specific high risk activities. Paper-based and electronic PTW systems are currently the two types of PTW systems used in industry; paper-based systems are the most widely used (Amm, 2021).

In industries such as telecommunications, oil and gas, and technology, the complexity of operations often introduces significant risks (Jusoh, 2022). PTW systems help to bridge gaps between workers, supervisors, and safety teams by ensuring that everyone involved understands the scope of work, potential risks, and the steps required to mitigate those risks. Through this, PTW systems foster a culture of safety where accountability to safety protocols are prioritized. The level of approval and policy of this type of permit is depending on the region of the company operates in, these could be company policies, legal requirements, or general best practices to ensure the safety of the workers. These are part of strategy that uses authorization and authority to manage risk in sites especially when there is work or construction commence on site (Patel et al., 2022). Permit to Work (PTW) systems are designed to protect workers when working in risky or dangerous operations on sites for example chemical hazards, electric hazard, work at height and more risky work that prone to accident and high risk. This permit is used by company or organization to ensure the worker is professionally trained and have necessary skills. The other purpose of PTW is to ensure there is no interruption to the operation of the company's business. The processes of this permit approval involves in evaluating the site risks, developing an appropriate safety protocol, considering risks, and maintaining effective communication throughout the whole undertaking. Overall, a well-implemented PTW system is more than a tool for regulatory compliance, it is a proactive measure to protect lives, protect the

environment, and maintain the operational integrity of an organization. By reducing the likelihood of accidents, ensuring thorough risk management, and fostering a culture of safety, PTW systems play a critical role in supporting sustainable and responsible business operations.

1.2 Problem Statement

The current permit to work (PTW) system at Sarawak Digital Economy Corporation is entirely paper based, which has leading to inefficiencies, high risk to errors, and potential safety hazards. With a lot of permit to be processed monthly, the current system no longer able to ensure that all of the permit is assessed in appropriate safety protocol as pressure to ensure the permit is processed on time range that is set by the company which is in 3 days. The current system is prone to misplacement, and lacks real-time monitoring on the permit, which can result in delayed permissions and approvals, incomplete records, and increased risk of unsafe activities onsite. The current permit to work in SDEC is hard for key stakeholders to monitor and analyse the project and activities progress that is commencing on site. This will lead to a lack of accountability among the workers towards safety among them.

The risk of errors is significantly heightened in a paper-based system. Handwritten forms are more prone to misinterpretation, illegible handwriting, or incomplete entries, all of which can affect the accuracy of the information being recorded. Missing or inaccurate data can result in improperly assessed risks, leading to unsafe working conditions. Errors in documentation may also create legal liabilities for the organization in the event of an incident, as incomplete or inaccurate records could be challenged during audits or investigations.

The lack of real-time monitoring is another major issue. In the current system, there is no way to check the status of a permit or see what is happening on-site immediately. This makes it hard for managers and stakeholders to keep track of ongoing work or respond quickly to any unexpected problems. If something urgent comes up, they might not even be able to approve or make any decision on any ongoing permit.

The current system also makes it very hard to monitor and analyse the progress of projects and activities on-site. There is no systematic system to store all the data, so approver unable to easily review or evaluate how things are going. Without this information, it is hard to improve safety measures or even know if deadlines are being met. Important safety issues might go unnoticed, which could lead to bigger problems in the future.

These problems show that the current PTW system is outdated and not effective anymore. Moving to a digital system would solve many of these issues and help make the workplace safer, more organized, and efficient.

1.3 Scope

The scope of this project is to design and implement a digital Permit to Work (PTW) system for Sarawak Digital Economy Corporation (SDEC), aiming to improve the safety and efficiency of their existing permit management process. This system will replace the current paper-based approach, which is prone to delays, errors, and inefficiencies. The new digital PTW system will introduce a centralized platform to streamline the process of applying permit, reviewing, and approving permits, where this system will make it faster, more reliable, and easier for employees and management to use.

One key feature of the system will be real-time tracking of permits and onsite activities. This will enable stakeholders to monitor the progress of permits at every stage of the workflow, ensuring that safety protocols are followed rigorously. Real-time updates will also make it easier to identify and address any emerging issues, reducing the risk of accidents or unsafe conditions. For management, this capability will provide improved visibility and control over ongoing projects, allowing them to make better informed decisions and respond promptly to any irregularities towards safety compliance.

The system will be designed with a focus on user-friendliness, offering an intuitive user interface that caters to the needs of both contractor and approvers. Contractor or employees will be able to quickly submit permit applications through the platform, while approvers can review and approve permits with minimal hassle. This simplification of the process

will significantly reduce the burden on staff, freeing up time to focus on critical tasks while ensuring permits are processed within the required time frame.

A critical component of this project will be the creation of a secure and centralized database to store all permit records and related documentation. This database will replace the disorganized and error-prone paper filing system, providing a reliable repository where permits can be easily accessed, reviewed, and analysed. By eliminating the risk of lost or misplaced documents, the new system will improve accountability and ensure that accurate records are available for audits, inspections, and compliance reporting.

To further enhance safety, the system will have features to reduce errors in the permit approval process. Automated checks and validations will ensure that all required fields are completed and that applications meet the necessary safety criteria before submission. This will help prevent common mistakes, such as incomplete or incorrect entries, that could lead to safety hazards or delays.

Additionally, the system will be developed with robust security measures to protect sensitive data and maintain compliance with privacy and safety regulations. By implementing access controls, encryption, and regular system audits, the platform will ensure that all records are secure from unauthorized access or tampering. This focus on data integrity will provide stakeholders with the confidence that the system meets the highest standards for safety and reliability.

This project aims to create a comprehensive and modern PTW system that not only addresses the inefficiencies of the current paper-based approach but also sets a new standard for safety and operational at SDEC. By expanding digital tool in the company, the system will contribute to a safer work environment, improve regulatory compliance, and ensure that all permit related processes are managed efficiently and transparently.

1.4 Objectives

The primary objectives of this project are:

- 1. To analyse and design an e-Permit to Work (PTW) system that provides safety monitoring on sites:**

The aim is to develop a system that offers real-time tracking and monitoring of onsite activities, ensuring compliance with the SDEC standard safety protocols. By analysing the current workflow and designing a solution that delivers instant updates on the status of permits, activities, and workers, the system will help prevent unsafe conditions and improve overall safety management.

- 2. To create efficient Permit Application Process and approval:**

Create an efficient and user-friendly platform that will create a simple flow of the permit application and approval processes. This will reduce the time required for obtaining necessary permissions and allow employees to focus more on their core tasks on site. At the same time, it will reduce the complexity of approval process flow by the SDEC user.

- 3. To develop PTW system with Accurate and Secure Permit Record-Keeping:**

To implement a centralized digital database that securely stores all permit data. This will eliminate the risk of misplaced documents and errors in record-keeping, providing accurate and easily retrievable records. It will provide an accurate record for any audit purposes and avoid any misplaced documents incidents or permit using permit to work system. This system will enhance security measures will protect sensitive information and ensure data integrity.

1.5 Methodology

RAD is a development method that speeds up the process through prototyping and constant feedback from users (Martin, 1991). By choosing RAD, we can create a PTW system that meets organization safety needs while being efficient and user friendly. RAD focuses on rapid prototyping and frequent user feedback, which is ideal for PTW systems that need to adapt to changing requirements. In a PTW system, safety regulations and operational procedures are strict, so it's important that the system is accurate and user-centered. RAD allows for flexibility, making it suitable for developing a Permit To Work system that can be updated based on user feedback and requirement changes.

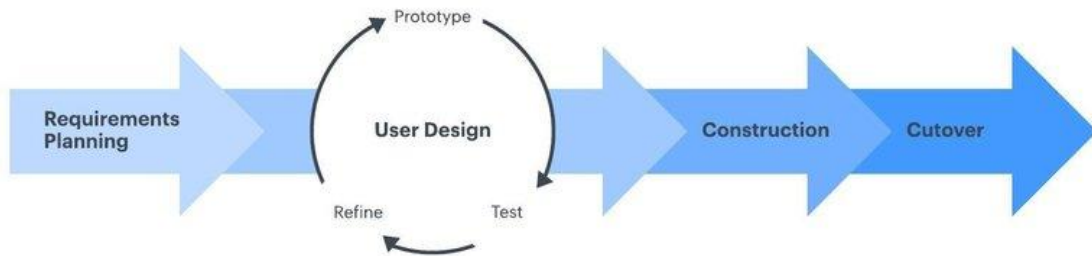


Figure 1.1 RAD methodology

1. Requirements Planning Phase

The first step in RAD is the requirements planning phase. In this phase, we will gather input from main stakeholder who will use or manage the PTW system, including safety officer, workers, and application approvers. This phase helps define the system's main functions, such as different user roles, risk assessment processes, and permission workflows including PTW approval processes.

2. User Design Phase

In the user design phase, it focus on build a prototype that includes main features, such as apply new permits, risk assessment, and following approval processes. RAD emphasizes that getting user feedback during this phase, so we would work closely with stakeholders to adjust the design based on their requirements. By refining the prototype with each round of feedback, we can make sure the PTW system is user friendly and meets safety requirements of the organization.

3. Construction Phase

The construction phase is when the PTW system becomes fully functional. The prototype will be developed by building out key modules, such as a biometric login feature, permit tracking, and hazard documentation. During this phase is also where the start of training users on the system so they can get comfortable with it and provide additional feedback for improvement.

4. Cutover Phase

In the cutover phase, the PTW system will be deployed across the organization. At this stage, we would provide training for all users and ensure they have resources to help them use the system. One benefit of the RAD method is that it encourages continued feedback even after launch, so can keep improving the system based on user input and new safety regulations.

1.6 Project Schedule

Table 1.0 Project schedule

Task	Start Date	End Date	Duration (days)
FYP 1			
Phase 1: Project planning	9/8/2024	30/8/2024	26
Identify project supervisor	8/8/2024	15/8/2024	7
Identify project title	19/8/2024	21/8/2024	2
Prepare brief proposal	22/8/2024	30/8/2024	8
Brief proposal review	28/8/2024	30/8/2024	3
Chapter 1: Project Introduction	26/8/2024	5/9/2024	9
Full proposal Preparation			
Identify Project Methodology	1/9/2024	4/9/2024	3
Full proposal review	4/9/2024	14/9/2024	10
Full proposal submission	14/9/2024	16/9/2024	2
User Requirement Gathering			
Meeting with system stakeholders	26/9/2024	4/10/2024	10
Project Timeline Planning	8/10/2024	17/10/2024	9
Preparing chapter 1 report			
Drafting chapter 1	18/10/2024	28/10/2024	10
Chapter 1 review with supervisor	24/10/2024	4/11/2024	12
Chapter 1 modification	4/10/2024	5/10/2024	1

Chapter 2: literature review	30/10/2024	22/11/2024	23
Identify similar system: system comparison	30/10/2024	6/11/2024	8
System design: Flow chart, Use Case and system UI Design	6/11/2024	20/11/2024	14
Chapter 2 review	31/10/2024	13/11/2024	14
Chapter 2 modification	13/11/2024	21/11/2024	8
Chapter 3: Methodology	29/11/2024	13/12/2024	15
System Design preparation: Review flowchart and use case diagram	29/11/2024	5/12/2024	6
System design modification	4/12/2024	11/12/2024	7
Prepare system prototype	5/12/2024	13/12/2024	8
Chapter 3 submission	29/12/2024	13/1/2025	15
FYP 2			
Chapter 4	20/3/2025	15/5/2025	56
Reviewing FYP 1 Report	20/3/2025	1/4/2025	13
Improve system UI	20/3/2025	30/4/2025	35
Develop system functionality	20/3/2025	15/5/2025	56
Chapter 4 drafting, review and modification	20/4/2025	14/5/2025	30
Chapter 5	20/4/2025	6/7/2025	46
Improve system functionality	30/4/2025	15/5/2025	15

Progress update meeting with stakeholders	20/4/2025	27/4/2025	7
Drafting chapter 5	25/4/2025	25/5/2025	30
Prepare presentation material FYP	25/5/2025	30/5/2025	5
Review chapter 5	25/5/2025	29/5/2025	5
Prepare User Training	21/5/2024	25/5/2024	4
Chapter 5 and system modification	25/5/2025	5/6/2025	31
Report review	5/6/2025	6/6/2025	2
Project presentation	20/6/2025	23/6/2025	3
FYP Symposium	1/7/2025	2/7/2025	2
Project closure and evaluation	1/7/2025	6/7/2025	5

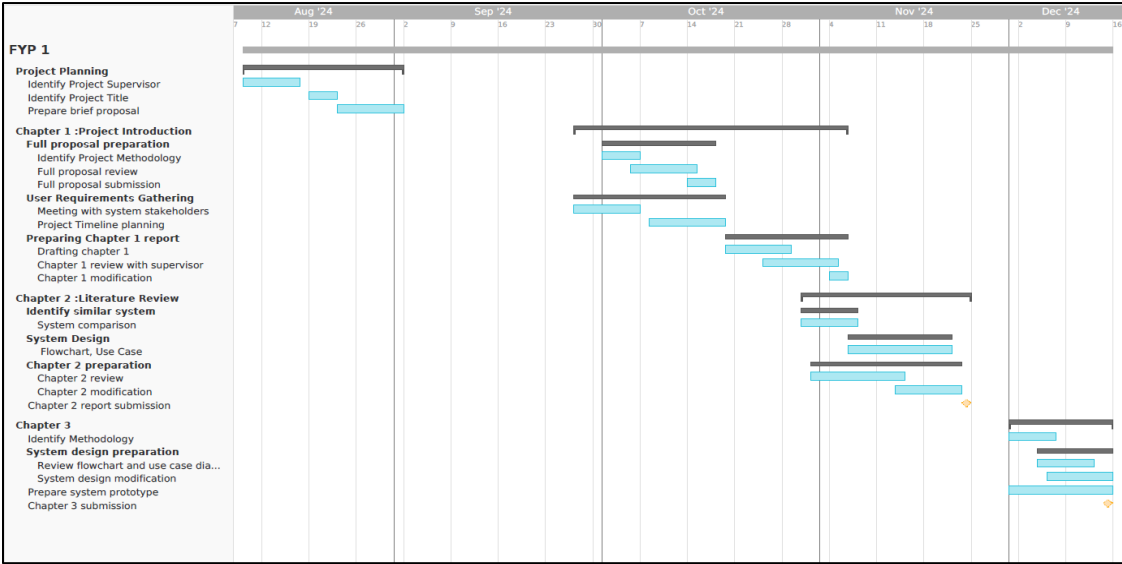


Figure 1.2 Project FYP1 Gantt chart

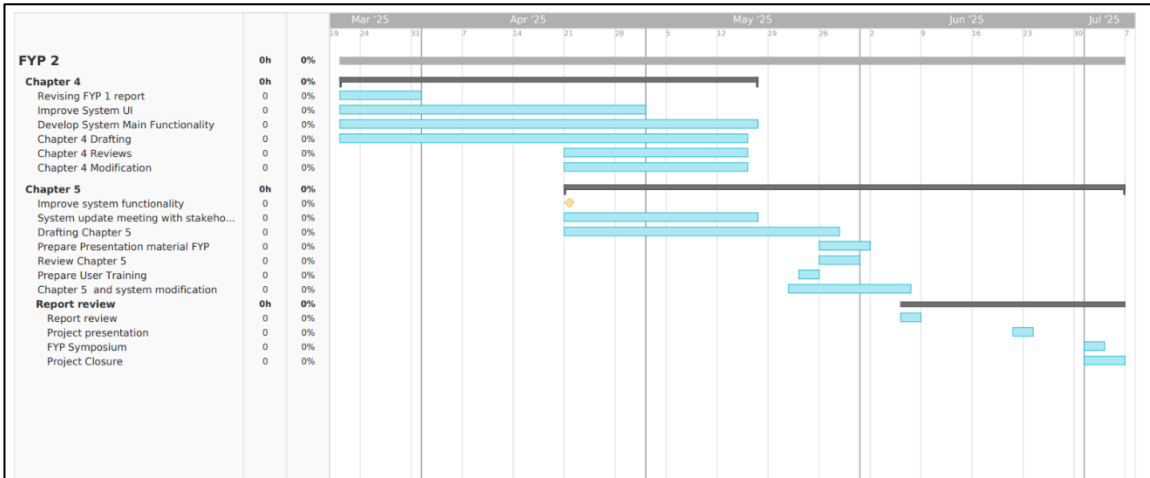


Figure 1.3 Project FYP 2 Gantt chart

1.7 Significant of Project

The development of a digital Permit to Work (PTW) system for Sarawak Digital Economy Corporation (SDEC) carries significant benefits for safety, efficiency, and data management. By transitioning from a paper-based system to an electronic one, this project will improve real-time monitoring and ensure that safety protocols are followed more effectively, reducing the risk of workplace accidents and ensuring safer operations on-site. The streamlined permit application and approval process will save time and reduce the complexity of permit management, allowing employees and management to focus on their core tasks without delays. Additionally, the system will enhance the accuracy and security of permit records, eliminating the possibility of lost or misplaced documents. This will lead to better accountability, easier auditing, and a clear record of all onsite activities. The centralized digital database will allow for quick access to information, which can help improve decision-making and provide stakeholders with an overview of ongoing operations. Ultimately, this project will boost operational efficiency, ensure compliance with safety standards, and promote a culture of safety and accountability at SDEC.

1.8 Expected Outcome

1. Efficient Digital Permit Management System

A fully functional e-Permit to Work (PTW) system that automates and simplifies the entire process, from permit application to approval, reducing manual intervention and paperwork.

2. Improved User Experience

A user-friendly interface designed for both employees and management that simplifies the permit workflow, making it easier to track and manage permits in real-time, regardless of location.

3. Real-Time Monitoring and Alerts

The system will provide real-time tracking of onsite activities and the status of permits, along with automated alerts and notifications for key milestones or issues that require immediate attention.

4. Centralized and Secure Data Storage

A centralized digital database that securely stores all permits, ensuring data accuracy, easy retrieval, and safeguarding of sensitive information with robust security measures, including user authentication and data encryption.

5. Enhanced Reporting and Auditing Capabilities

The system will generate detailed reports on permit activities, approval times, and safety compliance, making it easier to analyse performance metrics and ensure compliance with safety standards. It will also support audit trails for accountability.

6. Reduced Processing Time

By automating workflows and minimizing manual errors, the system will significantly reduce the time taken to process permits, and meeting the company's time frame for each permit processing time of 3 days or less.

1.9 Project Outline

Chapter 1 introduces the project, outlining its scope, objectives, and expected outcomes. It also provides a brief overview of the methodology to be used in developing the project. Chapter 2 focuses on the literature review, comparing features of the proposed system with existing PTW systems. It highlights system improvements and proposed features based on these findings.

Chapter 3 details the project requirements and design, elaborating on requirements gathering, system flow, and design elements such as use case and sequence diagrams. Chapter 4 covers the implementation phase, including the tools, programming languages, and environment settings utilized in the development process.

Chapter 5 discusses the testing phase, focusing on system functionality testing based on the developed modules. It outlines test cases and analyses testing outcomes.

Chapter 2: Literature Review

2.0 Chapter Introduction

In this chapter, it will explore the existing systems related to the Permit to Work (PTW) process to understand their features, strengths, and limitations. By comparing these systems, it will help to identify gaps and opportunities for improvement that can guide the development of an enhanced PTW system. Additionally, this chapter will review the technologies and tools commonly used in system development, such as databases, frameworks, programming languages and more other software to ensure the implementation is robust and efficient. This literature review will serve as a foundation for making informed decisions about the design and technologies required for the new PTW system, ensuring it meets the specific needs of users and addresses existing challenges effectively.

2.1 Similar existing systems

There are existing Permit To Work system that are used by different sector of company. Some company still implement paper based form permit and some already implemented digital permit to work system. There are two existing digital permit to work system that are currently used by organisation which are Universiti Teknologi Malaysia PTW online and Taylor’s University PTW system.

2.1.1 Universiti Teknologi Malaysia (UTM) PTW Online



Figure 2.1 UTM PTW homepage

Universiti Teknologi Malaysia (UTM) is one of Malaysia University that implemented Online Permit to work system to monitor any work conducted in UTM sites and facilities as shown in Figure 2.1. This Permit system was established in 2024. This permit system allow contractors to apply permit or work permission to enter the university to commence any construction in the university sites. However, this system has a few weaknesses that need to be improved, particularly in terms of website security and user interface design.

2.1.2 System Details

The UTM Permit to Work (PTW) system is a web based system. This system currently uses an outdated user interface, which can frustrate users and hinder accessibility on mobile devices due to its lack of responsive design. Without responsive features, the layout becomes difficult to navigate on tablets and smartphones, limiting users' ability to complete tasks efficiently. Additionally, slow loading time often due to large, unoptimized images and excessive unused scripts that will further impact the system's efficiency. This results in poor user satisfaction and reduce trust, as users are likely to abandon the system due to these performance issues. On the other hand, in terms of security of the system, UTM permit to work uses <http://ptw.utm.my/index.php> which uses HTTP (Hypertext Transfer Protocol) and not using HTTPS, which make the system lacks encryption and generally considered less secure to be use. Without using HTTPS, the data sent between user and server is not encrypted which make it more vulnerable to attacks. This will lead the system lack of data privacy and integrity.

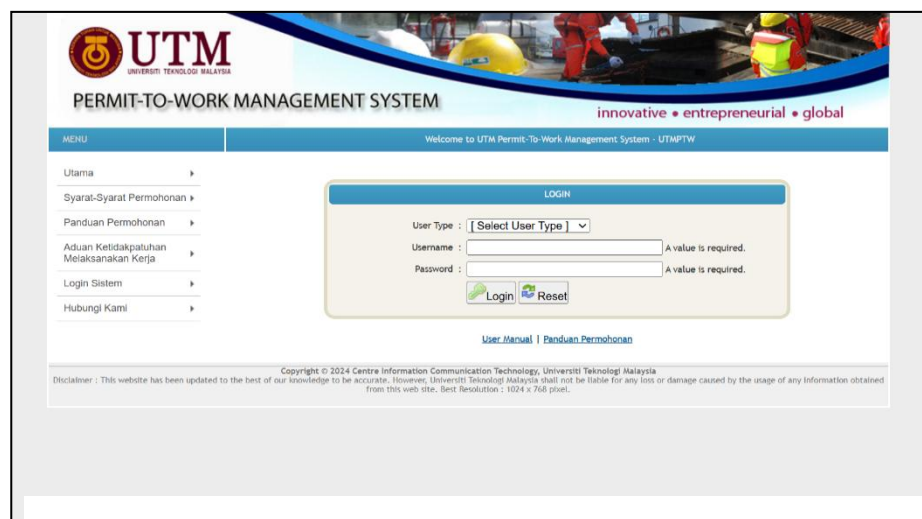


Figure 2.3 UTM PTW login page

2.1.3 Taylor's University

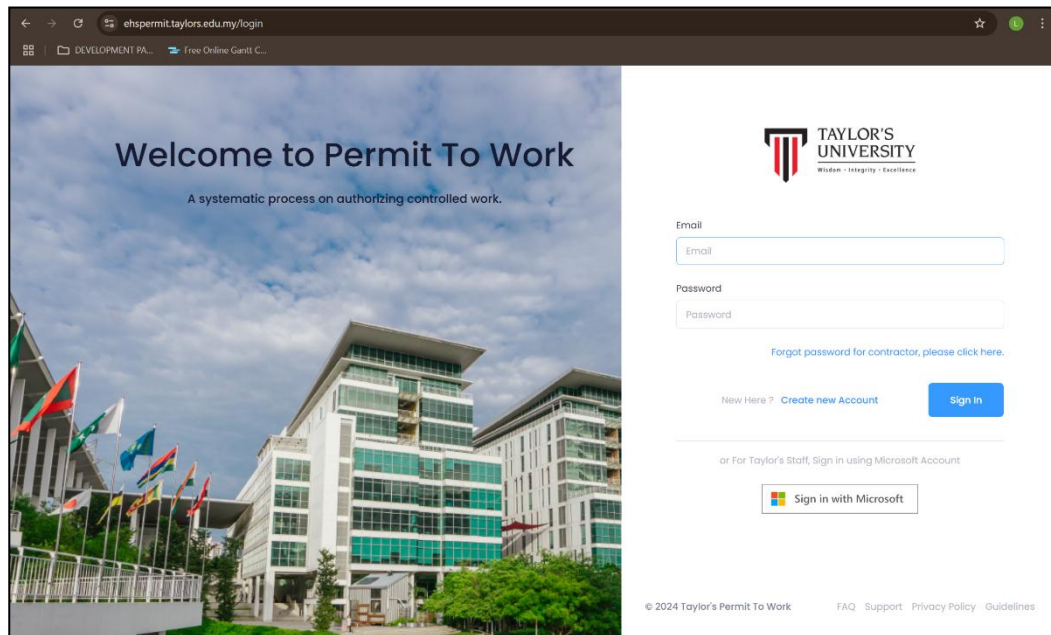


Figure 2.4 Taylor's Permit To Work

Taylor's University has launched Permit to work system on May 2022. This system will be used by Taylor's administrator to monitor project and works commence in Taylor's University sites and locations. Figure 2.4 shows the formal system at Taylor's University that helps to manage high-risk activities to ensure safety on campus. The PTW system sets a framework to oversee work processes like electrical maintenance, confined space work, hot work (like welding), and others where risks are high. This system aligns with Taylor's goals to fostering a safe learning and working environment for students, staff, contractors, and visitors by following safety protocols to prevent accidents and ensure compliance with occupational safety standards.

2.1.4 System Details

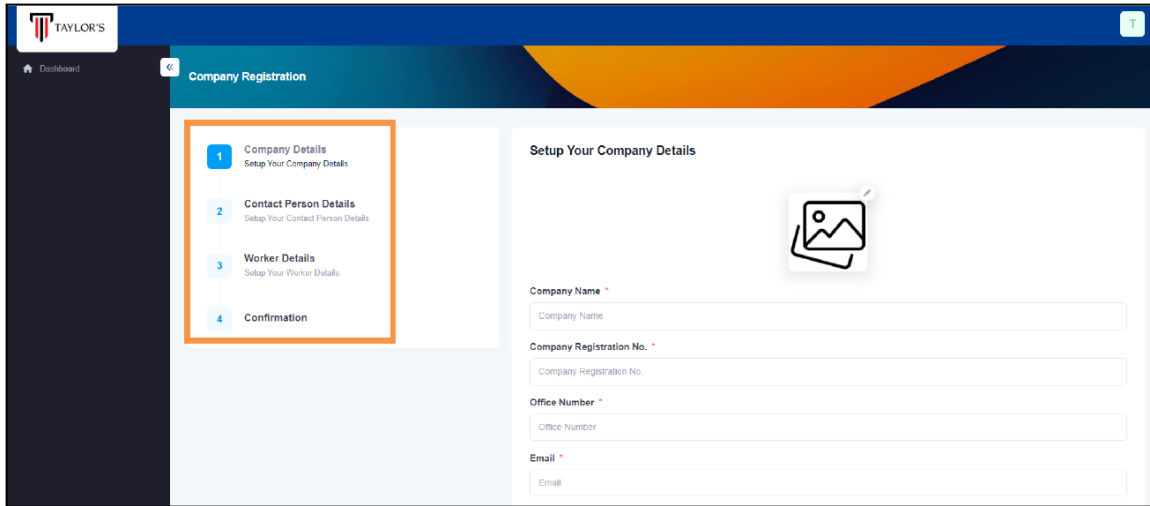


Figure 2.5 Registration process

This permit to work system by Taylor's University is a web based system . To have access to this permit to work system, user are required to register their company and the contact person on behalf of the company. After completing the account setup process, then user will be navigated to the account dashboard. Figure 2.5, showing the company details, contact person details and workers details that need to be completed by user before they can apply for a permit.

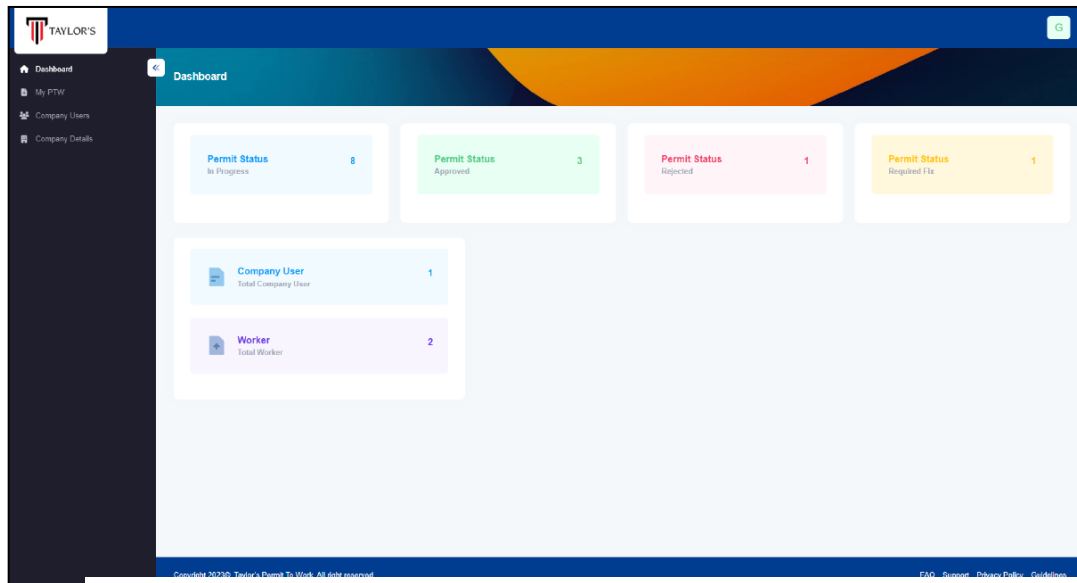


Figure 2.6 System dashboard

After completing the registration, system will display a dashboard and summary of permit status (pending, rejected, approved and in progress) and total of company workers . Figure 2.6 shows dashboard will help user to review their permit status summary and they can keep track of permit

progress. Taylor’s permit system allow user to view all of the application list and they have a user friendly user interface, which will help user to differentiate permit based on their status. Figure 2.7 below shows how the system have standardize colour for permit that is approved, rejected and in

NO.	PROJECT TITLE	PERMIT TYPE	ACTIVITY TYPE	PROJECT END DATE	STATUS	DURATION OF EXTENSION	STATUS OF EXTENSION	ACTION
1	070223	Non-Event	Maintenance & Repair	21/02/2023 12:00 pm	Approve	N/A	N/A	
2	070223 - 2	Event	Maintenance & Repair	21/02/2023 12:00 pm	Request Fix	N/A	N/A	
3	070223 - 3	Event	Maintenance & Repair	07/02/2023 12:00 pm	Draft	N/A	N/A	
4	130223	Event	Inspection	13/02/2023 12:00 pm	In progress	N/A	N/A	
5	a	Event	Maintenance & Repair	03/02/2023 12:00 pm	In progress	N/A	N/A	

Figure 2.7 List of PTW application

progress.

User can click button ‘apply permit’ to create a new permit to work and user can fill in all of the work details for example activity type, permit type and set location where the work will commence. User are also required to enter the list of staff that will get involves with the work and other details that are needed based on the organisation safety compliance. Figure 2.8 shows the permit application and most of the input type that are used in the permit application is select option. This will reduce the probability to type in a wrong wording when applying for permit.

Apply Permit
Dashboard - My PTW

PTW Form
Setup Your PTW Form

Enter your Taylor's University Permit To Work (PTW) Form

Project/Event Set-Up Title *
Project/Event Set-Up Title

Detailed Project Description *
Detailed Project Description

Permit Type *
-- Please Select --

Activity type *
-- Please Select --

Specify Exact Location of Work

Location 1 *
Please specify area, block, and floor

Location 2 (optional)
Please specify area, block, and floor

Figure 2.8 PTW form

2.1.5 SDEC Permit to Work paper-based form

PERMIT TO WORK

LET'S GO HOME SAFELY

PAGE 1

SECTION A (to be filled up by Vendor / Supplier / Contractor / Transporter)

Company Name :		Purchase Order / Work Order / Contract No : _____
Person In Charge :		PTW NO : _____
Address :		
Contact No. :		

The contractors assigned must provide ONE supervisor to supervise at sites until the task is completed & compliance to Department of Occupational Safety & Health (DOSH) / Occupational Safety & Health Act 1994 / Factories & Machinery Act 1967, other Local Authorities & Relevant Parties Requirements

SECTION B (to be filled up by Vendor / Supplier / Contractor / Transporter)

Description of Work : _____

Type of Activity : _____ (Inspection / Maintenance / Installation / Others)

Location / Site Name : _____ Region : _____

Start Date / Time : _____ For PTW Link - Site A Name / Link Site A - Site B End Date / Time : _____

Details of Staff (Tick Where Applicable for Related Requirement) :-

No	Name	IC No / Passport No	Contact No.	Designation	NTMSP	HRADC	WAI	Others (Please Specify)

DECLARATION AND APPROVAL BY CONTRACTOR TO COMMENCEMENT

I / We understand and accept all the terms and conditions the work prescribed is to be carried out and safety precautions that are necessary to complete the work safely as outlined in the appropriate method statement and risk assessments. If conditions are such that the method statement and risk assessments become invalid it is my responsibility to stop work immediately and notify the person who authorised this permit to work. The disposal of any residues of the hazardous material used will be in accordance with the Environmental Quality Act. The person who undertake this work also liable to comply to all the Statutory Requirement imposed by the authorities.

Signature, Name of Applicant & Company Stamp

Declared by (Supervisor):	Approved by (Company Management):
Signature	Signature
Name :	Name :
IC No :	IC No. :
Date :	Date :

SECTION C (to be filled up by SDEC Berhad)

* In-case of emergency please call the following Safety Officer/PIC

Name : _____ (PIC/ Regional Safety Department)	Concurred by:
Contact No : _____ or 999 (nearest Police Station / Bomba / Hospital)	Signature (Health & Safety Officer) Name : FATIMAH SULAIMAN Date :
Approved by:	Verified by:
Signature (Project Owner)	Signature (Security Officer)
Name :	Name :
Date :	Date :

PROPRIETARY OF SDEC

Figure 2.9 Sample of SDEC PTW form

Figure 2.9 shows the sample of permit to work form that is implemented in SDEC. SDEC still using paper-based form instead of digitalising the system. By using this method, staff and contractors encounter problems where the permit took longer to be approve as the method requires

contractor to meet approver in person and request for approval through email or personal message. This method also lack of real time monitoring where most of approver unable to keep track permit that is on going and closed. Another problem that is encountered by the user when applying permit using manual or handwritten permit, this will increase high risk of human errors. Permit to work is critical as this permit is to ensure that all applicants comply with the safety requirements and aware of the work risks associated with work conducted. These paper-based system will prone to misfiled documents as the amount of PTW applicants increases, user unable to store their permit record in correct manners as a record for audit purposes unless they have a proper and systematic filing system. However, for a long run, this system will not longer sustainable as the applicants of PTW will increases.

2.2 System Features Comparison

Table 2.1 System features comparison

System Features	Existing system		Paper-based form	Proposed system
	UTM permit to work system	Taylor's Permit to Work system	SDEC Paper Based form	SDEC e-Permit To Work system
New user registration	✓	✓	-	✓
User Login	✓	✓	-	✓
Workers Registration	-	✓	-	✓
View List of application	✓	✓	-	✓
Apply new permit to work	✓	✓	✓	✓
View Staff verification	-	✓	-	✓
Print Permit copy	-	✓	-	✓
Resubmit Returned Permit	-	-	-	✓

View approval history	-	✓	✓	✓
Forgot Password	✓	✓	-	✓
View List of Service Affecting sites	-	-	-	✓
Filter Permit by status	-	✓	-	✓
User Guideline page	✓	✓	-	✓

2.3 Tools and Technology

In this section, we will take a look at the tools and technology that will be use to develop this proposes system. This proposed system is a web based system that will used ease the process to apply permit to work.

2.3.1 CodeIgniter 4 Framework

The framework that will be use to developed this system is CodeIgniter 4. CodeIgniter 4 framework is a PHP full-stack web framework. CodeIgniter 4 follows the Model-View-Controller (MVC) architectural pattern, which helps separate business logic, presentation, and data manipulation layers. This structure improves code maintainability and scalability. CodeIgniter 4 requires PHP version 7.4 or higher, it requires updated PHP features such as strict typing, anonymous functions, and better performance. This framework implemented a powerful and flexible routing system that enables clean, user-friendly URLs and supports custom route definitions. The advantages of CodeIgniter 4 framework is that this framework is lightweight and high performance. This framework is simple to learn where it can be use by all developers from different level of coding skills. Additionally, CodeIgniter is a robust tools for debugging and error handling.

2.3.2 Laragon development environment

Laragon is local development environment that can be use by developers to develop web system. Laragon is a flexible and ease to use compare to XAMPP or WAMP as local development environment. To boost or ensure fast local development, Laragon implemented project specific URLs through virtual hosts for example 'http://myprojectname.test' . Laragon automatically creates the virtual host for projects and we are not required to configure project virtual hosts which means each project will have its own URL rather than implementing traditional way to access the project. Besides, Laragon supports multiple version of PHP, Databases and web servers where it will allow developer to switch between configurations easily. This will gives flexibility to developers to code using different databases.

2.3.3 MariaDB database

MariaDB database is a relational database management system(RDBMS) that is associated with MySQL. MariaDB is designed to be compatible with MySQL. This database is widely used for storing, managing and retrieving data in various application and system from a small projects to a big scale of projects. As the proposed system will receive big amount of application and data, MariaDB able to support large scale of projects that involves big amount of data.

2.3.4 BSA Authentication

BSA Authentication is a software solution designed to provide user biometric authentication for the Permit to Work (PTW) system. This technology ensures secure and efficient access control by requiring users to authenticate using their unique biometric traits, such as fingerprints, and facial recognition. By integrating biometric authentication, the system eliminates the risks associated with traditional password-based methods, such as forgotten credentials or unauthorized access.

Additionally, BSA Authentication enhances accountability within the PTW process, as it provides a definitive record of who accessed the system and when. This not only improves compliance with safety regulations but also reduces the potential for fraudulent activities. The software is designed to be user-friendly, ensuring seamless

integration into the PTW system with minimal disruption to workflows. With biometric authentication, the PTW system becomes more secure, reliable, and aligned with modern security standards.

2.3.5 Azure AI Document Intelligence

Azure AI Document Intelligence formerly known as Azure Form Recognizer, is a tool that can be integrated into the Permit to Work (PTW) system as an intelligent document scanner. It uses advanced AI models to extract key information from documents, such as permits, safety checklists, and approvals, with high accuracy and efficiency. By leveraging this tool, the PTW system can automate the process of reading and analysing paper-based or digital forms, reducing manual data entry errors and saving time. Additionally, it supports various document formats and languages, making it a flexible solution for streamlining workflows in PTW that rely heavily on documentation for operational safety. This integration not only improves data management but also enhances overall compliance with safety standards.

2.4 Chapter Summary

This chapter discusses the technologies used in developing the Permit to Work system, comparison of existing PTW systems and explains how each of the system permit applications flow. In this chapter, it discussed on the traditional paper-based PTW process and digital PTW systems. The manual method of PTW is slow, prone to human error, and document misplaced. By using existing digital system are faster, however some system still lack of features like reminders, real time updates or detailed tracking. The proposed system will improves this by automating workflows and send out notification for real time updates and ensure all the process of PTW is efficient. The technologies used in the proposed system will ensure that system will be fast, reliable and easy to be used by the users. Overall, Chapter 2 highlights how the new PTW system will implement the proposed technology to make the process faster and accurate.

Chapter 3: Requirement Analysis and Design

This chapter discusses on the methodology that will be used to develop the proposed system which is PTW system. The methodology is a method or framework to plan and analysis the process of developing the system. In requirement analysis and design phase, it can help to identify the problems based on the user's needs. In this chapter, activity diagram and class diagrams together with the user interface (UI) designs will be used to represent the overall concept of the proposed system.

3.1 Proposed system description

The proposed Permit to Work (PTW) system is designed to streamline and enhance the process of managing work permits in hazardous or regulated environments. It serves as a digital platform where all activities related to issuing, approving, monitoring, and closing permits are centralized for better efficiency and safety compliance. This system provides a structured workflow, ensuring that work is only carried out under safe conditions and with proper authorization from SDEC staff. The PTW system allows users, such as site owners, contractors, project owners and safety officers, to create and manage permits for different types of tasks, such as maintenance, electrical work, or confined sites entry. Each permit includes essential information such as work descriptions, associated hazards, required precautions, and the roles of individuals responsible for the work. By incorporating features like hazard identification, risk assessments, and approval workflows, the PTW system helps reduce risks and ensures accountability. It also supports the attachment of relevant documents, such as safety checklists and training records, making it easier to track compliance with regulations. Furthermore, the system generates real-time notifications and reports, helping management maintain an overview of ongoing and completed work. By automating many manual processes, the proposed system minimizes human error, increases productivity, and creates a safer working environment.

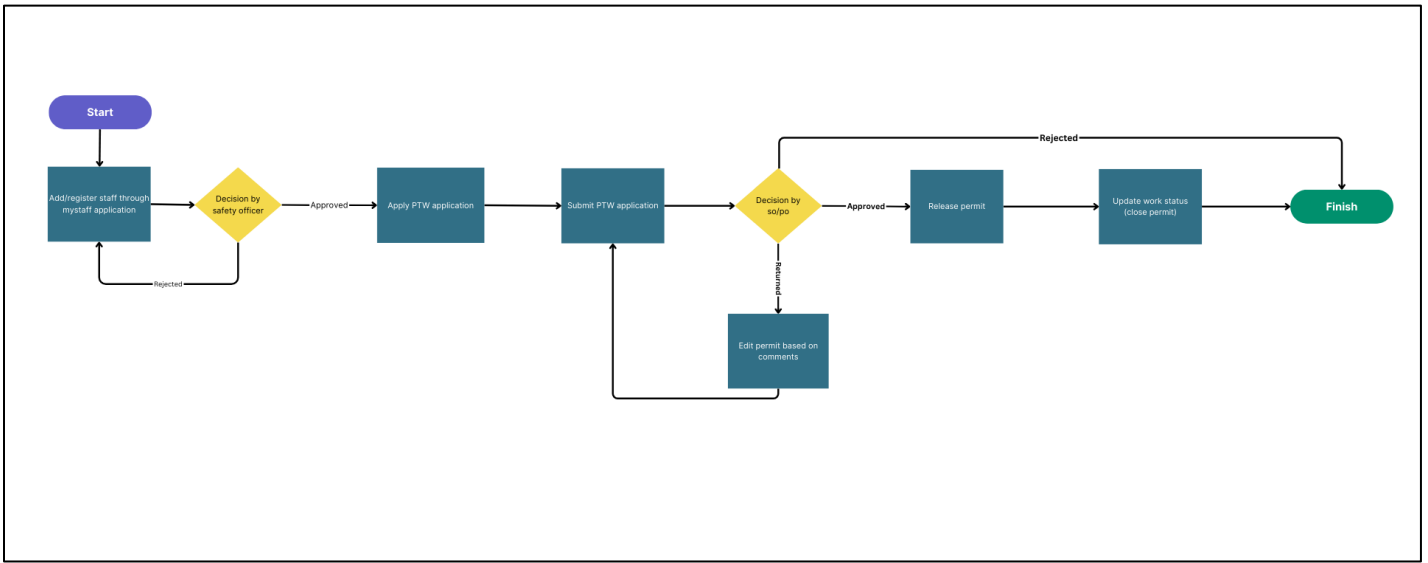


Figure 3.1 Permit to work system flowchart

Figure 3.1 represents the current workflow used in SDEC to apply for permit to work to enter construction sites, which outlines the step by step process for managing the proposed Permit to Work (PTW) system. The process begins with the registration of staff through the MyStaff application form. Once staff are added, a Safety Officer evaluates the registration. If the registration is rejected, the process loops back for necessary corrections. If approved, the staff can proceed to apply for the PTW.

Next, the PTW application is submitted for review. The application undergoes a decision-making process by the site owner or project owners. If the application requires further adjustments, comments are provided, and the applicant can amend the permit accordingly before resubmission. If the application is rejected, the process ends. However, if approved, the permit is released and they are permitted to enter the site.

After the permit is issued, the work status is updated, and the permit is closed upon completion of the relevant tasks. The workflow concludes with a final step, ensuring that all tasks associated with the permit have been completed appropriately. This structured workflow ensures compliance, accountability, and efficient processing within the PTW system.

3.2 Methodology

The development of the Permit to Work (PTW) system using the Rapid Application Development (RAD) methodology ensures an iterative and user-centric approach to creating a robust and efficient safety management tool. RAD emphasizes speed and adaptability in software development by focusing on rapid prototyping, continuous feedback, and collaboration with end-users throughout the development process. This methodology is suitable for systems like PTW, where the requirements of various stakeholders, such as safety officers, workers, and supervisors, must be carefully integrated to achieve a functional and user-friendly solution. Using RAD, the PTW system can be divided into modular components, such as permit creation, hazard assessment, workflow management, and reporting, which are developed and tested in parallel to accelerate the delivery timeline.

3.3 System Functional Requirements

Based on the understanding of the current flowchart to apply for permit to work to enter the construction sites for SDEC, Table 3.1 shows the functional requirements for the proposed smart PTW system.

Table 3.1 PTW functional requirements

Functional Requirement No	Category	Description
1	Permit Creation	<ul style="list-style-type: none"> • Allow users to create permits with required information • Include dynamic fields and validations based on the type of work. • Support saving drafts and submitting permits for approval.
2.	Permit Approval	<ul style="list-style-type: none"> • Send permits to appropriate approvers based on workflows. • Enable approvers to approve, reject, or request modifications(Returned). • Send notifications to Applicants for status updates.
3.	Permit tracking	<ul style="list-style-type: none"> • Track permit status in real time (e.g., pending, approved, rejected, expired, Closed). • Provide a analytics dashboard for ongoing, pending, and closed permits.

		<ul style="list-style-type: none"> Track permit expiration dates with automated reminders.
4.	Permit Work Updates & Closure	<ul style="list-style-type: none"> Allow Applicants to submit work updates for ongoing permits Verify if updates meet closure criteria and mark permits as "Complete" or "Incomplete." Automatically mark permits as "expired" if no response is provided
5.	Notifications & Alerts	<ul style="list-style-type: none"> Send notifications for any updates on permit status Alert Site Owner and Project Owner for overdue permits or incomplete updates
6.	Audit and reporting	<ul style="list-style-type: none"> Maintain an audit log for all actions taken within the system Generate reports for submitted, approved, rejected, or expired permits. Support report export in multiple formats (excel and CSV)
7.	System Accessibility	<ul style="list-style-type: none"> Ensure the system is mobile-friendly with responsive design Allow main functions (submitting, approving permits) available and easy to access on mobile devices and desktop
8.	System Access Control	<ul style="list-style-type: none"> Restrict data access to authorized users based on roles.

3.4 Requirement Gathering Method

The requirement gathering process for the PTW (Permit to Work) system was conducted through direct interactions with Sarawak Digital Economy Corporation (SDEC), system reviews, team meetings, and document analysis. These approaches ensured that the system was developed in alignment with the company's operational needs, compliance requirements, and existing workflows. The process began with stakeholder engagement, where discussions were held with key personnel, including safety officers, project managers, and system users, to understand their specific needs, challenges, and expectations for the digitalized PTW system. These direct interactions provided critical insights into the current manual permit approval process, identifying inefficiencies and pain points that needed to be addressed in the new system.

System reviews were conducted to analyse any existing digital tools or systems being used within the organization to ensure that the PTW system would integrate seamlessly with the company's digital infrastructure. Furthermore, team meetings played a crucial role in refining requirements and validating proposed system functionalities. Regular discussions were held with internal teams, including IT Team and system owners, to ensure that all technical and business aspects were considered. These meetings also facilitated iterative feedback, enabling adjustments to the system design based on inputs from stakeholders.

Additionally, document analysis was conducted to review existing company policies, standard operating procedures, permit application forms, and compliance regulations governing the PTW process. This step was essential in ensuring that the system adhered to regulatory requirements and organizational standards. The analysis of historical permit approval records also provided valuable data points for designing an efficient approval workflow that reduces processing time.

3.5 Use Case Diagram

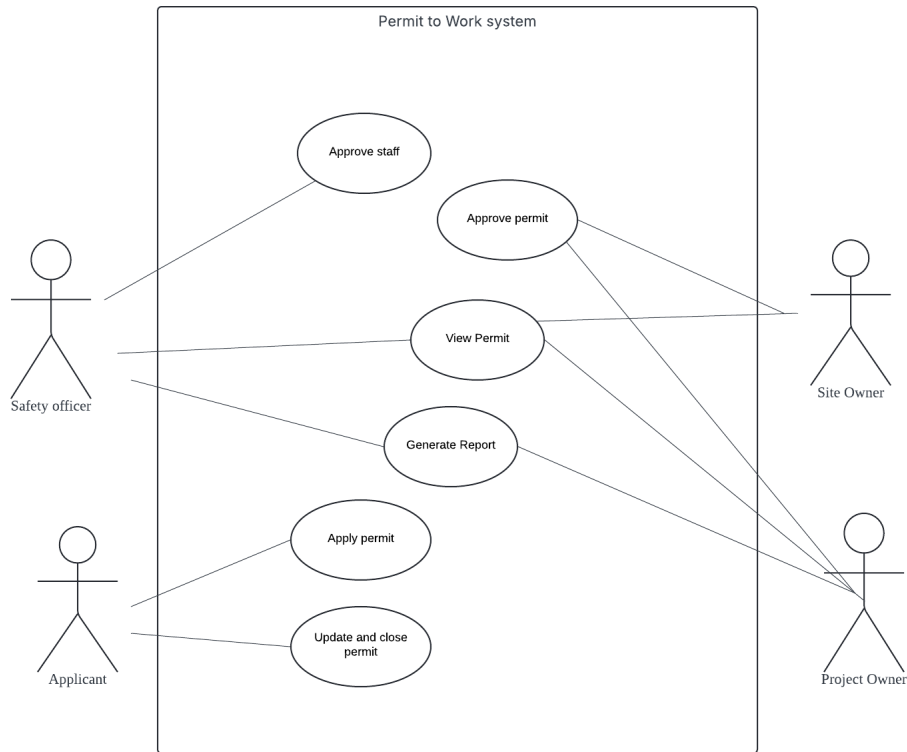


Figure 3.2 PTW system use case

The use case diagram for the Permit to Work System in Figure 3.2 show interactions between four key actors Safety Officer, Site Owner, Project Owner, and Applicant. The responsibilities of each of the actors are shown in Table 3.2. The Applicant can apply for and update permits, while the Safety Officer approves staff, views permits, and generates reports. The Site Owner and Project Owner approve permits, view permits, and generate reports. This system streamlines the permit approval process, enhances tracking, and ensures compliance through digital records, reducing manual paperwork and improving efficiency.

Table 3.2 Use case description

Use Case	Actor	Description
Approve Staff	Safety Officer	Safety Officer is responsible for approving staff members before they can apply for a permit. This ensures that only authorized personnel can proceed with the permit application process.

Approve Permit	Site Owner, Project Owner	The permit approval process involves reviewing submitted applications to ensure compliance with safety regulations. The Site Owner, and Project Owner have the authority to approve or reject permits based on the provided information.
View permit	Safety Officer, Site Owner, Project Owner	User can view permit details, including the status, validity, and associated documents. This functionality allows for monitoring and tracking permit progress.
Generate Report	Safety Officer, Site Owner, Project Owner	This function enables users to generate reports related to PTW applications. Reports can be filtered based on different parameters, such as date, status, and type, and are useful for auditing and compliance tracking.
Apply permit	Applicant	Applicants apply permit by submitting a request with the necessary details and supporting documents. This request is then reviewed by authorized personnel for approval.
Update and Close permit	Applicant	Once the work is completed, the applicant updates the permit status and provides closure details. This ensures that completed permits are documented and archived properly.

3.6 Activity Diagram

In this section, the various features of the Permit to Work (PTW) system are explored through detailed activity diagrams, which visually represent the workflows and processes involved in each feature. The activity diagrams provide a clear and structured overview of how each feature operates within the system, highlighting the sequence of actions, decision points, and interactions between different stakeholders. For example, the diagram for the permit creation feature illustrates the steps involved in initiating a new permit request, capturing essential details like the type of work, location, and hazards, and submitting it for review. By presenting these activity diagrams, this section aims to provide a comprehensive understanding of the PTW system’s functionality and the interactions between its features. These diagrams not only serve as a visual representation of the system's design but also help identify potential areas for improvement and optimization during development. Through this approach, the PTW system can be built to align with organizational safety goals and regulatory requirements while providing an intuitive and user-friendly experience for all stakeholders.

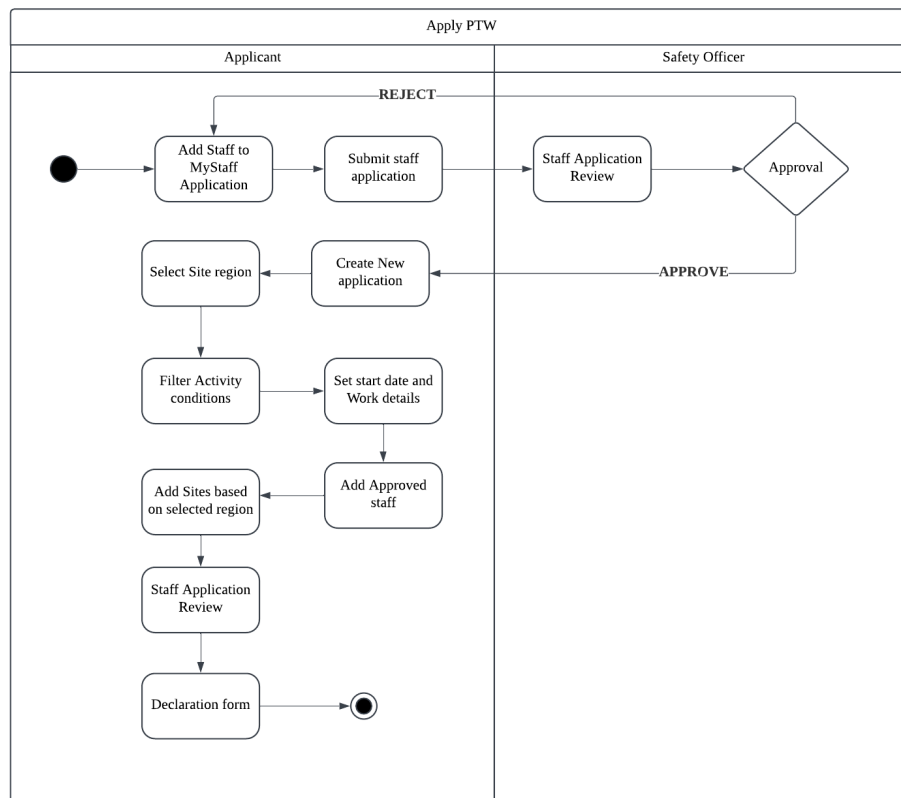


Figure 3.3 Apply PTW activity diagram

Figure 3.3 shows the process of applying new permit using the proposed system. The user is required to add or register their staff before creating a new permit to work. Each of the staff that is registered, needs to be verified by Safety officer to ensure all of staff or workers that involves with the work commence on site is fully equipped and trained well based on the work scope. After the staff is approved by the safety officer, the applicant can apply for a new permit to work application. The applicant needs to specify the site region, activity or work details. This will affect the list of approved staff that can be added to the list of staff in the form as the staff must be qualified to do work based on their skills and certifications. Other details they can add to ptw form are start and end date, add sites based on region selected and add approved staff. At the end of the form, they are required to sign or agree to the declaration form by SDEC.

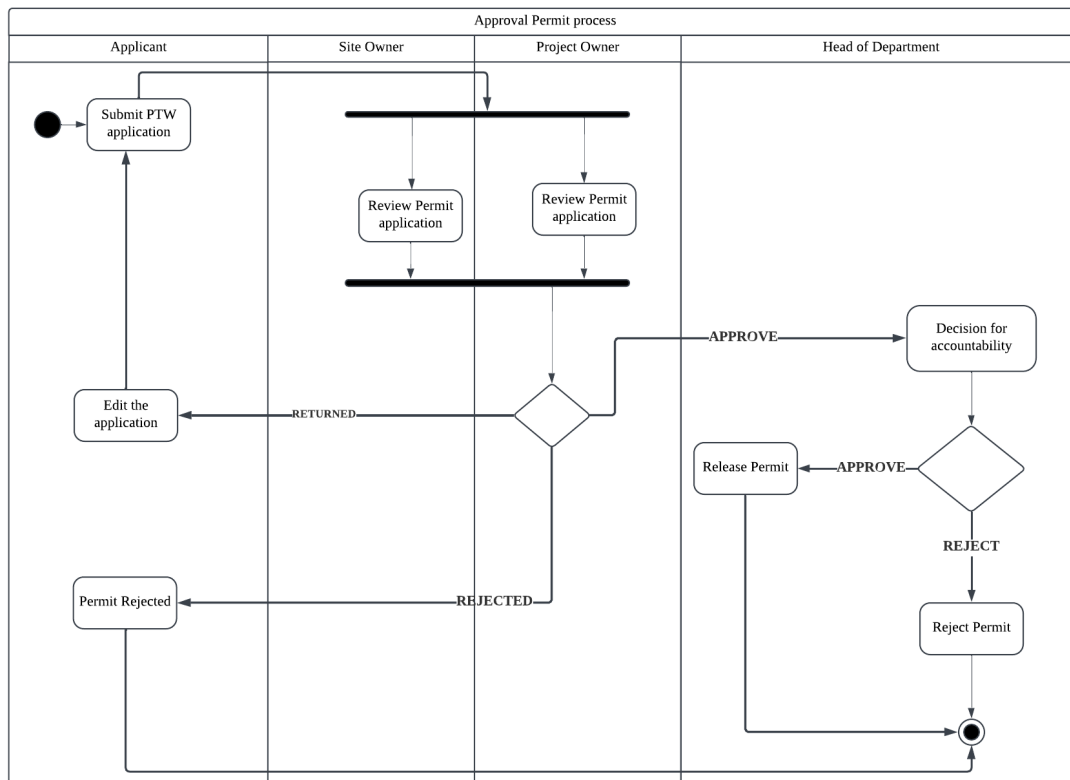


Figure 3.4 Approval permit process activity diagram

Figure 3.4 shows the approval process for PTW applications. There are 2-tier of approval process. The first tier of the approval process involves two stakeholders, which are site owner and project owner. The approval will be done simultaneously. If one of the approver rejects the permit the

permit will be auto rejected by the system. If both of the approver approved the permit, then the permit will need to be approved through the second tier of permit. The last tier of approval will involve the head of department of the permit project owner. This approval process is known as decision for accountability for the permit approval. This is to ensure that all of stakeholders are aware of the risk of the work commence on site and PTW critical level. If the permit is approved by the Head of department, then the permit will be released to the applicant. However, if rejected, the applicants need to apply for a new permit.

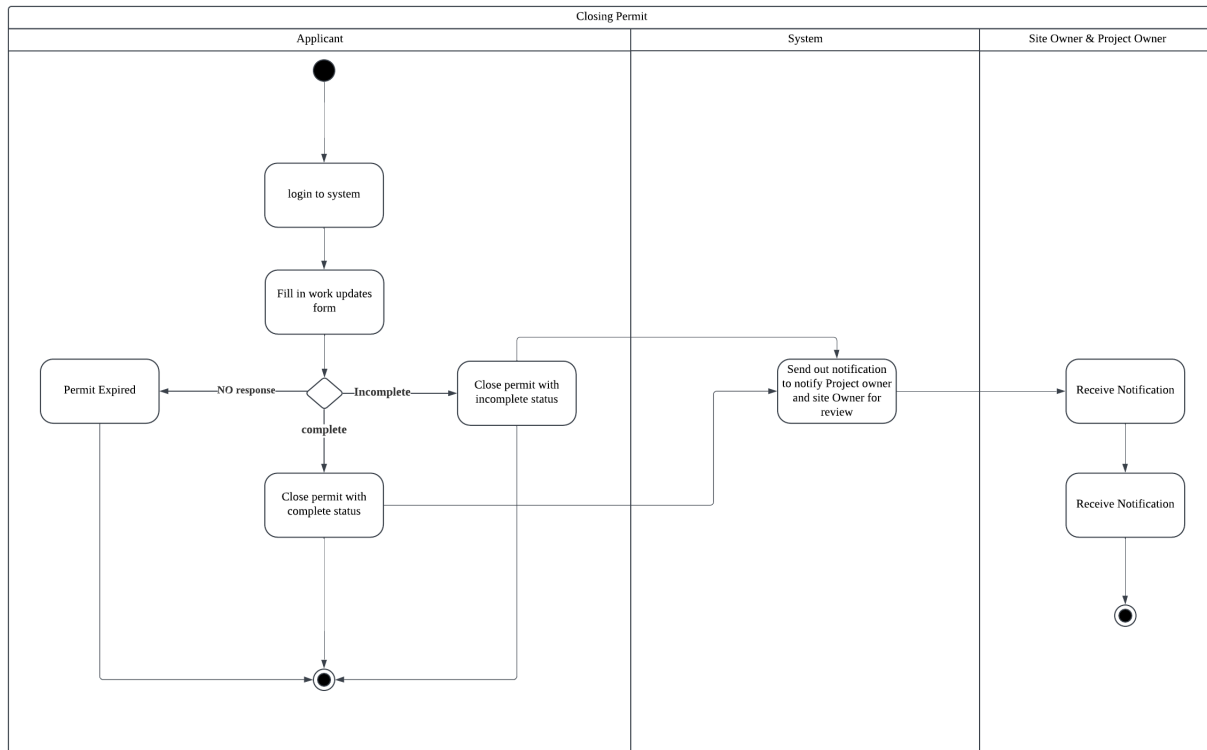


Figure 3.5 Closing permit process activity diagram

Figure 3.5 illustrates the process for closing a permit, involving three key stakeholders: the Applicant, the System, and the Site Owner & Project Owner. The process begins with the Applicant logging into the system and filling out a work updates form. Based on the submitted information, the system determines whether the permit closure is complete or incomplete. If the closure is marked as incomplete, the system closes the permit with an "Incomplete" status and sends notifications to the Site Owner and Project Owner for review. If the permit is complete, it is closed with a "Complete" status. In cases where the Applicant fails to respond, the permit is marked as expired. Notifications are sent to the Site Owner and Project Owner to ensure proper oversight and

review. This workflow ensures that the permit closure process is systematic and involves all necessary stakeholders for validation and accountability.

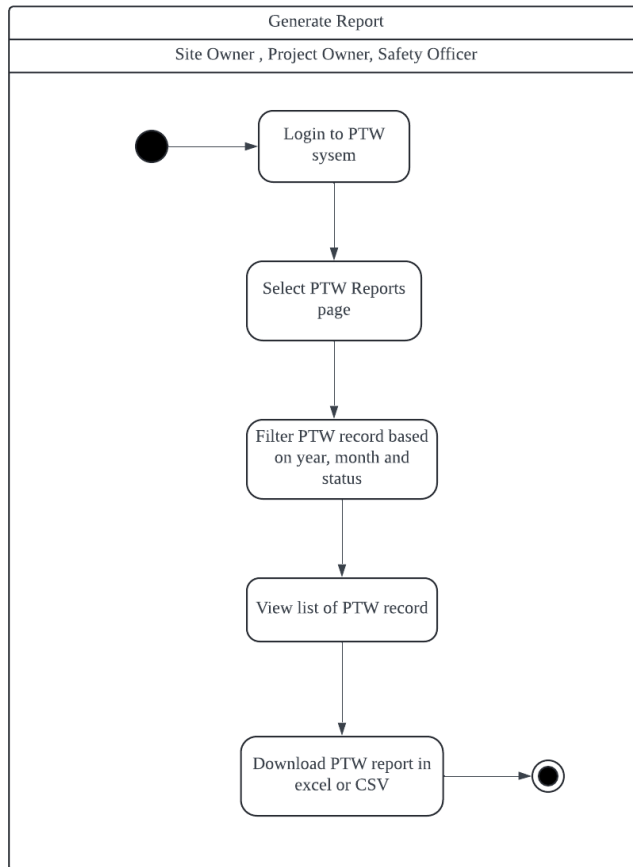


Figure 3.6 Generate report process activity diagram

Figure 3.6 illustrates the process flow for generating reports within the Permit to Work (PTW) system. The diagram outlines the sequential steps undertaken by authorized users, including the Site Owner, Project Owner, and Safety Officer, to retrieve PTW records for auditing and monitoring purposes. The process begins with the user logging into the PTW system, followed by navigating to the PTW Reports page. Users can then filter PTW records based on specific criteria such as year, month, and status. Once the relevant records are displayed, users can review the list before downloading the PTW report in Excel or CSV format. This report generation process is essential for tracking issued permits and serves as a critical tool for audits and compliance verification. By providing a structured mechanism to access historical PTW data, the system ensures transparency and accountability in workplace safety procedures.

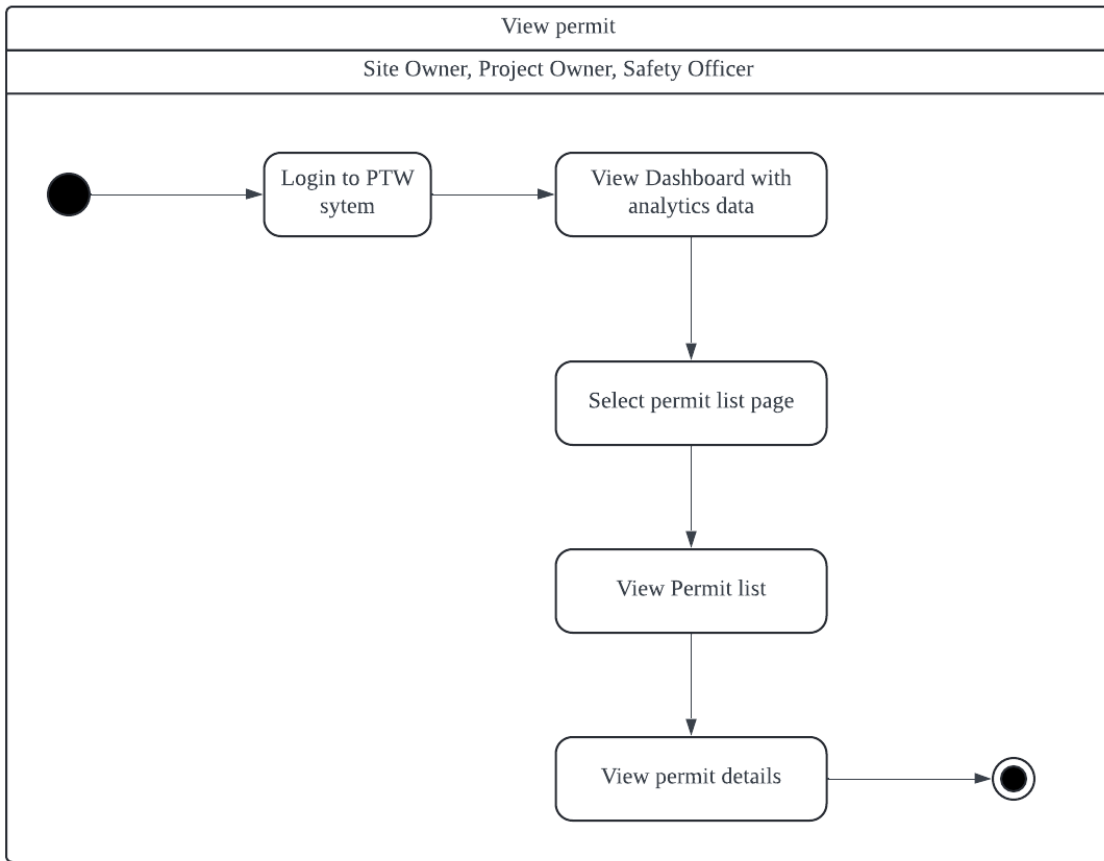


Figure 3.7 View permit activity diagram

Figure 3.7 shows the activity flow for the "View Permit" functionality within the PTW system. This activity diagram is applicable to three user roles: Site Owner, Project Owner, and Safety Officer. The process begins with the user logging into the PTW system. Once authenticated, the user accesses the dashboard, which presents relevant analytics data. From the dashboard, the user navigates to the permit list page. The system then displays a list of permits, allowing the user to select and view detailed information about a specific permit. The activity concludes upon viewing the permit details. This diagram effectively outlines the sequential steps involved in retrieving permit information, ensuring a clear understanding of the system's workflow.

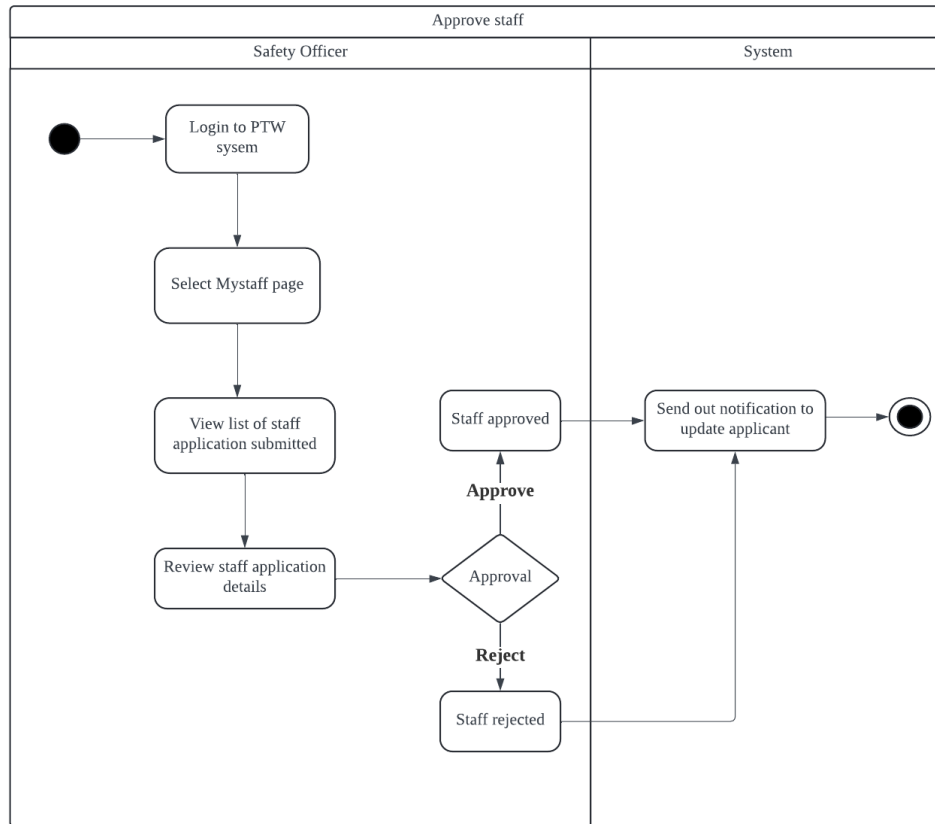


Figure 3.8 Staff approval activity diagram

Figure 3.8 presents the activity diagram for the "Approve Staff". This process involves the Safety Officer and the system, illustrating the steps required to review and approve or reject staff applications. The workflow begins with the Safety Officer logging into the PTW system and navigating to the "MyStaff" page. They then access the list of submitted staff applications and review the details of each application. Based on the evaluation, the Safety Officer can either approve or reject the staff application. If the application is approved, the system updates the status and sends a notification to inform the applicant. If the application is rejected, the system also notifies the applicant accordingly. This diagram effectively captures the structured decision-making process in staff approval, ensuring clear communication between the Safety Officer and the applicant.

3.5 Purpose of Flowchart and Activity diagram

Both flowcharts and activity diagrams are included to cater to different stakeholder needs and ensure comprehensive documentation. Flowcharts are widely used within the company for process visualisation, making them a familiar and easily understandable tool for non technical stakeholders. Since the company relies on flowcharts for workflow representation, incorporating them ensures that the documentation aligns with their internal standards and facilitates effective communication among users and decision makers. On the other hand, activity diagrams provide a structured and system focused view of the PTW process. They capture system interactions, including conditions, process flows, and decision points, which are essential for software development. These diagrams ensure that developers have a clear understanding of the system's logic, supporting accurate implementation and optimization of system workflows.

By including both flowcharts and activity diagrams, the report effectively serves multiple stakeholder flowcharts provide a high-level, easy to understand representation for users, while activity diagrams offer a more detailed breakdown for technical stakeholders especially developers. This approach ensures clarity in process documentation while maintaining alignment with the company's preferred visualisation methods.

3.6 Class Diagram

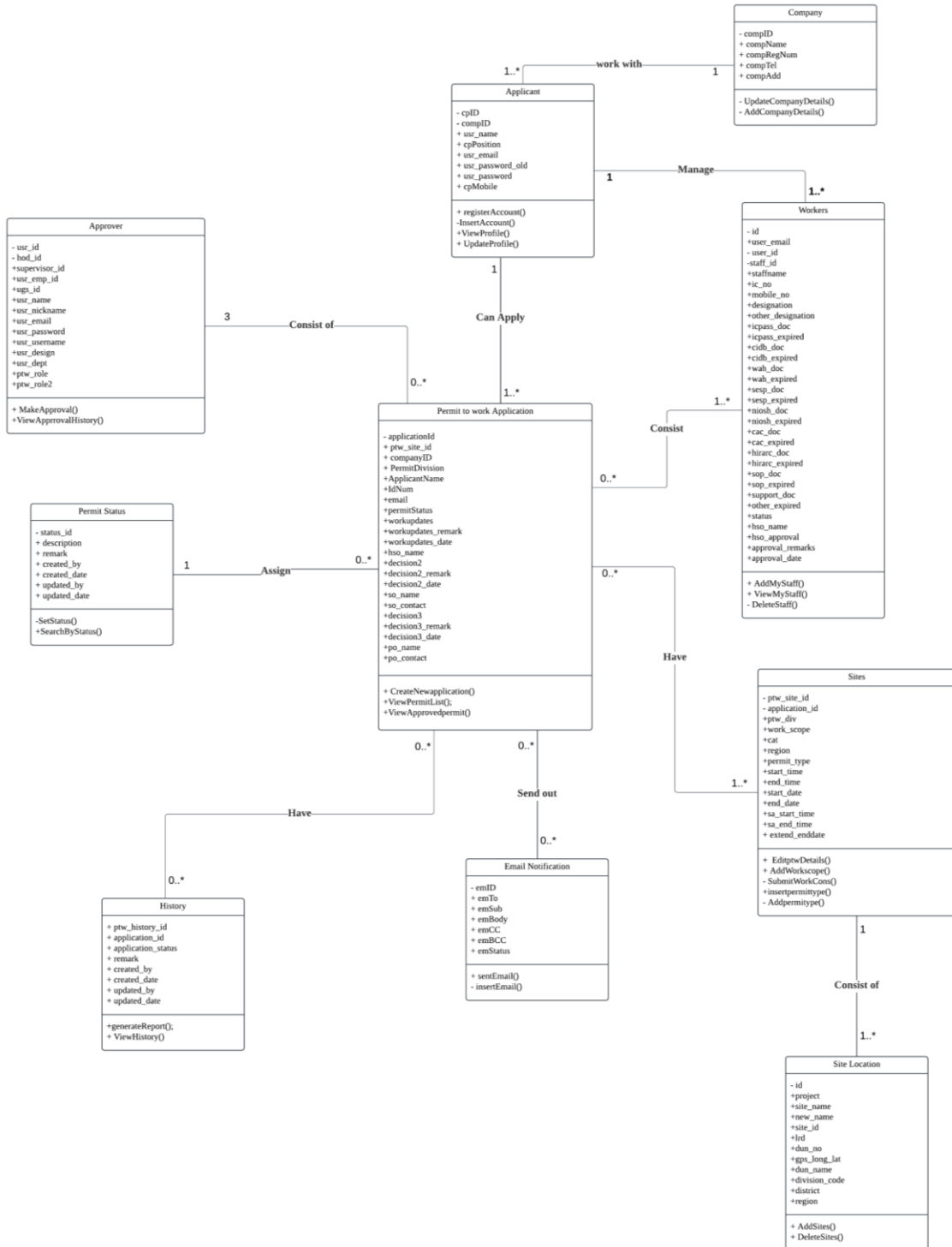


Figure 3.9 SDEC PTW system class diagram

The structural design of the Permit to Work (PTW) system is represented through a detailed class diagram, which serves as a blueprint for the database and object-oriented programming structure. The PTW system is designed to facilitate the management of high-risk activities by ensuring compliance with safety protocols, streamlining workflows, and enabling effective communication between stakeholders. The class diagram provides a visual representation of the system's main components, their attributes, and the relationships between them, offering a clear overview of how the system's data and processes are organized.

The class diagram in Figure 3.9 for the Permit-to-Work (PTW) system illustrates the components of the system and their relationships, providing a structured overview of how the system functions. At the core is the applicant class, which represents users who apply for permits. This class contains attributes such as `cID` (unique applicant ID), `compID` (), `usr_name`, `usr_position`, and `usr_email`, which capture personal and professional details. Additionally, it includes methods like `registerAccount()`, `viewProfile(cID)`, and `updateProfile()`, enabling users to register, view, and modify their accounts. The Approver class handles users that responsible for reviewing and approving permit applications. Attributes like `usr_id`, `head_id` , and `supervisor_id` establish the approver's identity and its respective supervisor, while `usr_email`, `usr_username`, and `usr_role` manage their contact and role information. Methods such as `makeApproval()` and `viewApprovalHistory(applicationId)` are provided to facilitate permit approval processes and track decision histories.

Central to the system is the Permit to work class, which represents each permit application. Attributes such as `applicationId`, `site_id`, `companyID`, `permitStatus`, and `workDetails` define all application details. Methods like `createNewApplication()` and `viewApproval()` allow applicants and approvers to create, view, and manage permits. This class links closely with other components, including Permit Status, which tracks application progress, and History, which records all of logs changes and updates for auditing purposes.

Other supporting classes include the Workers class, which manages staff details such as `user_id`, `staffRole`, and document expiry dates. The Company class stores company specific information like `compID`, `compName`, and `compEmail`. Additionally, the Sites and Site Location classes define worksite details, including project names, regions, and site id. The Email Notification class automates communication by storing email data and providing methods to send or record emails.

The relationships between these classes are shown through associations, such as the link between the Applicant and Permit to Work Application classes, which represents an applicant submitting a permit request. Similarly, the association between Approver and Permit to Work Application highlights the approval process. This interconnected structure ensures the system supports critical workflows, including permit creation, approval, status tracking, and communication, making it efficient and user-friendly.

3.7 ERD Diagram

3.7.1 First Normalisation ERD

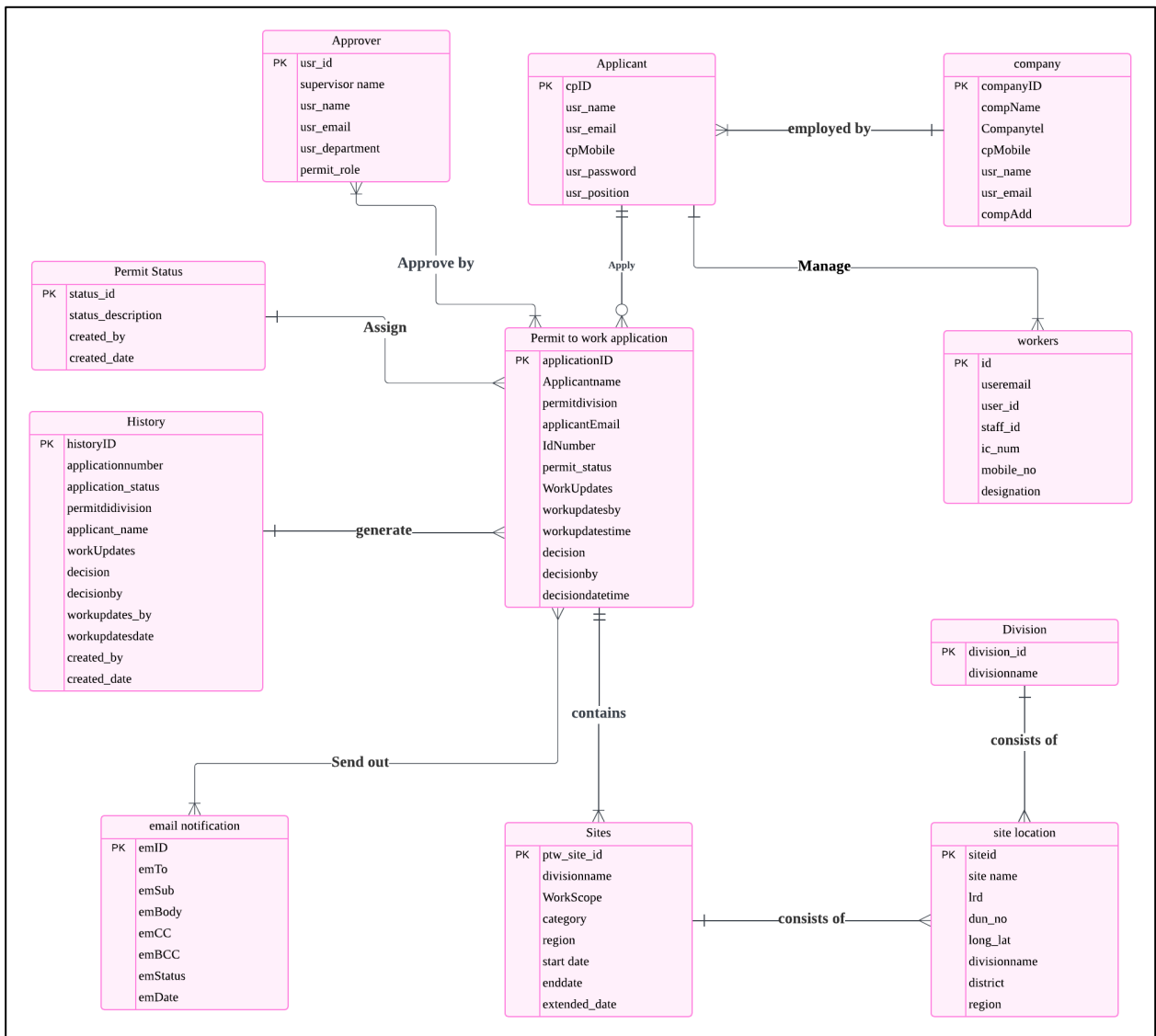


Figure 3.10 First normalisation ERD

Based on figure 3.6 first normal form (1NF) normalization in the Permit to Work (PTW) system focuses on organizing the data into well-structured relational tables while eliminating repeating groups and ensuring atomicity of attributes. The ERD demonstrates multiple entities with clear relationships:

1. **Applicant and Approver:** These tables store user-related data separately for applicants and approvers, ensuring clarity of roles. Each table has unique primary keys (e.g., `cpID`

for Applicant and usr_id for Approver) to identify individuals. The Applicant is linked to their respective company via the employed by relationship.

2. **Permit to Work Application:** This table captures application details with a unique identifier, applicationID. It includes fields like the applicant's name, email, division, permit status, and decision history, ensuring atomicity by storing individual attributes in separate columns.
3. **History Table:** The History table tracks updates and decisions related to PTW applications, ensuring that the application lifecycle is well-documented. Each entry is uniquely identified by historyID.
4. **Permit Status:** A separate table is used to define the various statuses a permit can have, ensuring a clear assignment and understanding of each permit's stage in the process.
5. **Sites and Division:** The Sites table stores site-specific data related to work scope, category, and dates (start, end, and extensions). It is linked to the Division table to identify which division of the site belongs to, ensuring no redundant data storage.
6. **Company and Workers:** The company table contains details about the organization, and the workers table tracks employees, connecting them via user identifiers (user_id).
7. **Email Notifications:** The email notification table handles communication details for applications, including recipients, content, and statuses, ensuring that notifications are structured and traceable.

3.7.2 Second Normalisation ERD

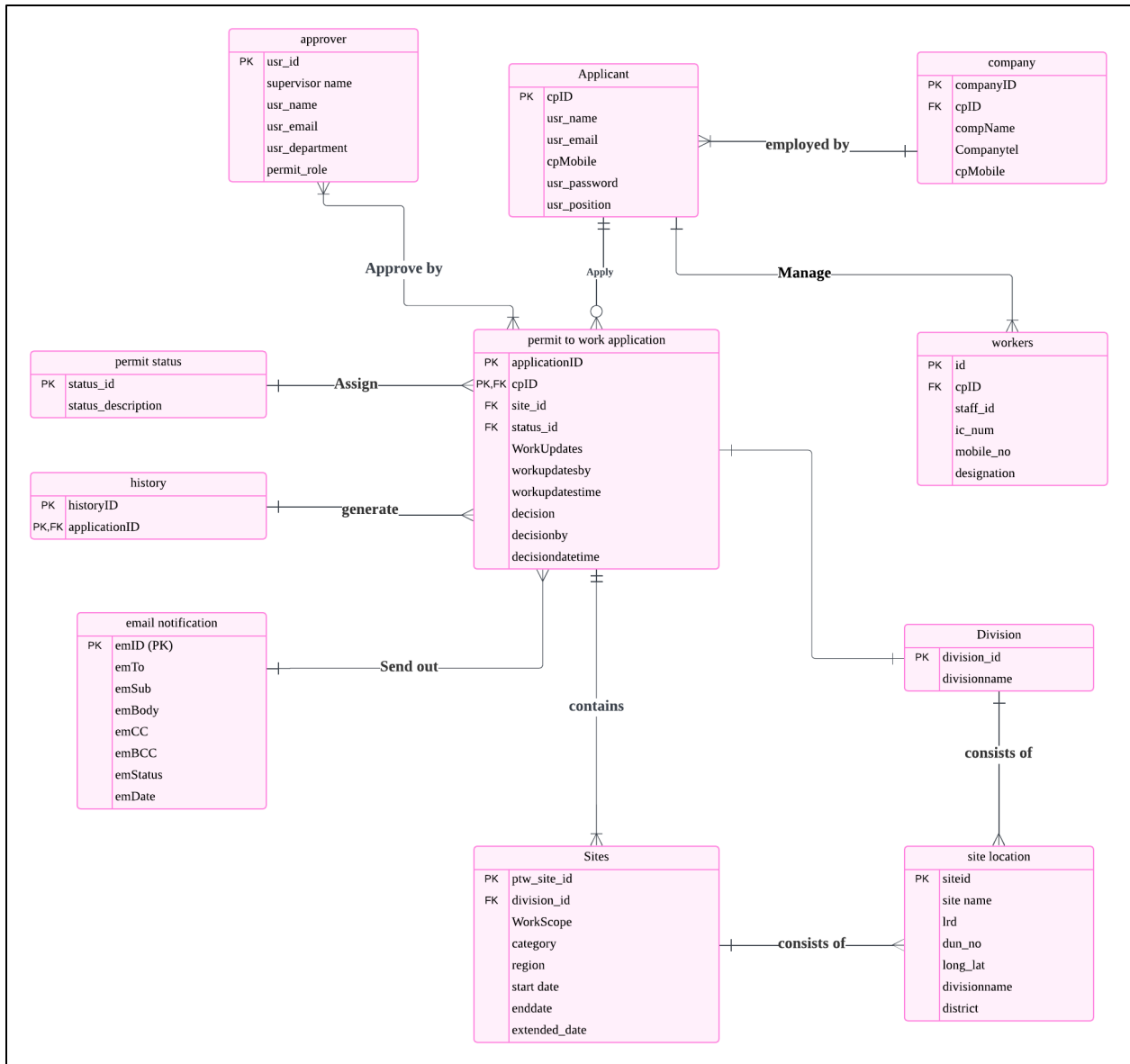


Figure 3.11 Second normalisation ERD

Figure 3.7 illustrates principles of the second normal form (2NF) by eliminating partial dependencies, ensuring that all non-key attributes are fully functionally dependent on the primary key, and organizing the data into multiple entities with meaningful relationships.

The Approver entity contains details of individuals who are responsible for approving work permits. It includes attributes such as user_id (primary key), supervisor_name, usr_name, usr_email, usr_department, and permit_role. These attributes store essential information about the approver's identity and role within the system.

The Applicant entity represents individuals applying for work permits. Attributes such as cpID (primary key), usr_name, usr_email, cpMobile, usr_password, and usr_position capture personal details and their role or position in the organization. Each applicant can apply for a permit associated with their credentials.

The Permit to Work Application entity is central to the system, containing details of the permit applications. It includes attributes such as applicationID (primary key), cpID (foreign key to Applicant), site_id (foreign key to Sites), status_id (foreign key to Permit Status), WorkUpdates, workupdatetime, workupdatesby, decision, decisionby, and decisiondatetime. This table links applicants to specific work locations and tracks the status and decisions related to each application.

The Permit Status entity defines the various statuses a permit application can have, such as "Pending," "Approved," or "Rejected." It includes attributes status_id (primary key) and status_description. This ensures a consistent and standardized approach to managing application statuses.

The History entity is used to record updates or changes made to work permit applications. Its attributes include historyID (primary key) and applicationID (foreign key), allowing the system to maintain a detailed log of changes for audit purposes.

The Email Notification entity is responsible for managing the notifications sent out by the system. It includes attributes such as emID (primary key), emTo, emSub, emBody, emCC, emBCC, emStatus, and emDate, which store details of email recipients, content, and delivery status. This functionality helps ensure applicants and approvers are informed about permit updates.

The Company entity holds information about companies employing applicants, including attributes such as companyID (primary key), cpID (foreign key to Applicant), compName, Companytel, and cpMobile. This entity connects applicants to their respective employers.

The Workers entity captures details of individuals working under an applicant. It includes attributes such as id (primary key), cpID (foreign key to Applicant), staff_id, ic_num, mobile_no, and designation, ensuring that the system tracks each worker's identity and role.

The Division and Site Location entities are used to organize and define work locations. The Division entity includes `division_id` (primary key) and `divisionname`, while the Site Location entity includes attributes such as `siteid` (primary key), `site_name`, `lrd`, `dun_no`, `long_lat`, `divisionname`, and `district`. These entities are further linked to the Sites entity, which defines specific work locations and their details, including `ptw_site_id` (primary key), `division_id` (foreign key to Division), `WorkScope`, `category`, `region`, `start_date`, `enddate`, and `extended_date`.

The relationships in the diagram ensure that applicants are associated with work permit applications, which are tied to specific sites and statuses. Approvers and workers are connected to these applications, while history logs and email notifications provide support for tracking and communication. The normalization process ensures data integrity and reduces redundancy by organizing data into meaningful and interrelated entities.

3.8 System User Interfaces

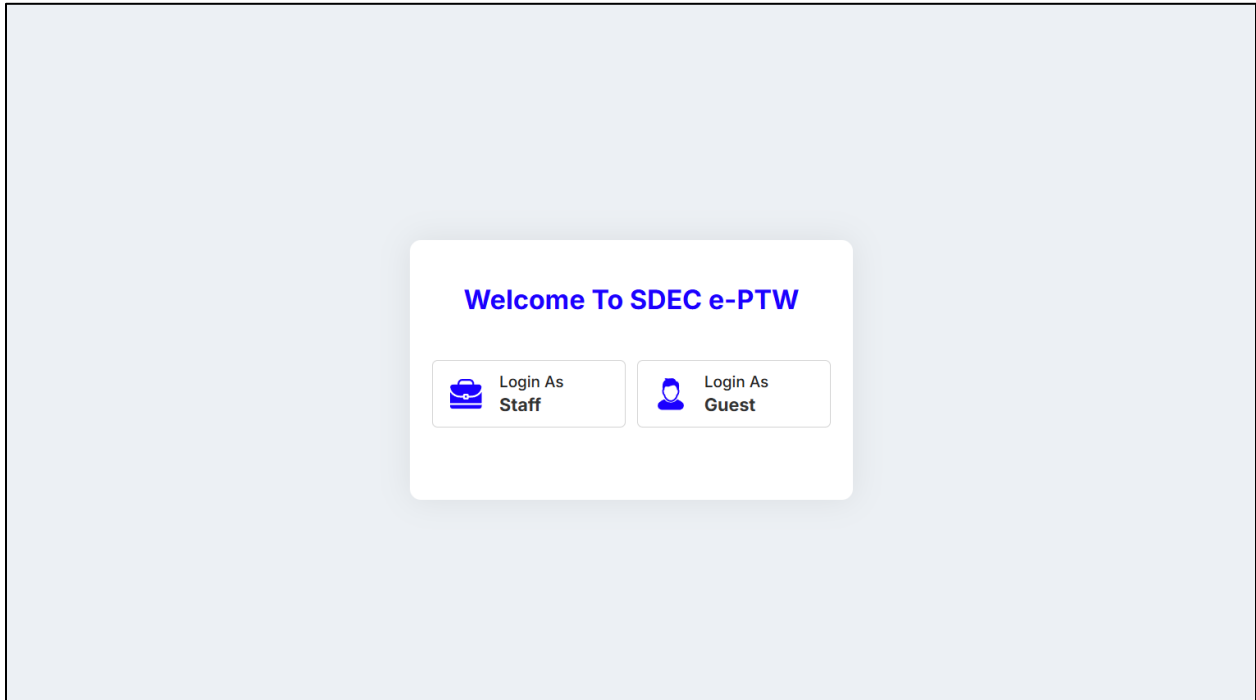


Figure 3.12 Landing page for PTW System

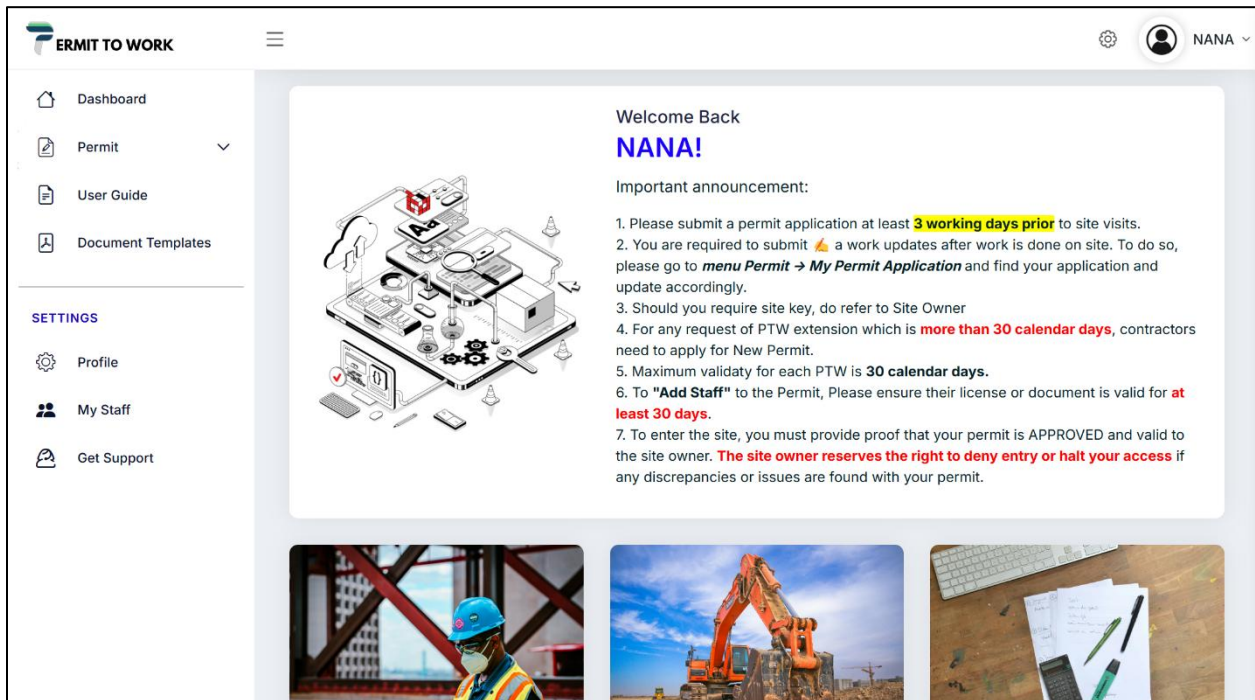


Figure 3.13 Homepage PTW

Figure 3.13 shows the landing page for PTW system. From this page, the user can select their role login to their respective login page. Both of the login page will have different ways to access the system. For Guest, they can create their own account to access the system however for staff, they need to contact system administrators to have access role as staff in the system. This is to ensure data confidentiality. In figure 3.13 illustrates the homepage to PTW once they successfully login to the system. The Home Page acts as the main page for the Permit-to-Work (PTW) system, welcoming users and offering easy navigation to essential features. At the left, a navigation bar provides access to options such as “Dashboard”, “Permit”, “Create Permit”, and “View Applications”. A welcome banner displays a brief introduction to the system, explaining its purpose and benefits. Below the banner, users can access quick links in the form of buttons or cards, directing them to actions like applying for a permit or view list of staff registered.

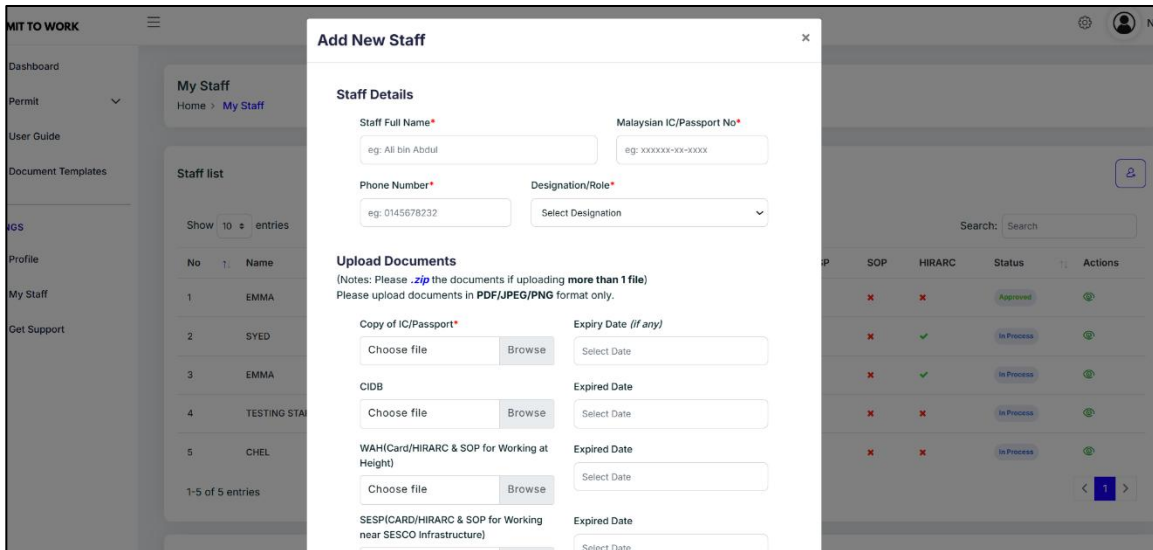


Figure 3.14 Add staff form

Figure 3.14 shows add mystaff page where the user can register their staff in the system. The Add MyStaff Page is a crucial part of the PTW system's user interface, designed to allow users, such as managers or administrators, to add staff members to the system. This page is focused on ensuring that staff details are entered accurately and efficiently while maintaining a professional and user-friendly design. The interface might also feature validation messages, which ensure all required fields are completed correctly. For example, if a mandatory field like Staff Name or phone number is left blank, the system will prompt the user to fill it in.

Permit Details

Application Details
Please fill in this form correctly

Start Date *
2024-12-03

End Date *
2024-12-04

Activity Category *
CORRECTIVE MAINTENANCE

Scope of Work *
test

Next

PTW by SDEC 2024

Figure 3.15 Application details form

The Application Details Form in the PTW system (Figure 3.15) is the user interface that allows users to input or review detailed information about a specific permit application. This form is designed to ensure all required data is captured accurately and efficiently for approval and processing.

It typically includes fields for basic application details, such as the applicant's name, company, and contact information, along with the permit type. Users are also prompted to provide work details, including the scope of work, site location, start and end dates, and category.

Permit To Work Reports

Select Year Select Month Select Status Filter CSV Excel

Show 10 entries Search: Search

Permit No	Region	Company	Status	Month	Year
SDEC202410-002	KUCHING 1	sdec	Permit Released	November	-0001
SDEC202410-003	KUCHING 1	Sarawak Digital Economy Corporation Berhad	Permit Released	October	2024
SDEC202410-004	KUCHING 1	Sarawak Digital Economy Corporation Berhad	Permit Released	October	2024
SDEC202410-007	KUCHING 1	Sarawak Digital Economy Corporation Berhad	Application In Process	October	2024
SDEC202410-009	BETONG	Sarawak Digital Economy Corporation Berhad	Application In Process	October	2024
SDEC202410-010	BETONG	Sarawak Digital Economy Corporation Berhad	Application In Process	October	2024

Figure 3.16 Generate report page

Figure 3.16 shows the page that will be open to authorized users to generate reports to keep track of the Permit to Work (PTW) records. This feature allows users such as the Site Owner, Project Owner, and Safety Officer to filter PTW records based on specific criteria, such as year, month, and status. By using this page, users can easily monitor permit applications, approvals, and statuses, ensuring better management and compliance with safety regulations. The report generation page provides an option to download reports in Excel or CSV format, making it convenient for documentation and auditing purposes. This feature is essential for maintaining a structured record of all permits issued, helping organizations track work progress, identify trends, and improve decision-making processes. With an intuitive user interface, the system ensures that users can efficiently generate and retrieve necessary reports without manual effort.

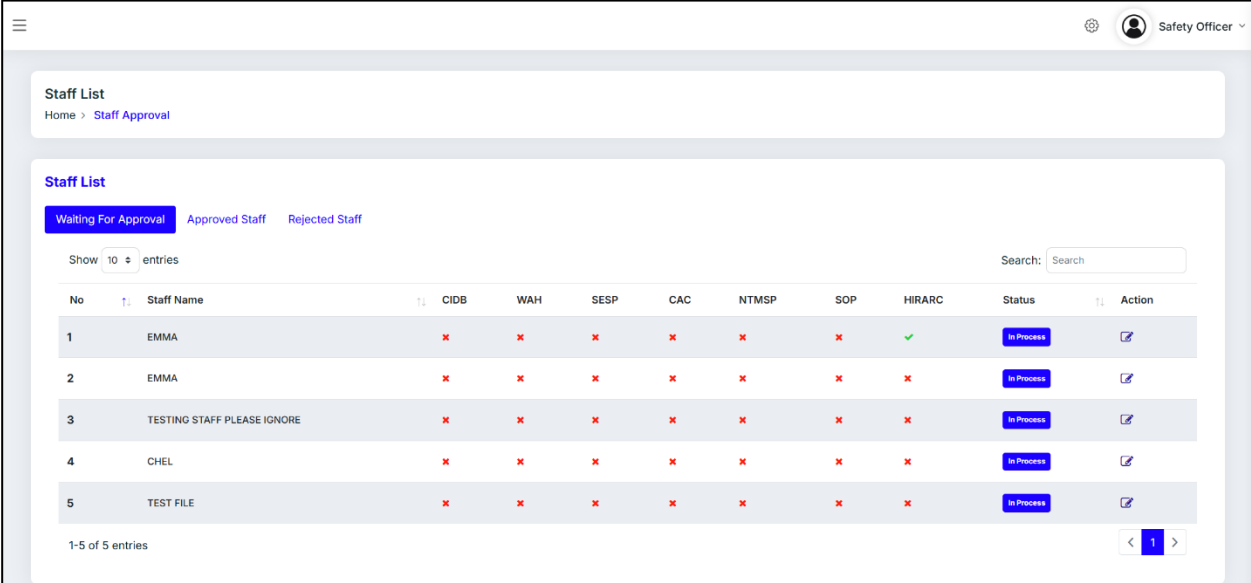


Figure 3.17 Staff approval list page for safety officer

Figure 3.17 shows the Staff Approval List page for the Safety Officer in the Permit to Work (PTW) system. This page displays a list of submitted staff applications that require approval. The Safety Officer can review the details of each staff application and decide whether to approve or reject them based on compliance with safety regulations. The interface is designed to provide an organized view of all pending applications, making it easier for the Safety Officer to track and manage approvals efficiently. Each application entry includes essential details such as staff name, application date, status, and actions for approval or rejection. This feature ensures that only

authorized and qualified staff are approved for work, enhancing safety and regulatory compliance within the system.

The screenshot shows a web interface for a Permit to Work (PTW) system. At the top, there are five navigation tabs: "View Application", "PTW Attachments", "Staff Details", "Decision Form by Project Owner", and "Decision Details". Below the tabs, the "Decision:" section contains three radio buttons: "Approve", "Return", and "Reject". The "Name" field is a text input containing the name "Lily". The "Phone Number" field is a text input with a placeholder "(eg: 013523487)". The "Remarks" section features a large text area with the placeholder text "Add remarks if any...". Below the text area, there is a red asterisk followed by the text "*If reject the application, please state the reasons..". At the bottom right of the form, there is a blue "Submit" button.

Figure 3.18 Permit approval form

Figure 3.18 displays the Permit Approval Form in the Permit to Work (PTW) system, which is used by the Site Owner and Project Owner to review and approve permit applications. This form provides a structured layout where the approvers can view all necessary details related to the permit, including applicant information, work details, safety measures, and supporting documents. The form includes action buttons for approval or rejection, along with a remarks section where the approver can provide feedback or request modifications before granting approval. This feature ensures that permits are thoroughly reviewed before approval, maintaining compliance with safety regulations and worksite requirements.

New Permit Applications
Permit: Waiting for approval, Please Review within 3 days

Permit Applications Filter by Region: All Regions

Show 10 entries Search:

No	Permit No	Region	Company	Category	Application Status	Description/Remarks	Actions
1	SDEC202502-006	KUCHING 3	Sarawak Digital Economy Corporation Berhad	Visit	Application In Process	Application Submitted	<input type="checkbox"/>
2	SDEC202501-003	KUCHING 1	sdec	Corrective Maintenance	Application In Process	Application Submitted	<input type="checkbox"/>

1-2 of 2 entries < 1 >

Figure 3.19 List of submitted permit to the system

Figure 3.19 displays the List of Submitted Permits page in the Permit to Work (PTW) system, where Safety Officers, Site Owners, and Project Owners can view all permit applications submitted to the system. This page provides an organised list of permits categorized by their status, including pending, approved, and rejected permits. Users can search the permits based on criteria such as applicant name, work type, and status to streamline the approval process. This page helps ensure that all submitted permits are properly tracked, reviewed, and processed efficiently, contributing to better workflow management and compliance with safety protocols.

3.9 Summary

Chapter 3 focuses on the Rapid Application Development (RAD) methodology, which was chosen for the PTW system development. RAD allows for quick prototyping, enabling the team to gather continuous input from stakeholders and refine the system in shorter development cycles. This approach ensures that the final system meets user requirements effectively while maintaining flexibility for changes. The class diagram is presented as a design for the system's structure, illustrating the relationships between key components such as applicants, approvers, permits, workers, and associated data entities. It provides a clear representation of how the system's objects interact. The activity diagram shows the step by step workflow of the permit to work process, from permit application submission to review, approval, or rejection. It highlights the system's decision making points and ensures smooth transitions between user roles. The flowchart simplifies the overall process flow, visually representing how data moves through the system. This diagram helps to clarify the sequence of actions and decisions, ensuring the process is easy to understand for all stakeholders. Finally, the user interfaces are briefly discussed, focusing on essential pages such as the login, home, create permit, and application details forms. The designs prioritize usability, clarity, and responsiveness, providing an good experience for users while ensuring all critical functionality is accessible. In summary, Chapter 3 combines the RAD methodology with detailed system designs, ensuring a well-structured and user centered approach to developing the PTW system.

Chapter 4 : Implementation

This chapter discusses the tools and technologies used in developing the Permit to Work (PTW) system, as well as the implementation process to ensure the system is built according to the design outlined in Chapter 3.

The selection of tools, such as programming languages, frameworks, and databases, is essential to ensure the system functions efficiently and meets the project requirements. Additionally, this chapter explains the step by step implementation process, including system development, coding, and integration. By following these steps, the goal is to create a well structured and functional PTW system that fulfils the objectives.

4.1 Setting up system development components

Before proceeding with the development of the Permit to Work (PTW) system, it is essential to install and configure the necessary system components to ensure a smooth implementation process. This section outlines the setup of the development environment, including the installation of required software, configuration of the web server, database setup, and integration. Proper installation and configuration are crucial to ensure that the system runs efficiently and aligns with the design specifications established in the previous chapter.

4.1.1 Laragon

Laragon is portable and good performance development environment that is build for modern web application development (Chandra & Setyaningsih, 2025). This development environment supports multiple programming languages including, PHP, Python, Node.js and many more. Unlike the traditional local servers, Laragon does not rely on the Windows services which allows it to operate efficiently with minimal system resources. To install Laragon, it can be downloaded from the official website <https://laragon.org> . The full version 2025 v8.1.0 package was chosen to include essential tools such as Apache, MySQL, and PHP. The installer was executed and the installation path was set up to C:\laragon\index for easy access.

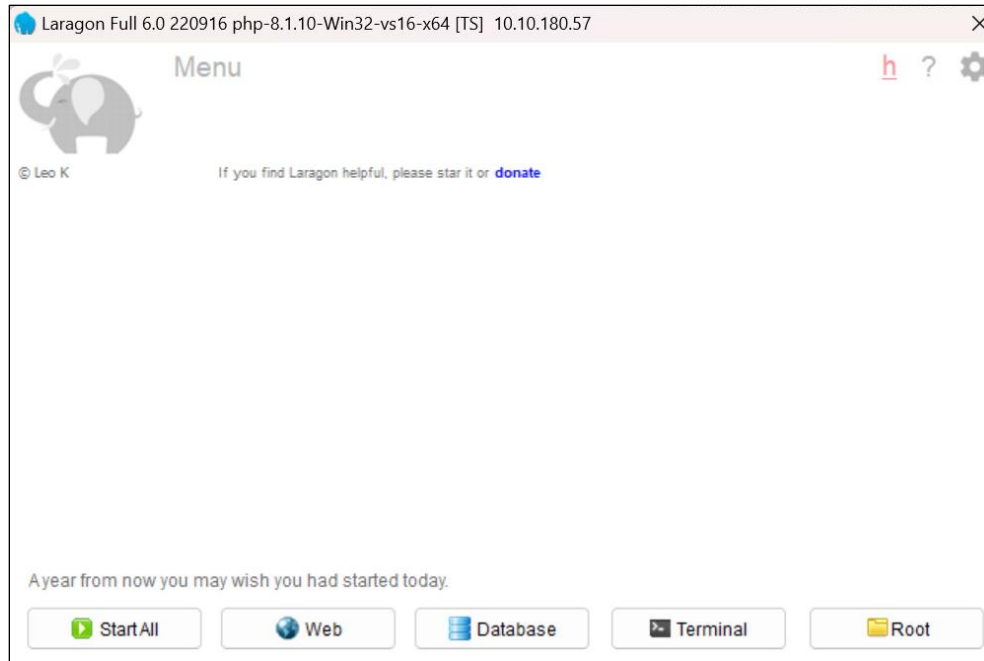


Figure 4.1 laragon setup

Figure 4.1 shown that Laragon was launched and the Apache and MySQL will start or prompt by clicking the “start all” button. In Laragon, the auto virtual hosts feature was enabled to simplify domain setup when want to access any project in this development environment. To create a new project, the project folder will be inserted to path `C:\laragon\www\project_folder` . After creating the project folder, we can start all services by clicking the button start all. Laragon will show a pop out notification that the virtual host for the project has been created automatically and can be accessed using the simplified domain name with format `http://project_name.test`. The project can be access through web browser like Google Chrome, Firefox and Microsoft Edge.

4.1.2 Visual Studio Code (VS Code)

Visual Studio Code is a source code editor that is developed by Microsoft. This editor is widely used for web development due to its flexibility and built in support for various type of programming languages. Visual Studio Code provides useful features for developer such as highlighting programming language syntax, debugging tools, which makes it an ideal

choice for development of Permit to Work (PTW) system. Visual Studio Code can be downloaded from official website <https://code.visualstudio.com/>. To enhance the development process, there are several extensions were installed like live server (to enable real time reloading for frontend development), neater (automate code formatting) and PHP Intelephense (to identifies the code error).

4.1.3 Dbeaver

Dbeaver is open source database management tool that supports multiple database systems, including MySQL, MariaDB, PostgreSQL, and more. It provides an intuitive graphical user interface for managing and executing query for databases, making it easier to work with MariaDB database for permit to work system. Dbeaver Community Edition can be downloaded from the official websites <https://dbeaver.io/>. The installation process was straightforward with default setting application. To connect with the localhost database, the new database connection option is chosen in the Dbeaver menu. Then, we can select database type which is MariaDB and enter the localhost details such as **host** (usually localhost or 127.0.0.1), **port** (default for MariaDB is 3306), **database name**, **username** (commonly root), and the **password** as shown in Figure 4.2.

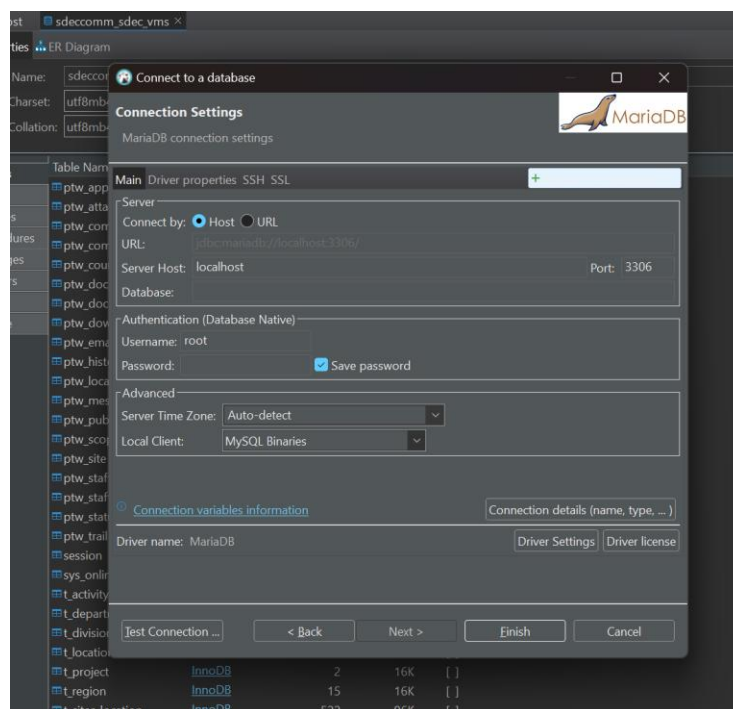


Figure 4.2 Configure database connection

After filling in the connection details, we can click on the “**Test Connection**” button to check if everything is set up correctly. If the test is successful, we can then proceed to “**Finish**”, and the database will appear in the DBeaver navigation panel.

Once connected, DBeaver allows us to easily browse tables, views, procedures, and other database objects. We can also run SQL queries using the SQL Editor, which makes it convenient to test, update, or retrieve data from the **permit to work** system’s MariaDB database. The graphical interface helps visualise data, making it easier to understand the relationships between tables and monitor the structure of the database without needing to type long terminal commands.

Overall, using DBeaver simplifies the management of the database for the **permit to work** system and improves the workflow by providing tools like query history, Entity Relationship (ER) diagrams, and data export or import options in one application.

4.2 Implementation of the proposed system

4.2.1 Overview of the proposed system

There are 4 types of users that will be use in the e-Permit to work system. Each of the user have specific roles and responsibilities and the system will control the user access. The module for each of the user is shown in table 4.1 below.

Table 4.1 System module and user

User	Module/Functions
System Admin	<ul style="list-style-type: none"> a) View all applied permit b) View All Staff application c) Site Settings
Safety Officer	<ul style="list-style-type: none"> a) View and approve staff b) View all applied permit c) Generate permit report
Site Owner and Project owner	<ul style="list-style-type: none"> a) View all applied permit b) Generate permit report c) Approve permit

Applicant	<ul style="list-style-type: none"> a) Apply permit b) View permit c) View MyStaff d) Add MyStaff e) View list of sites
-----------	---

4.2.2 System index page

Figure 4.3 shows the index page of the system, which acts as the landing page where users are required to choose their role. For staff login, only internal SDEC staff are allowed to access the system. To log in as staff, users must use their verified company email and password. Figure 4.4 shows the login page for staff. Meanwhile, public users such as contractors or companies can register their PTW account through the guest login page. The button register will be displayed in the guest login page as shown in figure 4.5.

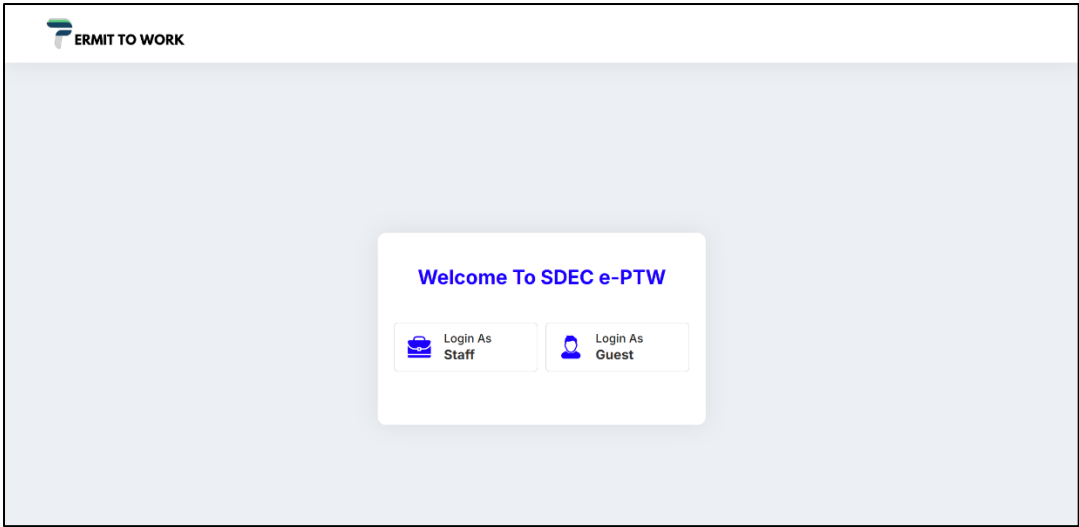


Figure 4.3 Index Page

As shown in Figure 4.6, for the first time user is required to fill in all of the company and contact person to be able to access the Permit to work system. Public or guest users can log in using the personal or company email they used during registration.

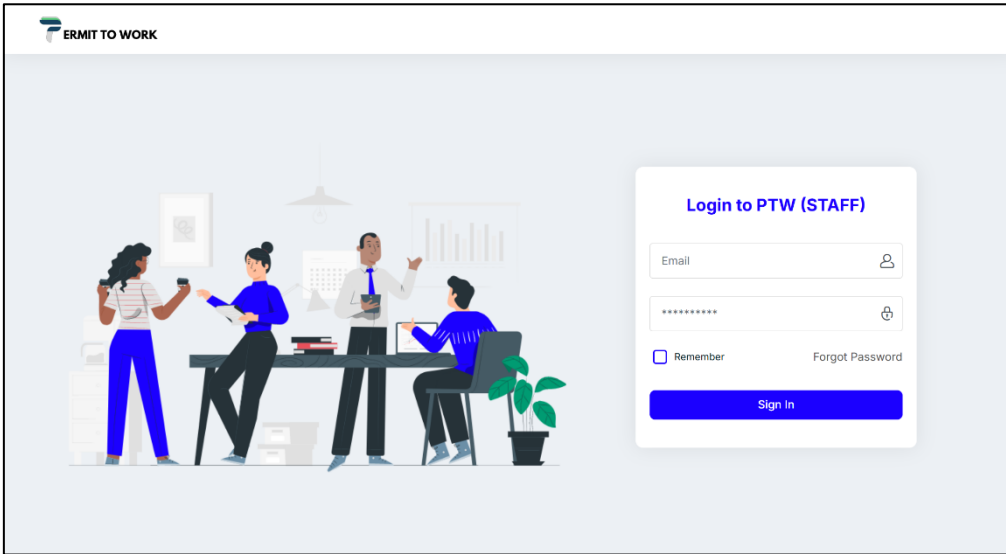


Figure 4.4 login page for staff

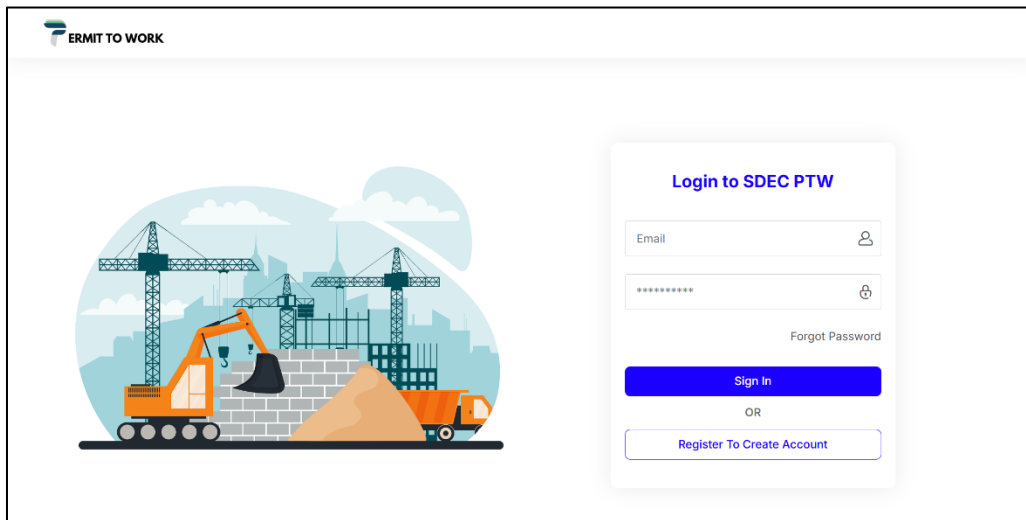


Figure 4.5 Guest login page

Figure 4.6 Register account for public user

4.2.3 System Features

a. Dashboard and home page

Figure 4.7 shows dashboard and home page for the system admin and permit approvers provide an overview of the PTW (Permit to Work) data for internal staff to track of the permit progress. Figure 4.8 shows the analytics graph for staff and ptw overview. It displays key statistics such as the total number of applications, approved permits, rejected requests, and pending approvals. This helps the admin to monitor the overall status of the system at a glance. The dashboard also includes visual elements like charts or graphs to make the data easier to understand. With this feature, the admin can track system activity in real time and make quick decisions when needed.

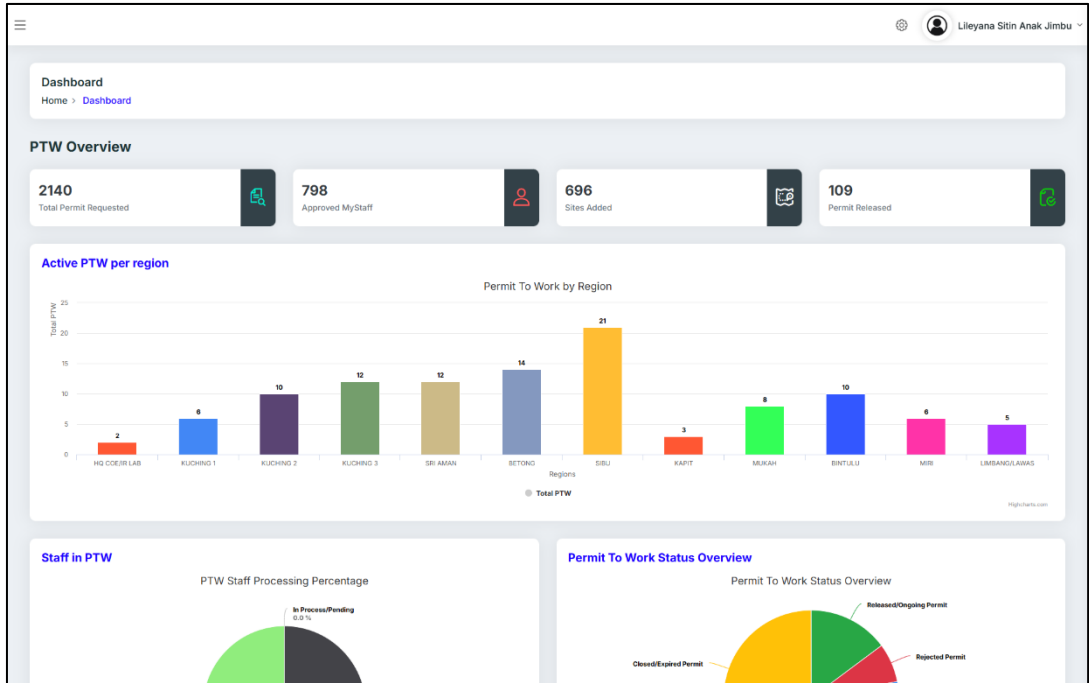


Figure 4.7 Admin dashboard

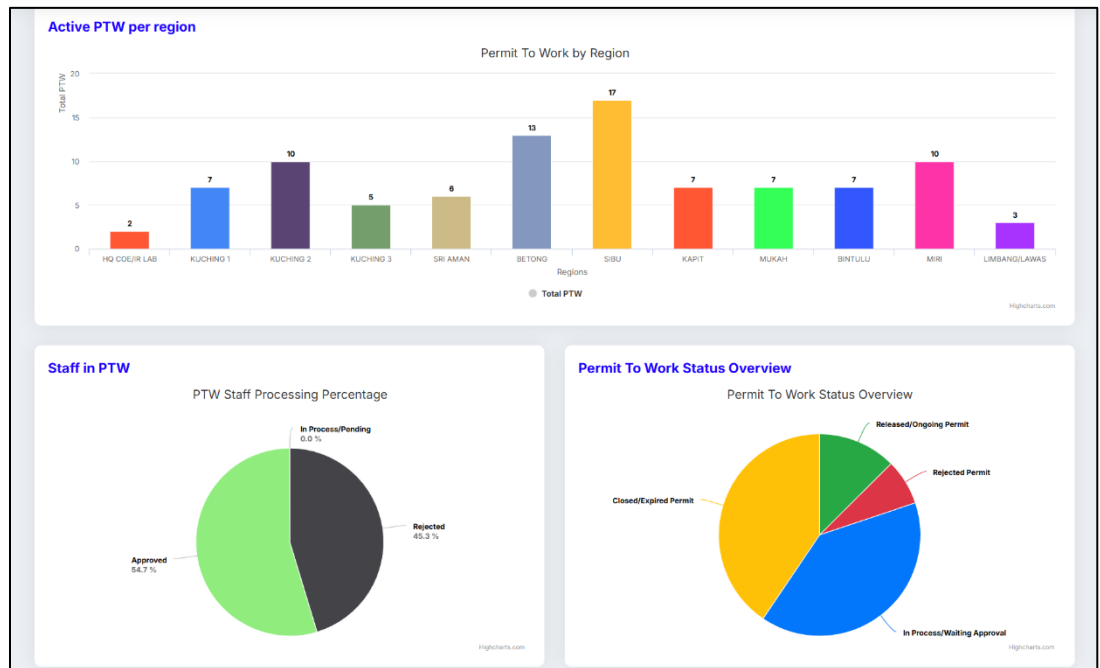


Figure 4.8 Analytics graph dashboard for staff and PTW overview

b. View all permit and staff application

Safety Officer, site owners and project owners will be able to view all Permit to Work (PTW) applications and staff applications submitted through the system. Figure 4.9 shows page that will be able to access by authorised users of the system. User can access the details of every permit, regardless of its status whether it is approved, pending, or rejected. Through this page, the admin can monitor the number of permits applied and track system activity. They are also able to preview and print any attachments uploaded for each permit.

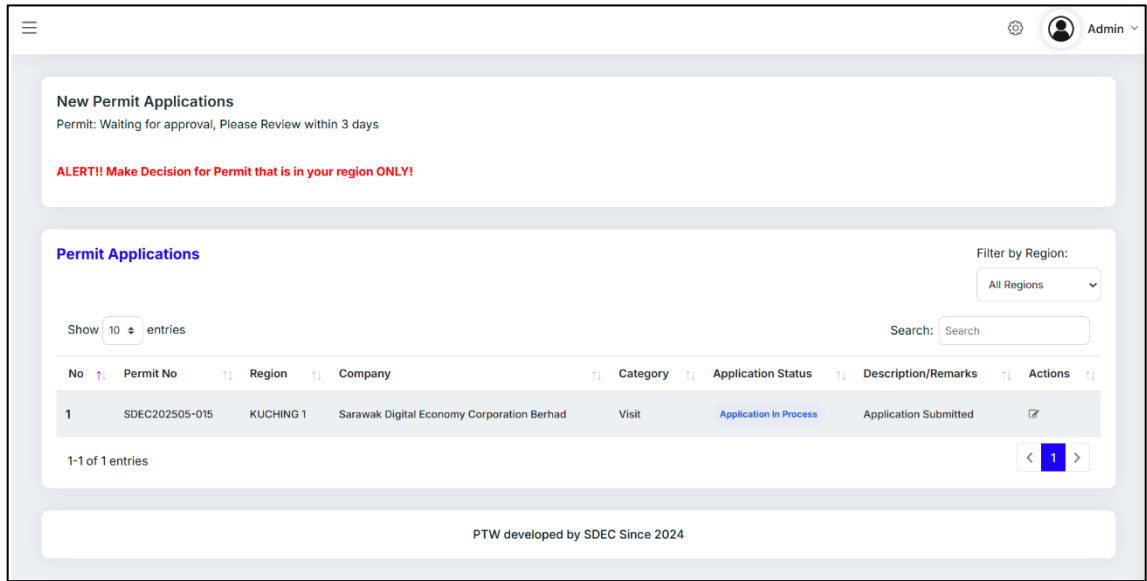


Figure 4.9 List of applied permit

Meanwhile, staff applications that is submitted through the system will also be visible to the admin, site owners, safety officer and project owner. They can preview all of the staff application details and monitor the progress of the staff application status. Figure 4.10 shows the page where user can view list of in progress, approved and rejected staff. However the expired staff validity will not be visible for admin.

The screenshot displays the 'Staff List' page in the MyStaff application. At the top, there is a breadcrumb trail: 'Home > Staff Approval'. Below this, there are three tabs: 'Waiting For Approval' (selected), 'Approved Staff', and 'Rejected Staff'. A search bar is located on the right side of the page. The main content is a table with the following columns: No, Staff Name, CIOB, WAH, SESP, CAC, NTMSP, SOP, HIRARC, Status, and Action. Two rows of data are visible, both for a staff member named 'EMMA'. The first row has a status of 'In Process' and a green checkmark in the HIRARC column. The second row also has a status of 'In Process' and red 'x' marks in the CIOB, WAH, SESP, CAC, NTMSP, and SOP columns.

No	Staff Name	CIOB	WAH	SESP	CAC	NTMSP	SOP	HIRARC	Status	Action
1	EMMA	x	x	x	x	x	x	✓	In Process	[Edit]
2	EMMA	x	x	x	x	x	x	x	In Process	[Edit]

Figure 4.10 List of all MyStaff application

c. Site Settings

Figure 4.11 shows site settings page where the system administrator manages all information related to the work sites available in the system. This feature is important to ensure that only valid and updated site details are used when users submit their Permit to Work (PTW) applications. In this section, the admin has full control to add new site by clicking button on the top left of the page this includes entering details such as the site ID, site name, location and region to the site. Figure 4.12 shows the page that will be display if admin click the add new site button. In addition, the admin can also update the information of existing sites in case there are changes such as site name corrections, updated addresses, or any other necessary modifications. ‘Pen’ button in the site setting page will allow admin to edit the sites details. Figure 4.13 shows the edit site page when admin wants to edit sites details in the system. This ensures that all site records remain accurate and relevant over time. If a site is no longer active or no longer needed in the system, the admin has the option to delete it, which helps in maintaining a clean and manageable site database. Figure 4.14 shows the pop out to get confirmation on whether the user want to delete the sites details after clicking ‘bin’ icon.

Sites Configuration
You can add, delete and edit sites in this page. Kindly recheck the sites in the system.

[Add New Site](#)

Show 10 entries Search:

Sites ID	Site Name	Sites New Name	LRD	Region	Actions
SMA76010004	Kg. Jantan	-	JANT	KUCHING 1	Edit Delete
SMA76010005	Kg. Tanjung	-	NUAM	KUCHING 1	Edit Delete
SMA76010006	Kg. Pasir Tengah	-	NGAH	KUCHING 1	Edit Delete
SMA76010007	Kg. Siru Melaju	-	SIRU	KUCHING 1	Edit Delete
SMA76010008	Kg. Pasir Hilir	-	HLI	KUCHING 1	Edit Delete
SMA76010009	Kg. Stass	-	STAS	KUCHING 1	Edit Delete
SMA76010010	Kg. Jagoh Pinemu	-	PIND	KUCHING 1	Edit Delete
SMA76010011	Kg. Bogag	-	OGAG	KUCHING 1	Edit Delete
SMA76010012	Kg. Borong	-	BONG	KUCHING 1	Edit Delete
SMA76010013	SK Suba Buan	-	BABU	KUCHING 1	Edit Delete

101-110 of 696 entries < 1 ... 10 11 12 ... 70 >

Figure 4.11 Site settings page

Add New Site form
Please double check your sites before adding new sites to the system!

Project *

Site ID *

Site Name *

Site New Name

LRD *

DUN No

GPS long & Lat

DUN Name

Division

District *

Region *

[ADD SITE](#) [BACK](#)

Figure 4.12 Add sites form

Edit Site form
Edit sites details here!

Project * MySRBN FH2

Site ID* 662773399

Site Name* KAMPUNG ATAS

Site New Name

LRD* ATAS01

DUN No N02

GPS long & Lat 1.486797 110.169572

DUN Name TASKI BIRU

Division KUCHING

District* KUCHING





















Region* KUCHING 1

EDIT SITE **BACK**

Figure 4.13 Edit site form

Add New Site

Show 10 entries Search: Search

Sites ID	Site Name	Sites New Name	LRD	Region	Actions
SDECDC02	SDEC DATA CENTER 2	-	SDECDC02	HQ-COE	 
SMA76010001	Kg. Per...		RIGI	KUCHING 1	 
SMA76010002	Serayan		SERA	KUCHING 1	 
SMA76010003	Kg. Pas...		PASI	KUCHING 1	 
SMA76010004	Kg. Jant...		JANT	KUCHING 1	 
SMA76010005	Kg. Tanj...		NJAM	KUCHING 1	 
SMA76010006	Kg. Pas...		NGAH	KUCHING 1	 
SMA76010007	Kg. Siru Melayu	-	SIRU	KUCHING 1	 
SMA76010008	Kg. Pasir Hilir	-	HILI	KUCHING 1	 
SMA76010009	Kg. Stass	-	STAS	KUCHING 1	 

1-10 of 520 entries

PTW developed by SDEC Since 2025

Figure 4.14 delete site confirmation pop out

To ensure the integrity of the site information during updates, the system uses a backend function that performs secure data handling. Figure 4.15 displays the PHP code responsible for updating site data in the database. This function, `updatesitedata($sitedata)`, is part of the `Sites` class and demonstrates object-oriented principles applied in the PTW system. It begins by starting a database transaction and checking whether the input data is provided. This validation step ensures that no empty or null values are processed, and if the input is missing, the system throws an `InvalidArgumentException` to prevent incomplete operations. If the input is valid, it proceeds to update the corresponding site record in the `t_sites_location` table based on the site ID.

Upon successful completion, the transaction is committed and a success log message is generated. The function includes comprehensive exception handling to maintain data integrity and system reliability. It catches specific exceptions such as invalid input (`InvalidArgumentException`) and runtime errors (`RuntimeException`), as well as general exceptions to handle unexpected conditions. In each case, the system logs the error and safely exits the process without corrupting the data. This layered exception handling ensures robustness and consistency when managing site details while helping developers identify and resolve issues quickly during maintenance or debugging.

```
class Sites
{
    0 references | 0 overrides
    public function updatesitedata($sitedata): bool
    {
        // Start the transaction
        $this->db->transStart();
        try {
            // Check if data is provided
            if (empty($sitedata)) {
                throw new \InvalidArgumentException(message: 'No site data provided for update.');
            }

            // Perform the update
            $this->db->table('t_sites_location')
                ->where('id', $sitedata['id'])
                ->update($sitedata);

            // Complete the transaction
            $this->db->transComplete();

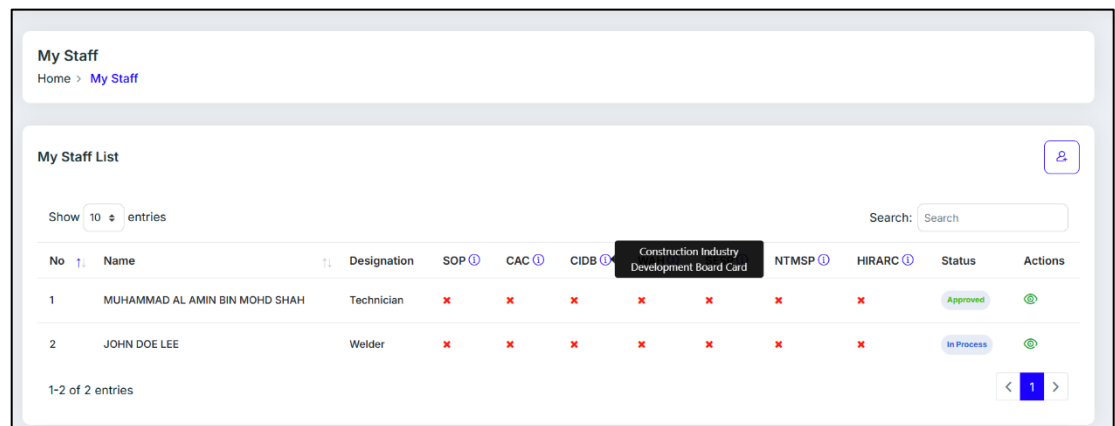
            // Check if the transaction was successful
            if ($this->db->transStatus() == FALSE) {
                throw new \RuntimeException(message: 'Database transaction failed while updating site data.');
            }

            // Log success
            log_message(level: 'info', message: 'Site data updated successfully. Site ID: ' . $sitedata['id']);
            return true;
        } catch (\InvalidArgumentException $e) {
            log_message(level: 'error', message: 'Invalid argument: ' . $e->getMessage());
            return false; // Or handle as per your application's requirements
        } catch (\RuntimeException $e) {
            log_message(level: 'error', message: 'Runtime error: ' . $e->getMessage());
            return false;
        } catch (\Exception $e) {
            // Catch any other unexpected exceptions
            log_message(level: 'error', message: 'Unexpected error: ' . $e->getMessage());
            return false;
        }
    }
}
```

Figure 4.15 Backend code snippet from the Sites class showing the update operation for modifying existing site information

d. Add and view mystaff applications

The view and add MyStaff section allows users, especially those who are responsible for applying permits, to manage the list of staff involved in the work. In Figure 4.16 and Figure 4.17 show pages where users can view all the staff members they have previously added to the system, along with important details such as staff name, position, and certificate status. To enhance user experience, the page in figure 4.16 also shows the tooltips marked with an information icon ("i") next to each document label, such as SOP (Standard Operating Procedure), CAC (certificates of competency), NTMSP (NIOSH TM Safety Passport) and CIDB (Construction Industry Development Board Card). These tooltips provide the full name or description of each required document or certification. For example, hovering over "CIDB" displays "Construction Industry Development Board Card." This feature is especially useful for users who are unfamiliar with the abbreviations or terms used in the form. By offering quick, clear explanations without cluttering the interface, the tooltips help reduce confusion and improve the accuracy of document uploads during staff applications. The system helps ensure that only staff with valid and approved certificates especially those approved by the Safety Officer are eligible to be assigned to specific permit applications. Users also have the option to add new staff by filling in details like name, identification number, designation, and uploading relevant supporting documents or certifications. Figure 4.18 shows the modal form that will appear if user clicks the 'human' button on top right of the page. Once added, these staff members will appear in the list and can be selected when applying for a permit.



The screenshot displays the 'My Staff' application interface. At the top, there is a breadcrumb trail: 'Home > My Staff'. Below this is the 'My Staff List' section, which includes a search bar and a dropdown menu set to '10 entries'. The main content is a table with the following columns: No, Name, Designation, SOP, CAC, CIDB, NTMSP, HIRARC, Status, and Actions. Two staff members are listed:

No	Name	Designation	SOP	CAC	CIDB	NTMSP	HIRARC	Status	Actions
1	MUHAMMAD AL AMIN BIN MOHD SHAH	Technician	✗	✗	✗	✗	✗	Approved	👁️
2	JOHN DOE LEE	Welder	✗	✗	✗	✗	✗	In Process	👁️

At the bottom of the table, it shows '1-2 of 2 entries' and a pagination control with a blue button labeled '1'.

Figure 4.16 list of MyStaff application

This feature makes it easier for users to manage their team and ensure that only qualified personnel are assigned to work activities under each permit.

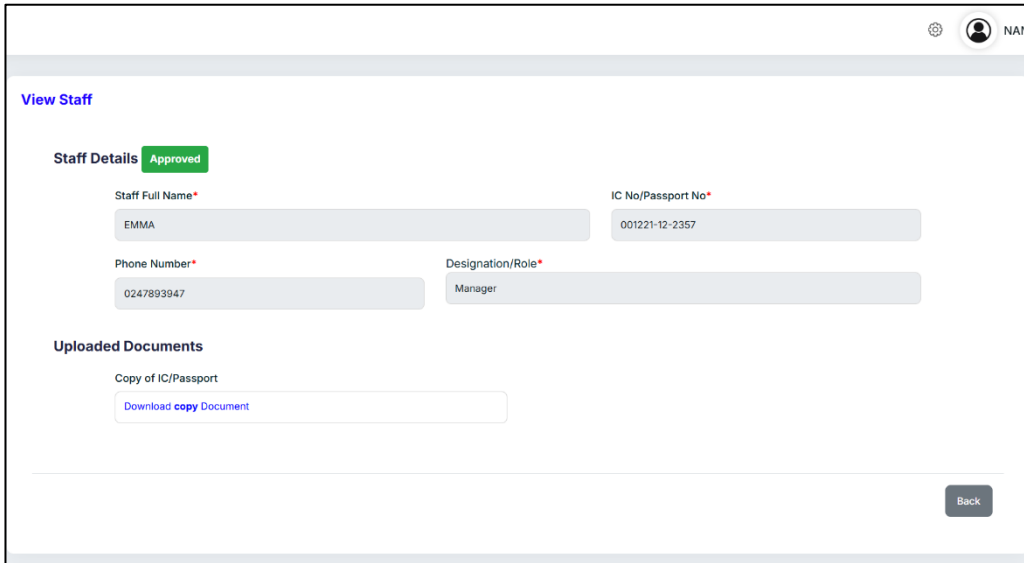


Figure 4.17 MyStaff application details

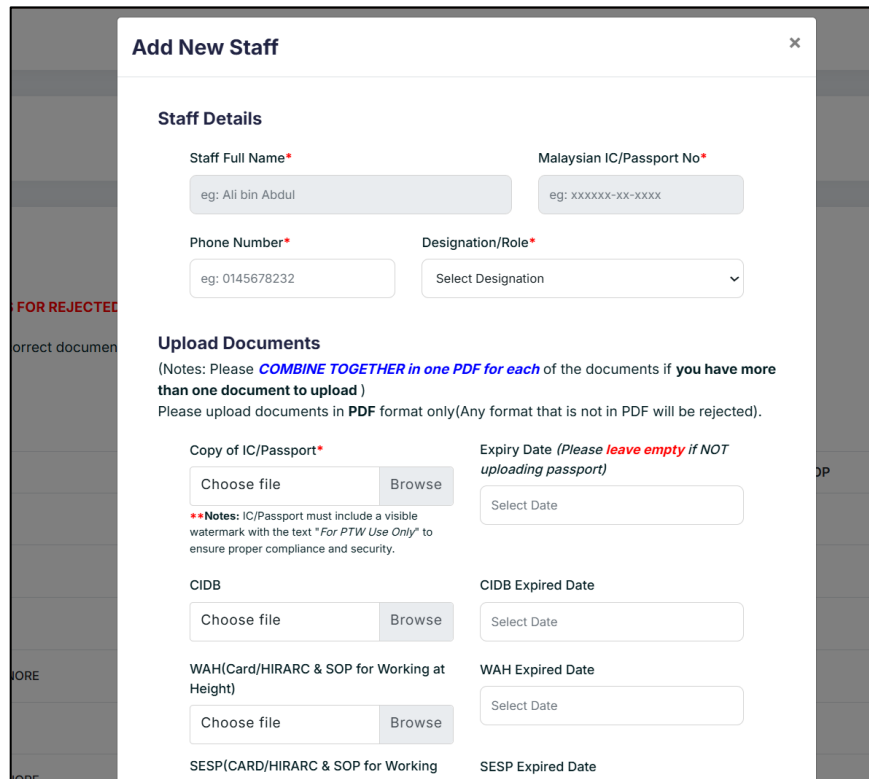


Figure 4.18 Add MyStaff application modal

i. Microsoft Azure Document Intelligent

In addition to the manual input of staff details, the system also incorporates the use of AI-powered document scanning to streamline the process of adding new staff. Specifically, the full name and IC number or passport number of a staff member will be automatically extracted from the uploaded identification document using Azure AI Document Intelligence. This integration, as shown in Figure 4.19, allows the system to connect to Microsoft Azure's document analysis API, which uses machine learning to accurately read and extract text data from scanned documents such as PDFs. When a user uploads an IC or passport document, the system sends it to Azure's AI service, which processes the file and returns the extracted information. These details are then automatically filled into the relevant form fields, reducing manual effort and minimizing errors.

```
class PublicController extends BaseController
0 references | 0 overrides
public function extractIC(): ResponseInterface
{
    $file = $this->request->getFile(fileID: 'ic_pdf');

    if (!$file || !$file->isValid()) {
        return $this->respond(data: ['error' => 'Invalid file.'], status: 400);
    }

    // Move to temp folder
    $filename = $file->getRandomName();
    $file->move(targetPath: WRITEPATH . 'uploads', name: $filename);
    $filepath = WRITEPATH . 'uploads/' . $filename;
    $binaryData = file_get_contents($filepath);

    // Azure details ***Confidential
    $endpoint = "end-point";
    $apiKey = "API KEY";
    $modelId = "modelic";
    $url = "$endpoint/formrecognizer/documentModels/$modelId:analyze?api-version=2023-07-31";

    $headers = [
        "Content-Type: application/octet-stream",
        "Ocp-Apim-Subscription-Key: $apiKey"
    ];

    $ch = curl_init($url);
    curl_setopt(handle: $ch, option: CURLOPT_POST, value: true);
    curl_setopt(handle: $ch, option: CURLOPT_POSTFIELDS, value: $binaryData);
    curl_setopt(handle: $ch, option: CURLOPT_HTTPHEADER, value: $headers);
    curl_setopt(handle: $ch, option: CURLOPT_RETURNTRANSFER, value: true);
    curl_setopt(handle: $ch, option: CURLOPT_HEADER, value: true);

    $response = curl_exec(handle: $ch);
    $header_size = curl_getinfo(handle: $ch, option: CURLINFO_HEADER_SIZE);
    $header = substr(string: $response, offset: 0, length: $header_size);
    curl_close(handle: $ch);

    if (!preg_match(pattern: '/operation-location: (.*)i', subject: $header, matches: &$matches)) {
        return $this->respond(data: ['error' => 'Azure did not return operation-location.'], status: 500);
    }
}
```

Figure 4.19 Azure AI document intelligence integration code

The main benefit of using Azure AI Document Intelligence in this system is that it simplifies and speeds up the data entry process for users. Instead of typing out names and identification numbers, which can sometimes lead to mistakes, the system ensures accuracy by relying on AI to capture this data directly from official documents. This not only improves the user experience but also enhances data integrity, especially when dealing with large numbers of staff applications. It is particularly useful in situations where users need to register multiple workers quickly and accurately while ensuring that the details match official records. This feature reflects the system's goal of using smart technologies to improve efficiency and reduce the workload for users handling permit applications.

e. View and Approve staff applications

The view and approve staff applications section is part of the Safety Officer module and is designed to help the safety officer manage staff PTW applications efficiently. As illustrates in Figure 4.20, safety officer can view all staff applications submitted by user before they apply for permit, along with their details and supporting documents. Based on the information provided, the safety officer can either approve or reject the application depending on whether it meets the safety requirements and guidelines set by the company. Before making a decision, the safety officer has the option to review the contents of each application thoroughly. They can also leave comments or feedback if certain documents are missing or if corrections are needed. Figure 4.21 shows the form to make decision on the permit and compulsory fields that needs to be filled by safety officer. Comments will be marks as compulsory by the system if the safety officer choose option to reject the staff application. This feedback helps guide the staff in making necessary improvements or adjustments to their application. Figure 4.22 shows the rejected staff application that include remarks to show the applicant that the reason of the rejection. By allowing comments, the system also promotes clear communication between staff and the safety officer, ensuring that safety standards are met before any work begins on site.

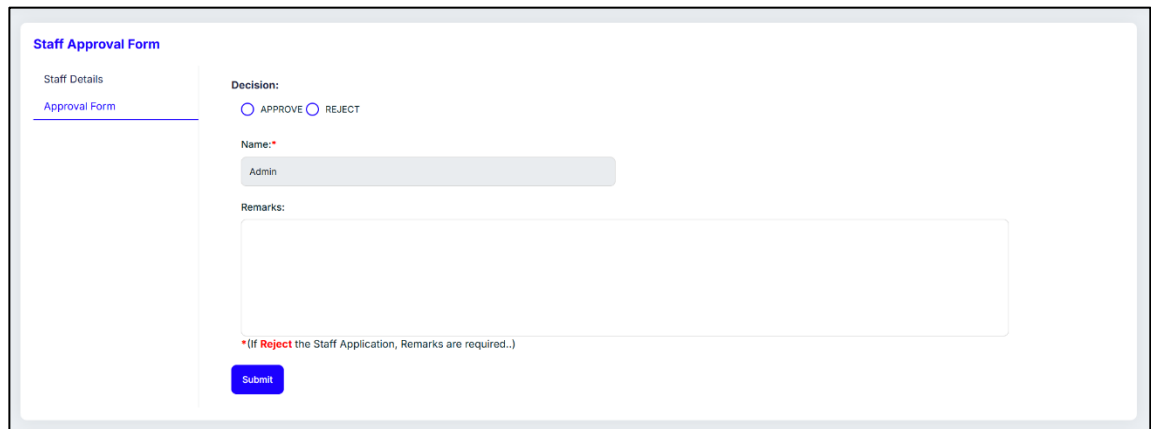
The screenshot displays a web interface titled "Staff Approval Form". On the left, there is a sidebar with "Staff Details" selected. The main content area shows the following information:

- Staff Details:** A green "Approved" status tag is visible. Fields include "Staff Full Name*" (CHEL), "IC No/Passport No*" (001221-12-2357), "Phone Number*" (0247893947), and "Designation/Role*" (Contractor).
- Uploaded Documents:** Two sections are shown. The first is "IC/Passport" with a "Download copy Document" button and an "Expired Date" of "16 Apr 2025". The second is "Other Supporting Documents" with a "Download Other Document" button and an "Expired Date (if any)" of "30 Oct 2025".

A "Back" button is located at the bottom right of the form.

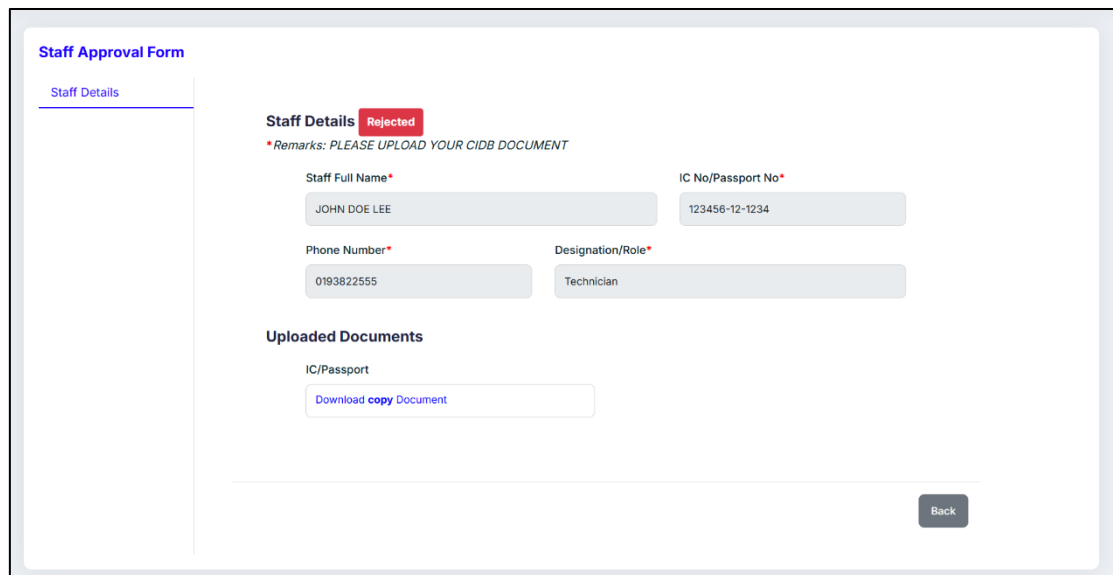
Figure 4.20 View staff details

Overall, this section plays a crucial role in maintaining a safe working environment by giving the safety officer full control and responsibility over the approval process.



The screenshot shows the 'Staff Approval Form' interface. On the left, there is a sidebar with 'Staff Details' and 'Approval Form' (the latter is selected). The main content area has a 'Decision:' section with two radio buttons: 'APPROVE' (selected) and 'REJECT'. Below this is a 'Name:*' field containing 'Admin'. A 'Remarks:' text area is empty. A red asterisk note below the text area reads: '* (If Reject the Staff Application, Remarks are required..)'. At the bottom, there is a blue 'Submit' button.

Figure 4.21 Staff approval form



The screenshot shows the 'Staff Approval Form' interface with the 'Staff Details' tab selected. A red 'Rejected' status is displayed at the top. Below it, a red asterisk note reads: '* Remarks: PLEASE UPLOAD YOUR CIDB DOCUMENT'. The form contains several input fields: 'Staff Full Name*' with 'JOHN DOE LEE', 'IC No/Passport No*' with '123456-12-1234', 'Phone Number*' with '0193822555', and 'Designation/Role*' with 'Technician'. Under the 'Uploaded Documents' section, there is a field for 'IC/Passport' with a 'Download copy Document' button. A 'Back' button is located at the bottom right.

Figure 4.22 View staff details with remarks

f. Apply permit

The Apply Permit feature is available to all registered users of the system, allowing them to submit new Permit to Work (PTW) applications. As shown in Figure 4.23, the first step in the process requires the user to select a permit region. Each application is limited to only one region, meaning users can only choose one

region per permit. Once the region is selected, the system will proceed to the next step, as illustrated in Figure 4.24, where the user must choose at least one of the activity conditions that is listed in the form. This selection is important because it helps the system filter and display only the staff members who meet the specific criteria required for that activity. The filtering is based on valid certificates that have already been approved by the Safety Officer. After selecting the activity condition, Figure 4.25 shows the page where users must choose the permit type, whether it is service affecting or non-service affecting. Based on this selection, the system will guide the user to the main application form which is the permit application details as shown in Figure 4.26.

In this form, users are required to provide detailed information about the permit, including the start and end date, activity category, and a clear description of the work scope. Following that, the user must upload any necessary attachments that support the application, such as safety plans or technical documents. Figure 4.27 shows where the system allows users to choose multiple sites under the same region for one application. Once the site selection is completed, the user can add staff to the permit, where again the system will only show staff that meet the filtered requirements as shown in Figure 4.28. Finally, before submitting the application, the user must agree to the declaration form as shown in Figure 4.29 , which confirms that all provided information is accurate and complete. Once agreed, the user can submit the application, and it will then be processed according to the system's approval flow.

New Application

PTW Form
Fill in this form correctly

**** Alert:** Please note that once you submit your decisions, they are final and cannot be changed. Take your time to review your choices before proceeding.

Select Region

Select Region

HQ-COE

Site Region

- HQ-COE
- KUCHING 1
- KUCHING 2
- KUCHING 3
- SBI & MAN

Figure 4.23 Select permit region

Permit Work

**** Alert:** Please note that once you submit your decisions, they are final and cannot be changed. Take your time to review your choices before proceeding.

Permit Work Conditions
Please choose at least **ONE (1)** activity condition below

INFO! Please select the correct options. This section affects the **list of staff** you can add to the permit. Ensure that your staff's licenses and certificates are **valid for at least 30 days** from the permit start date.

Work At Height/RIGGER

SMART 600

Visiting Only

Electrical near SESCO Infrastructure

Remote Location

Others

[Next](#)

Figure 4.24 Select work conditions

Permit Type

Select Permit Type:

**** Alert:** Please note that once you submit your decisions, they are final and cannot be changed. Take your time to review your choices before proceeding.

SA (Service Affecting)

NSA (Non-Service Affecting)

[Next](#)

Figure 4.25 Select permit type

Permit Details

Application Details
Please fill in this form correctly

Start Date * **End Date ***

Activity Category * **Scope of Work ***

Next

Figure 4.26 Permit application details

Site Details

Add Site

Site List

SEARCH SITES...

No	LRD	Site ID	Sites Name	Division	District	Select
1	PONG	SMA76010025	Kg. Tanjung Apong	SAMARAHAN	ASAJAYA	<input type="checkbox"/>
2	AMBR	SMA76010026	Kg. Sambir	SAMARAHAN	ASAJAYA	<input type="checkbox"/>
3	RPAN	SMA76010027	Kg. Serpan Laut	SAMARAHAN	ASAJAYA	<input type="checkbox"/>

Figure 4.27 Add sites to permit

Staff Details

Add Staff

STAFF ADDED
No staff added.

Staff List

Show 10 entries Search: Search

No	Name	CIDB	WAH	SESP	CAC	NTMSP	SOP	HIRARC	Action
1	TEST	✓	✓	✓	✓	✓	✗	✓	<input type="button" value="⌵"/>

1-1 of 1 entries

Figure 4.28 Add staff/workers to permit

Declaration

D. Declaration

I/We understand and accept all the terms and conditions the work prescribed is to be carried out and safety precautions that are necessary to complete the work safely as outlined in the appropriate safely as outlined in the appropriate method statement and risk assessments. If conditions are such that the method statement and risk assessments become invalid it is my responsibility to stop work immediately and notify the person who authorized this permit to work. The disposal of any residues of the hazardous material used will be in accordance with the Environmental Quality Act. The person who undertake this work also liable to comply to all the Statutory Requirement imposed by the authorities.

Submitted By

ID Number/Passport No*

Figure 4.29 Declaration form

To ensure the smooth handling of new permit submissions in the backend, the system uses a dedicated function within the PTWApplication class to process and store all the relevant data provided by the applicant. As illustrated in Figure 4.30, the insertPTWApplication() function is responsible for generating a new application record in the ptw_application table. It begins by retrieving the current year and month to help build a unique reference number (ptw_no) for each new permit. This reference number combines the year, month, and an incremented counter value stored in the ptw_counter table. This approach ensures that each application is uniquely identified.

The function also generates unique strings for the application_id and site_id to avoid duplication and maintain data integrity. Before inserting the new data, the function sets the application status to “Draft” and the submission flag to “Not submitted”, allowing users to edit the application before final submission. All details including applicant’s name, contact information, company ID, site information, and system-generated id number are inserted into the database securely within a transaction block. This implementation ensures the consistency and reliability of the data entry process when users submit new PTW applications.

```

class PTWApplication
public function getCompanyDetails($companyId): mixed
}

//store/insert data to db(site/ptwapplication and counter)
0 references|0 overrides
public function insertPTWApplication($companyId, $divCode, $username, $userId, $email, $phone, $compName, $compAdd): string
{
    $year = date(format: 'Y');
    $currentMonth = date(format: 'm');
    $date = new DateTime(datetime: 'now', timezone: new DateTimeZone(timezone: 'Asia/Kuala_Lumpur'));
    $date = $date->format(format: 'Y-m-d H:i:s');
    $this->db->transStart();

    // Fetch and increment counter in a single operation
    $counterRow = $this->db->table('ptw_counter')
        ->select('ptw_no')
        ->get()
        ->getRowArray();

    $counter = isset($counterRow['ptw_no']) ? intval(value: $counterRow['ptw_no']) : 0;
    $newCounter = str_pad(string: $counter + 1, length: 3, pad_string: '0', pad_type: STR_PAD_LEFT);
    $refNum = "SDEC{$year}{$currentMonth}-{$newCounter}";

    $appId = generateRandomString(length: 20);
    $siteId = generateRandomString(length: 20);

    $appStatus = '001'; // Draft
    $submitFlag = 'N'; // Not submitted

    // Insert into ptw_application table
    $this->db->table('ptw_application')->insert([
        'application_id' => $appId,
        'company_id' => $companyId,
        'cpID' => $userId,
        'ptw_div' => $divCode,
        'ptw_no' => $refNum,
        'ptw_year' => $year,
        'ptw_month' => $currentMonth,
        'name' => $username,
        'email' => $email,
        'mobile_no' => $phone,
        'add1' => $compAdd,
    ]);
}

```

Figure 4.30 Backend code snippet from the PTWApplication class showing insertPTWApplication() function

g. Approve Permit

The Approve Permit section is a key part of the system where authorized approvers, such as site owner and project owners, are responsible for reviewing and making decisions on submitted Permit to Work (PTW) applications. Figure 4.31 shows the tab of permit approval form that will be used by permit approvers. In this section, the approver can choose to approve, reject, or return a permit depending on the information provided. Before taking any action, the approver can view all the details of the application, including descriptions of the work, the selected site, and any attached documents that can be viewed in the same page. If the permit is complete and meets all safety and operational requirements, the approver can approve it directly. However, if the application is incomplete, contains incorrect information, or lacks important documents, the approver has the option to either reject the application or return it to the applicant for revision. When returning or rejecting a permit, the approver can also include comments or feedback using the

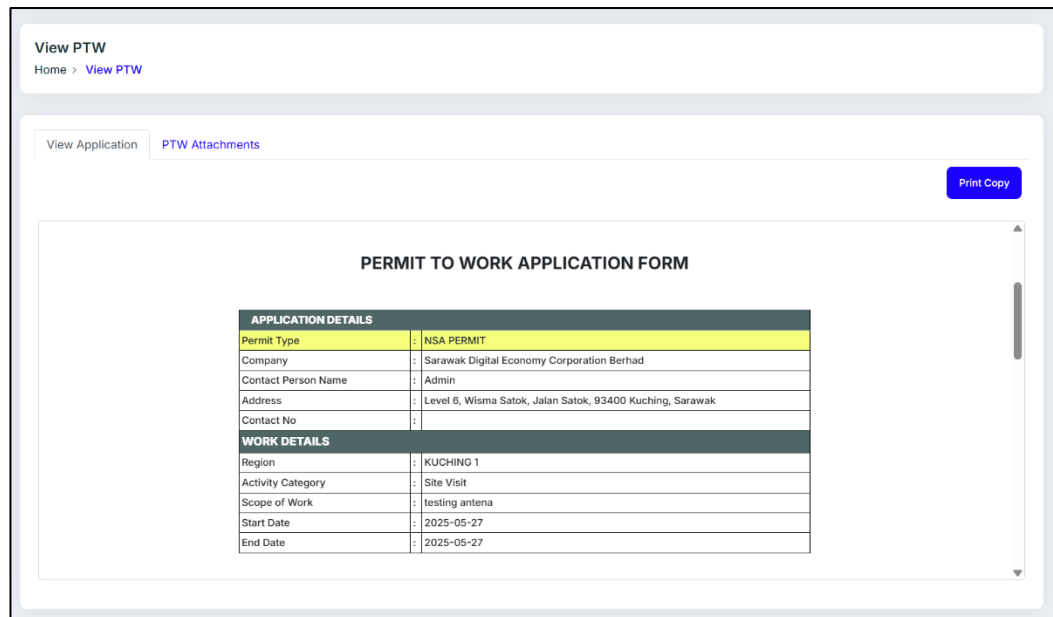
provided comment box to clearly explain the reason for their decision. This helps ensure that applicants understand what needs to be corrected or why the application was not accepted. The process typically involves the approver logging into the system, checking the list of pending applications, reviewing the details of a selected permit, choosing the appropriate action (approve, reject, or return), writing a comment if necessary, and then submitting their decision. This feature ensures that every PTW application goes through a proper review process to maintain workplace safety and compliance.

The screenshot shows a web interface for approving a PTW application. At the top, it says "Approving" and "PTW Approval > Approving". Below this are navigation tabs: "View Application", "PTW Attachments", "Staff Details", "Decision Form by Project Owner", and "Decision Details". The "Decision" section has three radio buttons: "Approve", "Return", and "Reject". The "Name" field contains "Admin". The "Phone Number" field has a placeholder "(eg: 013523487)". The "Remarks" section has a text area with the prompt "Add remarks if any...". A red asterisk note below the text area reads "*If reject the application, please state the reasons..". A blue "Submit" button is located at the bottom right.

Figure 4.31 Permit approval form

h. View permit details

The View Permit Details section allows users to see all the information related to their submitted Permit to Work (PTW) applications. Figure 4.32 shows page where users can track the progress of their applications, including the current status such as pending, approved, rejected, or returned. They can also view the full details of the permit they submitted, such as the selected region, activity conditions, permit type, work scope, dates, selected sites, and staff involved. Any attachments that were uploaded during the application process can also be viewed or downloaded. Additionally, if the application has been returned or rejected, users can read the comments or feedback provided by the approver, helping them understand what needs to be corrected before resubmission. This section is useful for keeping users informed and updated about their permit status, making it easier to manage and follow up on ongoing work applications.



The screenshot displays a web interface for viewing a Permit to Work (PTW) application. At the top, it shows the breadcrumb 'Home > View PTW'. Below this, there are two tabs: 'View Application' and 'PTW Attachments'. A 'Print Copy' button is located in the top right corner. The main content area is titled 'PERMIT TO WORK APPLICATION FORM' and contains two tables of details.

APPLICATION DETAILS	
Permit Type	: NSA PERMIT
Company	: Sarawak Digital Economy Corporation Berhad
Contact Person Name	: Admin
Address	: Level 6, Wisma Satok, Jalan Satok, 93400 Kuching, Sarawak
Contact No	:

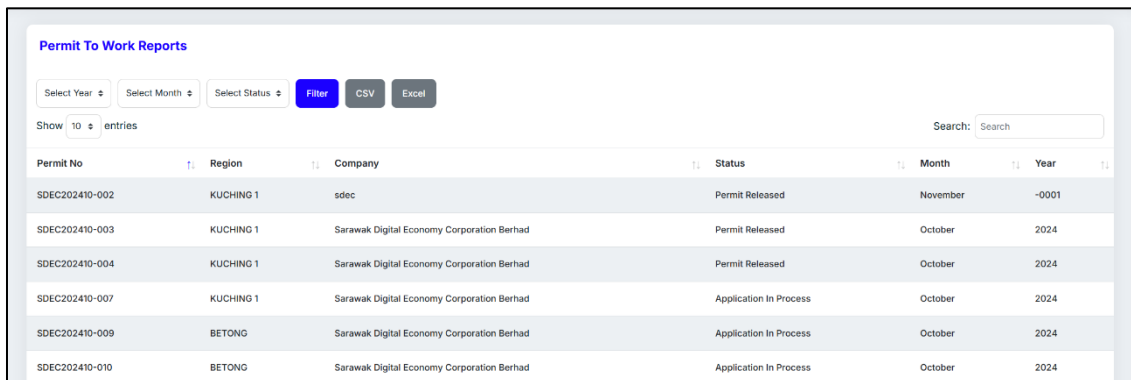
WORK DETAILS	
Region	: KUCHING 1
Activity Category	: Site Visit
Scope of Work	: testing antenna
Start Date	: 2025-05-27
End Date	: 2025-05-27

Figure 4.32 Permit details

i. Generate Permit Report

The Generate Permit Report function allows the system admin or authorized users to create detailed reports based on the Permit to Work (PTW) applications submitted through the system. This feature helps in tracking and analysing permit data over a selected period of time. Users can filter the report by various criteria such as year, region and permit status (approved, pending, or rejected). Once the filters are applied, the system will generate a clear and organised report that shows all the relevant information in table format. Figure 4.33 shows the page to generate report for all PTW records.

The generated report can be used for monitoring work activities, identifying patterns or issues, and supporting decision making processes. It is especially useful during audits or monthly reviews, as it provides a quick summary of the permit activities across all sites. In addition, users have the option to download the report in Comma Separated Values (CSV) or Excel format, making it easier to store, print, or share with other departments. This function helps improve record keeping, and management of the PTW system.



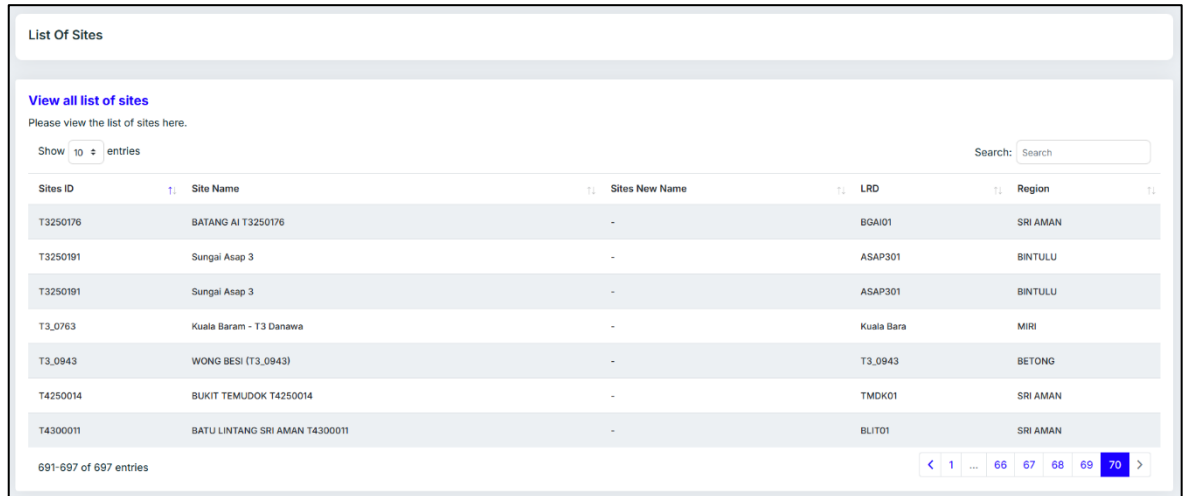
The screenshot displays the 'Permit To Work Reports' interface. At the top, there are filters for 'Select Year', 'Select Month', and 'Select Status', along with buttons for 'Filter', 'CSV', and 'Excel'. Below the filters, there is a search bar and a 'Show 10 entries' indicator. The main content is a table with the following data:

Permit No	Region	Company	Status	Month	Year
SDEC202410-002	KUCHING 1	sdec	Permit Released	November	-0001
SDEC202410-003	KUCHING 1	Sarawak Digital Economy Corporation Berhad	Permit Released	October	2024
SDEC202410-004	KUCHING 1	Sarawak Digital Economy Corporation Berhad	Permit Released	October	2024
SDEC202410-007	KUCHING 1	Sarawak Digital Economy Corporation Berhad	Application In Process	October	2024
SDEC202410-009	BETONG	Sarawak Digital Economy Corporation Berhad	Application In Process	October	2024
SDEC202410-010	BETONG	Sarawak Digital Economy Corporation Berhad	Application In Process	October	2024

Figure 4.33 generate permit report

j. View list of sites

Figure 4.34 shows list of sites page that is designed to provide public users with easy access to information about all sites within the system. This section allows users to preview important site details such as the Site ID, site name, and the region each site belongs to. It acts as a reference tool for contractors or company representatives who are preparing to submit a permit application, helping them identify the correct site based on their project location. By referring to this list, users can ensure they select the appropriate site that matches the actual work area during the permit application process. This feature is especially helpful in avoiding errors or confusion when dealing with multiple sites across different regions. Although users can view the site details, they cannot edit or delete them, as this is strictly managed by the system administrator through the Site Settings for internal user.



List Of Sites

[View all list of sites](#)

Please view the list of sites here.

Show 10 entries

Sites ID	Site Name	Sites New Name	LRD	Region
T3250176	BATANG AI T3250176	-	BGAI01	SRI AMAN
T3250191	Sungai Asap 3	-	ASAP301	BINTULU
T3250191	Sungai Asap 3	-	ASAP301	BINTULU
T3_0763	Kuala Baram - T3 Danawa	-	Kuala Bara	MIRI
T3_0943	WONG BESI (T3_0943)	-	T3_0943	BETONG
T4250014	BUKIT TEMUDOK T4250014	-	TMDK01	SRI AMAN
T4300011	BATU LINTANG SRI AMAN T4300011	-	BLIT01	SRI AMAN

691-697 of 697 entries < 1 ... 66 67 68 69 70 >

Figure 4.34 List of sites

k. History Audit Logs

One of the important features in e-Permit to Work (PTW) system is the History Audit Log, which helps track and monitor user activities and permit updates. This feature is supported by two database tables `ptw_history` and `ptw_trail`. Figure 4.35 shown the database table for `ptw_history` and figure 4.36 shown the table of `ptw_trail`. The `ptw_history` table stores every change made to a permit or staff application, such as when a permit is submitted, approved, or rejected. It also keeps information like the user

who made the change, the status, and the time and date it happened. On the other hand, the ptw_trail table records general user actions like login, logout, and what pages the user visited. This includes who did what, and when it was done. This log can be accessed by internal user through database. The system provide this data in the system to make it easier for management to track all activities transparent. It also helps during audits, because the system keeps a clear record of everything that happens inside the system.

ptw_history_id	application_id	application_status	rsmak	created_by	created_date	updated_date
8	3644377798RtCeEfyx	phvXZr2CPLCP3qCR	001	New Application-Draft	1	2025-06-29 14:45:09.000
9	5ngpQDCtCbMfUaWw	hMxNhemNg4WP3RS	012	PTW Approved -SDEC202506-019	SITE OWNER KUCHING 1	2025-06-29 14:52:06.000
10	5QJLEAYhKzZOGSYx	9eakaoXlBthwupQ76	3	MyStaff Update -9eakaoXlBthwupQ76	Safety Officer	2025-06-29 08:20:29.000
11	698h9h30ZBV0E0BVa	ZygCvdT0qGFFBzTr	3	MyStaff Update -ZygCvdT0qGFFBzTr	Safety Officer	2025-06-24 03:44:47.000
12	6jMMKAxvufR7owxPh	G8omVDRkMAxUcRJMk	002	PTW Submitted -SDEC202506-016	1	2025-06-29 14:41:43.000
13	7ioTgOSXtphMUAyTy	HoWafe1wNwAz3HR9	001	New Application-Draft	7	2025-06-29 15:50:13.000
14	7MvPTHGSVtCUZ6xGzW	DSi54JZSHw9r35wLd	002	PTW Submitted -SDEC202506-029	7	2025-06-29 16:23:23.000
15	8FeesMdcSS7eRpp4ZL	edR9gJtoqG0d8GInVg	012	PTW Approved -SDEC202506-011	LILEYANA	2025-06-29 14:39:18.000
16	8P55Lwv3S9pZ3B9NS	ZS0ltnf30yGhUSJCF	001	New Application-Draft	1	2025-06-24 04:31:00.000
17	8Y6mMkM4tZqCDDd	4c75qMhH8BldmlyRr	012	PTW Approved -SDEC202506-013	SITE OWNER KUCHING 1	2025-06-29 14:34:52.000
18	agp5N5N30CSpZ7oq	LbDfVqJ0W9y9yCQhVA	002	PTW Submitted -SDEC202506-001	1	2025-06-24 04:11:27.000
19	akINuCPyTlWfWd	xppqUQ3wvdkGPDu5Mh	3	MyStaff Update -xppqUQ3wvdkGPDu5Mh	Safety Officer	2025-06-29 13:14:51.000
20	baTsq3Cpym7K0JdyCrd	ZS0ltnf30yGhUSJCF	002	PTW Submitted -SDEC202506-005	1	2025-06-29 14:43:01.000
21	BBHHS0CvIDGZGzQgr	lqU3tJdCHHrHhWw	001	New Application-Draft	1	2025-06-29 15:30:38.000
22	BlOSf5My6lQ90uVf	oX6XdwZz5bM0sAID0	001	New Application-Draft	5	2025-06-29 13:16:35.000
23	buX00RHEHm0V0kay	phvXZr2CPLCP3qCR	012	PTW Approved -SDEC202506-018	SITE OWNER KUCHING 1	2025-06-29 14:52:00.000
24	bu55Lwv3S9pZ3B9NS	ZS0ltnf30yGhUSJCF	012	PTW Approved -SDEC202506-001	SITE OWNER KUCHING 1	2025-06-29 14:35:11.000
25	cedfHAB4y6kdy2075X	gm788h0V0JRRB17y2c	017	PTW Submitted -SDEC202506-025	LILEYANA	2025-06-29 15:45:26.000
26	Cm6dSH7d5v5dGHqf	AcbD7B8Crd5mp5GIR	012	PTW Approved -SDEC202506-001	PROJECT OWNER ENGINEERING	2025-06-24 03:53:42.000
27	dHmUD9DkgdY5u2z6zC	4eyeah132fYjM8KqDsu	012	PTW Approved -SDEC202506-026	LILEYANA	2025-06-29 16:20:50.000
28	dKuU70D9DkgdY5u2z6zC	4eyeah132fYjM8KqDsu	001	New Application-Draft	7	2025-06-29 15:45:47.000
29	DmqQ0BPfRgk3shaW9	4Phnd4m1ZROKQD2D4g	002	PTW Submitted -SDEC202506-012	5	2025-06-29 13:26:13.000
30	Du0RmLpAAd06Qn6N	z28Ye1mUW0FNB014ZQ	012	PTW Approved -SDEC202506-022	SITE OWNER KUCHING 1	2025-06-29 15:39:13.000
31	ePcZpCHYhMvJSPFN8	0D4KRKZGj7e7hbnTO	3	MyStaff Update -0D4KRKZGj7e7hbnTO	Safety Officer	2025-06-29 13:15:09.000
32	Fj0pR0u0D9DkgdY5u2z6zC	D9i84Jd3hY9w6wD	001	New Application-Draft	7	2025-06-29 16:22:17.000
33	Redk6bRouTvdNfLU	45pMAMRtHChWm7f	012	PTW Approved -SDEC202506-017	SITE OWNER KUCHING 1	2025-06-29 14:51:48.000
34	mm6m6V5FPTf4q4Q	ZS0ltnf30yGhUSJCF	012	PTW Approved -SDEC202506-005	SITE OWNER KUCHING 1	2025-06-29 14:51:24.000
35	FRCTBaW050506Kb	Zy7NP9xWw9pY8WdAP	012	PTW Approved -SDEC202506-004	SITE OWNER KUCHING 1	2025-06-29 14:33:44.000
36	gNIGobw0Opq5Ushiqe	UMRkXpYRq6HwBq5f1	001	New Application-Draft	2	2025-06-29 15:39:56.000
37	HikwU70zRy3M6gh	EdRXJdLMH4MhYnyy5	002	PTW Submitted -SDEC202506-021	1	2025-06-29 15:28:24.000
38	Iqas5UJHKGonwewFL8	G8omVDRkMAxUcRJMk	012	PTW Approved -SDEC202506-016	SITE OWNER KUCHING 1	2025-06-29 14:51:38.000
39	KJHgAD6D06D9P9GvC	gJwFp8rGpk4VFA04W	001	New Application-Draft	7	2025-06-29 16:24:34.000
40	KZ45g5fERU01E8EP	KUJkRk0wCfSC7H8K	001	New Application-Draft	5	2025-06-29 13:26:23.000
41	ke0tD06d6mAtEG05	hMxNhemNg4WP3RS	002	PTW Submitted -SDEC202506-019	1	2025-06-29 14:48:22.000
42	kn2h6w69Nz7Jedw	UMRkXpYRq6HwBq5f1	017	PTW Submitted -SDEC202506-024	LILEYANA	2025-06-29 15:44:44.000
43	ksuQ70x8d8R8Y0XT	KcJMY50L05dmbH94K	001	New Application-Draft	5	2025-06-29 13:35:36.000

Figure 4.35 ptw_history table - application activity log

trailid	user_email	user_id	status	updated_date
36	safety@sdcc.com.my	Safety Officer	MyStaff Update -9eakaoXlBthwupQ76	2025-06-29 16:20:29.000
37	lleyana02@gmail.com	Safety Officer	MyStaff Update -D3ayJm7f0a17m3z1	2025-06-29 16:21:00.000
38	lleyana02@gmail.com	7	LOGIN ACCOUNT	2025-06-29 16:24:09.000
39	lleyana02@gmail.com	7	LOGIN ACCOUNT	2025-06-29 16:24:38.000
40	lleyana02@gmail.com	7	New application SDEC202506-008	2025-06-29 16:49:40.000
41	lleyana02@gmail.com	7	LOGIN ACCOUNT	2025-06-29 21:11:39.000
42	lleyana02@gmail.com	7	New application SDEC202506-009	2025-06-29 21:12:06.000
43	safety@sdcc.com.my	5	LOGIN ACCOUNT	2025-06-29 21:14:20.000
44	lleyana02@gmail.com	Safety Officer	MyStaff Update -xppqUQ3wvdkGPDu5Mh	2025-06-29 21:14:51.000
45	lleyana02@gmail.com	Safety Officer	MyStaff Update -0D4KRKZGj7e7hbnTO	2025-06-29 21:15:09.000
46	safety@sdcc.com.my	5	New application SDEC202506-010	2025-06-29 21:16:35.000
47	safety@sdcc.com.my	5	PTW Submitted -SDEC202506-010	2025-06-29 21:18:35.000
48	safety@sdcc.com.my	5	New application SDEC202506-011	2025-06-29 21:18:52.000
49	safety@sdcc.com.my	5	PTW Submitted -SDEC202506-011	2025-06-29 21:20:22.000
50	safety@sdcc.com.my	5	New application SDEC202506-012	2025-06-29 21:20:42.000
51	safety@sdcc.com.my	5	New application SDEC202506-013	2025-06-29 21:24:25.000
52	safety@sdcc.com.my	5	PTW Submitted -SDEC202506-013	2025-06-29 21:25:23.000
53	safety@sdcc.com.my	5	PTW Submitted -SDEC202506-012	2025-06-29 21:26:13.000
54	safety@sdcc.com.my	5	New application SDEC202506-014	2025-06-29 21:26:23.000
55	safety@sdcc.com.my	5	PTW Submitted -SDEC202506-014	2025-06-29 21:35:18.000
56	safety@sdcc.com.my	5	New application SDEC202506-015	2025-06-29 21:35:36.000
57	lleyana02@gmail.com	7	LOGIN ACCOUNT	2025-06-29 21:55:15.000
58	sokch@sdcc.com.my	2	LOGIN ACCOUNT	2025-06-29 22:33:15.000
59	lleyana02@gmail.com	SITE OWNER KUCHING 1	PTW Approved -SDEC202506-004	2025-06-29 22:33:44.000
60	safety@sdcc.com.my	SITE OWNER KUCHING 1	PTW Approved -SDEC202506-012	2025-06-29 22:34:21.000
61	lleyana02@gmail.com	SITE OWNER KUCHING 1	PTW Approved -SDEC202506-011	2025-06-29 22:34:51.000
62	lleyana02@gmail.com	SITE OWNER KUCHING 1	PTW Approved -SDEC202506-001	2025-06-29 22:35:11.000
63	lleyana02@gmail.com	7	LOGIN ACCOUNT	2025-06-29 22:37:57.000
64	safety@sdcc.com.my	LILEYANA	PTW Approved -SDEC202506-010	2025-06-29 22:39:08.000
65	safety@sdcc.com.my	LILEYANA	PTW Approved -SDEC202506-011	2025-06-29 22:39:18.000
66	safety@sdcc.com.my	LILEYANA	PTW Approved -SDEC202506-014	2025-06-29 22:39:25.000
67	lleyana02@gmail.com	1	LOGIN ACCOUNT	2025-06-29 22:40:02.000
68	lleyana02@gmail.com	1	New application SDEC202506-016	2025-06-29 22:40:20.000
69	lleyana02@gmail.com	1	PTW Submitted -SDEC202506-016	2025-06-29 22:41:43.000
70	lleyana02@gmail.com	1	PTW Submitted -SDEC202506-005	2025-06-29 22:43:01.000
71	lleyana02@gmail.com	1	New application SDEC202506-017	2025-06-29 22:43:17.000

Figure 4.36 ptw_trail- user activity log

I. Email notification and reminder

The e-Permit to Work (PTW) system is equipped with an automated email notification feature that improves communication and helps users stay informed throughout the permit and staff application process. This feature ensures users are updated on key events without needing to constantly log in to the system. One of the notifications in the system is the Permit Expiry Reminder, which alerts users before a permit reaches minimum 3 days before its expiration date the purpose of this notification is to remind ptw applicant to update their work progress to close the permit. Figure 4.37 shows the permit expired reminder notification email. If a permit has already expired, the system sends a follow up permit expired notification to inform the user that the permit has expired and system has update the status to expired as shown in figure 4.38.

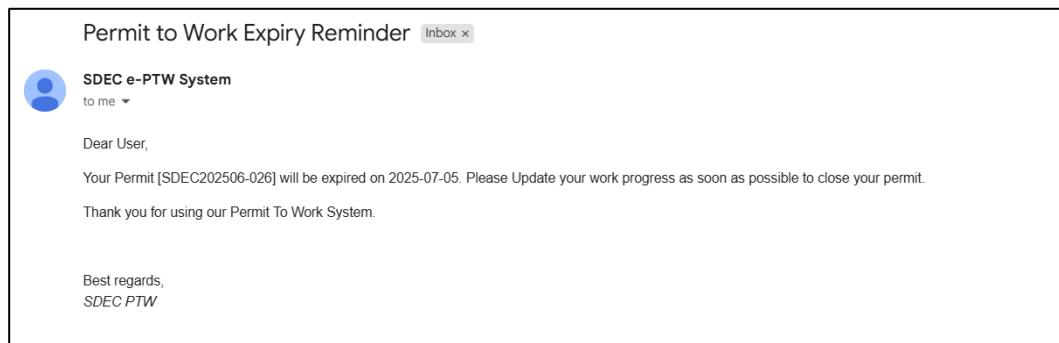


Figure 4.37 permit expiry reminder email notification

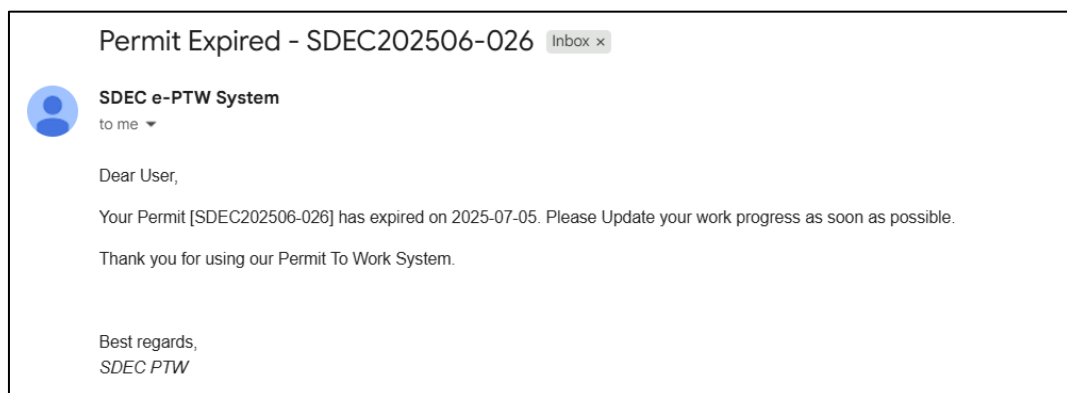


Figure 4.38 expired permit email notification

In addition, the system automatically sends an application status update email when a permit is either approved, rejected, or returned as shown in figure 4.39. This keeps users aware of the progress of their applications and includes relevant information such as the permit number and current status.

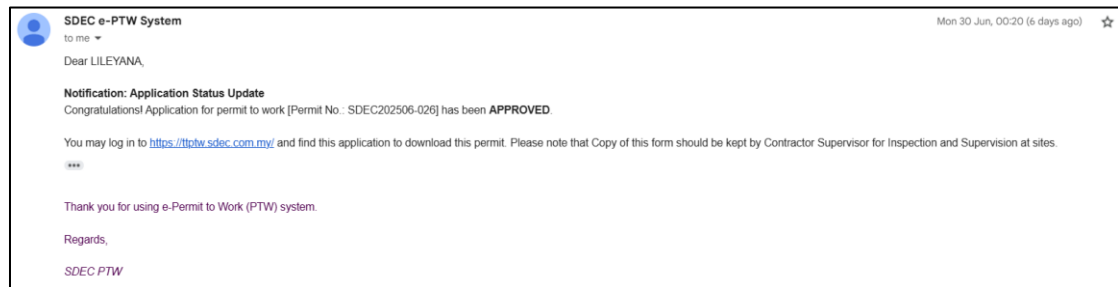


Figure 4.39 permit approval email notification

Lastly, users are also notified when there are changes to their MyStaff applications through a staff application status update email. This ensures that any updates or actions required for staff-related documents are clearly communicated. Figure 4.40 demonstrates the example of staff application update email.

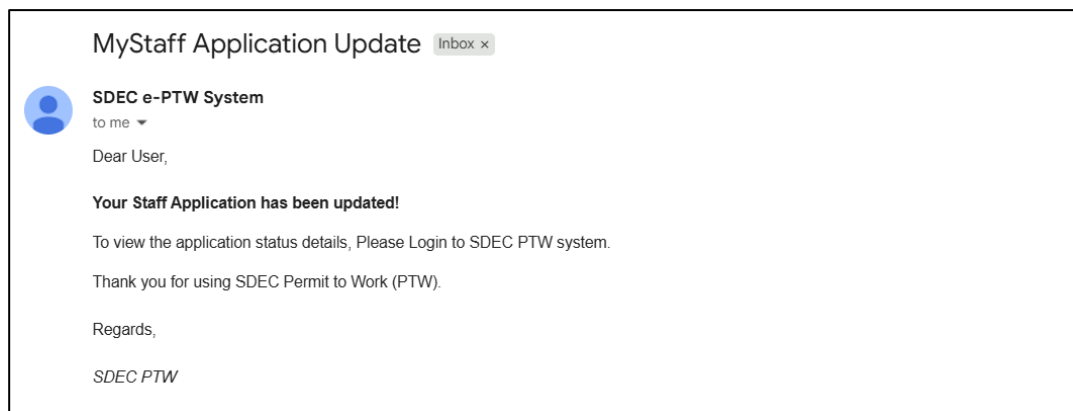


Figure 4.40 staff application update email notification

4.3 Chapter 4 summary

This chapter explains how the Permit to Work (PTW) system was developed and implemented. It covers the tools and technologies used to build the system and introduces the main modules and features. The system includes several modules for different types of users, such as admin, safety officers, site owners, project owners and public users like contractors. Important features include user login, apply permit, approve or reject permit, manage sites, view and add staff, and generate reports. Each module is designed with specific roles in mind so that users only see and use functions that match their responsibility. This chapter shows how the system was built step by step using the right tools and how each feature helps users complete their tasks effectively.

Chapter 5: Testing

This chapter presents the testing phase of the Permit to Work (PTW) system, which aims to ensure the reliability, functionality, and performance of the system before deployment. Testing is a crucial stage in system development, as it helps to identify and rectify any defects or inconsistencies within the system's components. The main objective of this phase is to verify that the system meets the specified requirements and performs as intended under various conditions.

This chapter outlines the testing strategies applied to the PTW system, including the test environment, test cases, results, and analysis. Testing activities are carried out based on the modules developed, and any issues found during the process are documented and addressed.

5.1 Functional Testing

Functional testing was selected as the main method to test each feature of the PTW system based on the system's functional requirements. This type of testing is important to ensure that all modules and functions work as intended, such as form submissions, login processes, validation checks, and data handling. In this project, functional testing is chosen because it allows user and developer to verify whether the core functionalities of the system meet the specifications outlined during the planning phase. By performing this testing, we were able to detect bugs, logic errors or missing features as this is ensuring the system is stable and reliable.

5.1.1 Unit Testing

This section describes the individual testing performed on each module of the PTW system to ensure that specific functions work as intended. Unit testing was carried out during the development phase to detect and fix bugs early. Each function, such as login, permit application, and staff approval, was tested in isolation using valid and invalid inputs to verify expected outcomes. This helped improve the system's reliability before moving on to integration and user testing.

5.1.1.1 System Test Case

The following section presents the detailed system test cases designed and executed to verify the core functionalities of the Permit to Work (PTW) system. Each test case outlines the specific scenario being tested, the steps taken during testing, the input data used, and the expected versus actual outcomes. These test cases cover all modules of the system, including login and registration, permit application, approval workflows, dashboard views, report generation, and staff application processes. The goal of this testing is to ensure that every module behaves as intended under both normal and invalid conditions, thereby confirming the overall reliability, accuracy, and completeness of the system prior to deployment.

5. Login and Registration Module

Table 5.1 Test case for register and login module

Module Name: Login and registration							
Test Case Description: User able to login and register							
Testing Objective: To verify dashboard displays key statistics correctly based on user role							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC001	Login	1. Navigate to login page	Valid email and password	Redirect to home page	Redirect to home page	Pass	
TC002		2. Enter email and password 3. Click login button 4. Observe system response	Invalid email or password	“Login failed. Invalid email or password” message displayed	“Login failed. Invalid email or password” message displayed	Pass	
TC003	Registration (For Public user only)	1. Click register button in login page	Valid data (with correct ema	‘account created successfully’ message displayed	‘account created successfully’ message displayed	Pass	

TC004		<ol style="list-style-type: none"> 2. Fill in all account credentials. 3. Click button 'create account' 4. Observe system response 	Invalid data password not match	'Password not match' message displayed	'Password not match' message displayed	Pass	
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b. Homepage and Dashboard view

Table 5.2 Test case for homepage and dashboard view

Module Name: Homepage and dashboard view							
Test Case Description: User able to view statistics and homepage							
Testing Objective: To verify dashboard displays key statistics correctly based on user role							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC005	View dashboard as Admin	1. Navigate to the module	Login as Admin	Show total permits, staff, and visual stats	Stats shown correctly	Pass	

TC006	View dashboard as Safety Officer	2. Enter input data 3. Submit form 4. Observe system response	Login as Safety Officer	Show filtered stats for safety permits	Filtered stats shown	Pass	
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c. New Permit application

Table 5.3 Test case for new permit application

Module Name: New Permit							
Test Case Description: User can create and apply new permit in the system							
Testing Objective: To verify that users can apply for permits correctly and system processes application.							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC007	Add new permit	1. Click ‘create new application’ side tab	Valid permit start and end date	‘Application submitted successfully’ pop out message displayed	‘Application submitted successfully’ pop out message displayed	Pass	
TC008		2. Fill in all required form 3. Submit form 4. Observe system response	Invalid start date and end date	Error messages displayed and unable to proceed to next page	Error messages displayed and unable to proceed to next page	Pass	

d. Permit application approval

Table 5.4 Test case for permit application approval

Module Name: Permit application approval							
Test Case Description: User should able to make approval for submitted permit.							
Testing Objective: To verify that authorized users can approve, reject, or return permits.							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC009	Approve valid permit	1. Navigate to the permit approval	Click approve with valid data	Status updated to approved	Status approved	Pass	
TC010	Reject permit with comment	modules 2. Enter input data 3. Submit form/action 4. Observe system response	Reject and enter feedback	Status updated to rejected	Rejected with comment	Pass	

e. MyStaff Application Approval

Table 5.5 Test case for MyStaff application

Module Name: MyStaff Application Approval							
Test Case Description: Safety Officer can make decision or approval on staff application							
Testing Objective: To verify that safety officer can review and process staff applications.							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC011	Approve staff application	1. Navigate to the module 2. Enter input	Review documents and approve	Status updated to approved	Approved	Pass	
TC012	Reject Staff application	data 3. Submit form/action 4. Observe system response	Reject without feedback	Validation for required comment	Error shown	Pass	
TC013			Reject with Feedback		Successfully submitted shown	Pass	

f. Report Generation

Table 5.6 Test case for report generation

Module Name: Report generation							
Test Case Description: User can generate PTW report and download a copy of report							
Testing Objective: To verify system generates report based on filter and allows download.							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC014	Filter report by year	1. Click 'Reports' tab	Select year and status	Report generated and displayed	Report shown	Pass	
TC015	Download report	2. Enter the filter data 3. Click documents download button 4. Observe system response	Click download as CSV	File downloaded	CSV downloaded	Pass	

g. MyStaff Application

Table 5.7 Test case for MyStaff Application

Module Name: MyStaff application							
Test Case Description: User can add, upload MyStaff application in the system							
Testing Objective: To verify users can add new MyStaff Application.							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC016	Add new staff	1. Navigate to the module	Valid staff info and docs	Staff added to list	Staff listed	Pass	
TC017	Invalid staff data	2. Enter input data 3. Submit form/action 4. Observe system response	Missing required certs	Validation message	Error shown	Pass	

h. Site Management

Table 5.8 Test case for Site Management

Module Name: Site Management							
Test Case Description: Admins can add, delete and update sites details in the system.							
Testing Objective: To ensure admin can manage sites details in the system.							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC0018	Add new site	1. Navigate to the module	Valid site details	Site added to system	Site listed	Pass	
TC0020	Edit existing site	2. Enter input data 3. Submit	Modify site location	Site updated	Updated successfully	Pass	
TC0021	Delete site	form/action 4. Observe system response	Click delete on site	Site removed	Site deleted	Pass	

i. View Permit Details

Table 5.9 test case for view permit details

Module Name: View Permit Details							
Test Case Description: User can review feedback and permit details.							
Testing Objective: To ensure the user can view feedback and progress of the applied permit.							
Test Case ID	Test Scenario	Test Steps	Test Data	Expected Result	Actual Result	Status	Severity Failure
TC023	Open submitted permit	1. Navigate to the module 2. Enter input data	Click on permit title	All permit data shown	Details displayed	Pass	
TC024	Check permit feedback	3. Submit form/action 4. Observe system response	Permit rejected with comment	Feedback visible	Comment shown	Pass	

5.1.2 User Acceptance Testing (UAT)

The purpose of User Acceptance Testing (UAT) is to make sure that the system works as expected from the user's point of view before the system goes live. UAT is important because it helps confirm that the system meets the actual needs and expectation of the users.

For this project, UAT was conducted with selected staff from Sarawak Digital Economy Corporation (SDEC), involving different user roles such as System admin, SDEC staff, Approver, and Safety Officer. Each user tested the system features that were relevant to their role, such as submitting and approving permits, adding staff, viewing reports, and uploading documents.

All participants were given test cases to follow, and their feedback was collected to identify any bugs or usability issues. Most of the users were satisfied with the system's functions and found it easy to use. Minor suggestions were noted and have been improved in the final version of the system.

The full UAT sheet showing the test cases and responses can be found in Appendix B. Additionally, a signed UAT confirmation form from one of the system owners is included in Appendix C to show approval of the system after testing.

5.2 Non-Functional Testing

Non-functional testing was carried out to assess aspects like usability, performance, and security. The focus was on ensuring the PTW system is safe, secure, user-friendly, and suitable for real-world deployment.

5.2.1 Usability Testing

Usability testing involved real users, including admins, safety officers, and staff, who provided feedback based on ease of navigation, clarity of instructions, and visual structure. Responses confirmed that navigation and the interface are intuitive. Users found real-time feedback and error messages helpful, and overall, permit tracking and form submission were seamless and efficient.

5.2.2 Security Testing

Since the PTW system handles sensitive and safety related data, security was a major concern. The system includes various security implementations such as authentication mechanisms where only registered users can access their assigned modules. Role-based access control restricts each user type (Admin, Safety Officer, Staff) to specific functionalities. Input validation is implemented to prevent SQL injection and ensure required fields are properly filled. Secure session handling is achieved using session tokens to prevent session hijacking. Uploaded files are limited to certain types (for example PDF) with size restrictions and sanitization checks to avoid malicious content. Passwords are hashed using secure algorithms before being stored in the database. These security measures were tested through code inspection and simulated attacks, such as invalid login attempts and SQL like entries, and the system responded appropriately in all scenarios.

Additionally, the system implements session checking to ensure that users do not have multiple active sessions simultaneously, which helps prevent unauthorized session reuse or hijacking. If a session is detected to be active elsewhere, the system will automatically log out the previous session to maintain secure access control. Furthermore, the system hides real path URLs by using formatted routes defined in the backend code, preventing users from guessing or accessing unauthorized paths. This

routing mechanism enhances security by conceal the actual file structure and reducing the risk of URL based attacks.

5.3 Testing Result Analysis

5.3.1 User Acceptance Testing Result Analysis

Appendix C shown User Acceptance Testing (UAT) was conducted to validate that the e-Permit to Work (PTW) system functions. There were eight users participated in the testing, each representing a different role within the system admin, Safety Officer, Project Owner, Site Owner, and General Users. Figure 5.1 shows role distribution of the system tester. These participants were assigned tasks such as applying for a permit, reviewing applications, approving or rejecting permits, review staff application and managing site management.

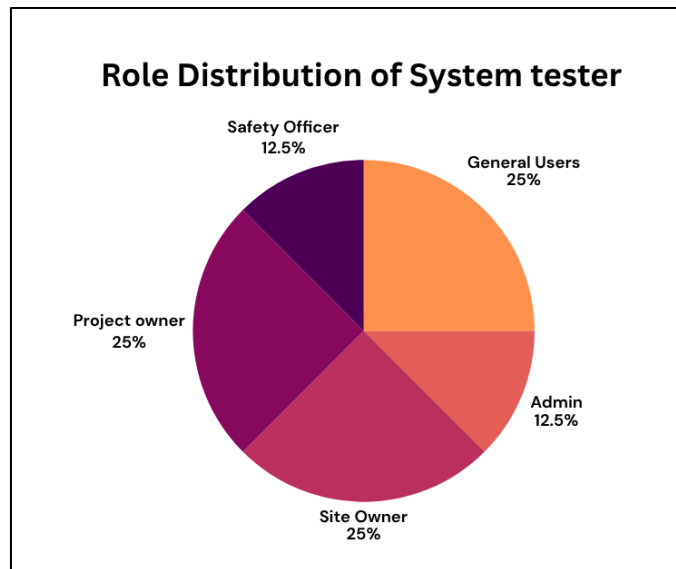


Figure 5.1 Graph of tester role distribution

The results from UAT demonstrated that the system is functioning correctly and aligns with user expectations. Most participants were able to complete their assigned tasks without encountering system errors. Figure 5.2 summarises the outcome of UAT conducted. 72 test cases executed by 8 system tester were successfully passed with 0% severe failures and minor issues were mostly

related to form validations and user interfaces. They found the interface is user friendly and the key features such as real time permit tracking, application validation, and approval workflows helped reduce confusion and improved overall efficiency of PTW process. Some minor feedback regarding user notifications and dashboard layout was gathered for future improvements. Overall, the UAT demonstrates that the system is well received and ready for deployment.

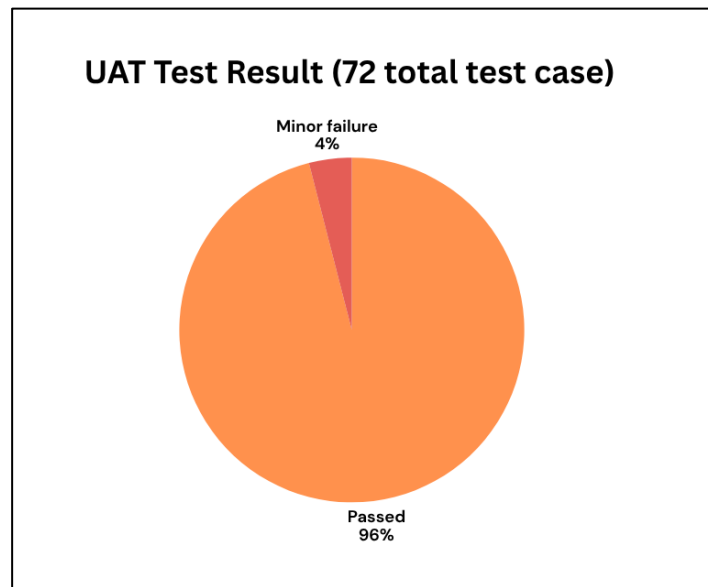


Figure 5.2 UAT Test result graph

5.3.2 Usability testing analysis

5.3.2.1 Demographic Information

Usability testing was performed to assess how easy and efficient it is for users to interact with the PTW system. A total of eight participants, comprising different user roles, were observed while using the system. They were asked to perform tasks relevant to their roles, such as submitting permits, reviewing applications, generating reports, and viewing PTW statistics. The demographic breakdown of the testers IT experience level is as follows 25% were beginner level, 50% were intermediate level and 25% were in advanced level. In terms of roles, the participants included 1 Admin, 1 Safety Officer, 2 Project Owners, 2 Site Owners, and 2 General Users. This variety ensured that feedback captured both technology expert and less experienced perspectives. Feedback from testers indicated a high level of satisfaction with the system's layout and ease of use. Most users agreed that the system flow was easy to learn and required little to no formal training. The majority found the navigation clear, the forms responsive, and the system suitable to their daily work needs. Figure 5.3 shows the statistic data of tester IT experience level.

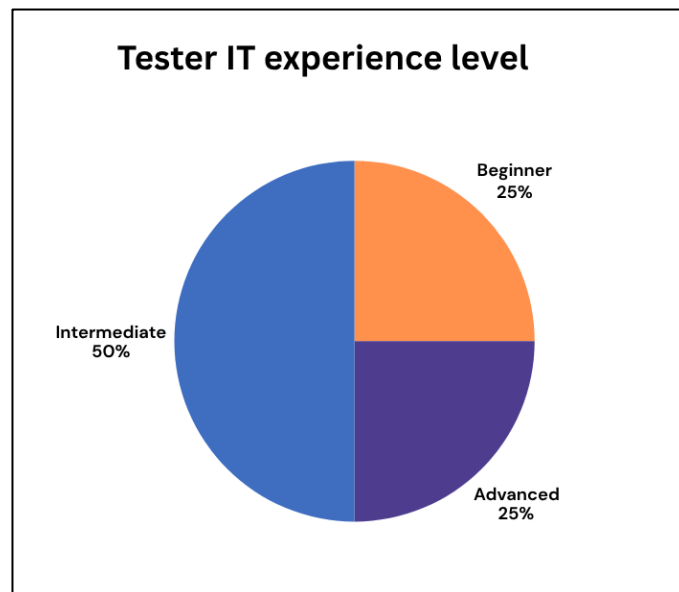


Figure 5.3 Chart of tester IT experience level

The majority of testers are within the 25-34 age group, representing the highest user as shown in figure 5.4. This group is typically active in operational and supervisor roles making them ideal evaluators for the PTW system. A smaller portion of participants were aged 18-24, usually consisting of junior staffs. No testers were above the age of 44. This age distribution ensured that the system was tested by users who are both responsible for safety compliance and familiar with digital tools.

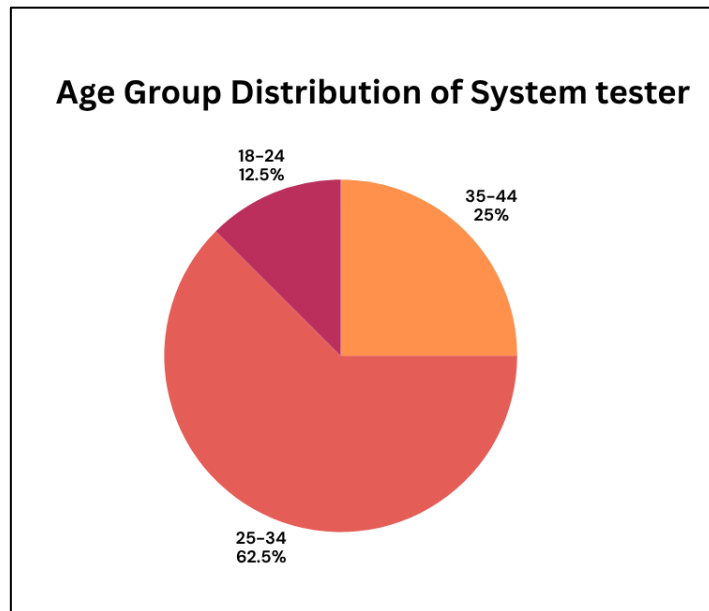


Figure 5.4 Age Group Distribution of Testers

5.3.2.2 Usability testing result

Figure 5.5 presents the feedback collected from users regarding the usefulness of the PTW system. The data was gathered through a usability testing survey consisting of four key statements related to how the system supports the work process. The respondents were asked to rate each statement using a scale disagree, and agree. Overall, the feedback demonstrates that users view the system as a highly useful tool that simplifies the permit process but also improves efficiency of task management. There were minimal of negative responses collected has reflects the strong user confidence in the system's usefulness.

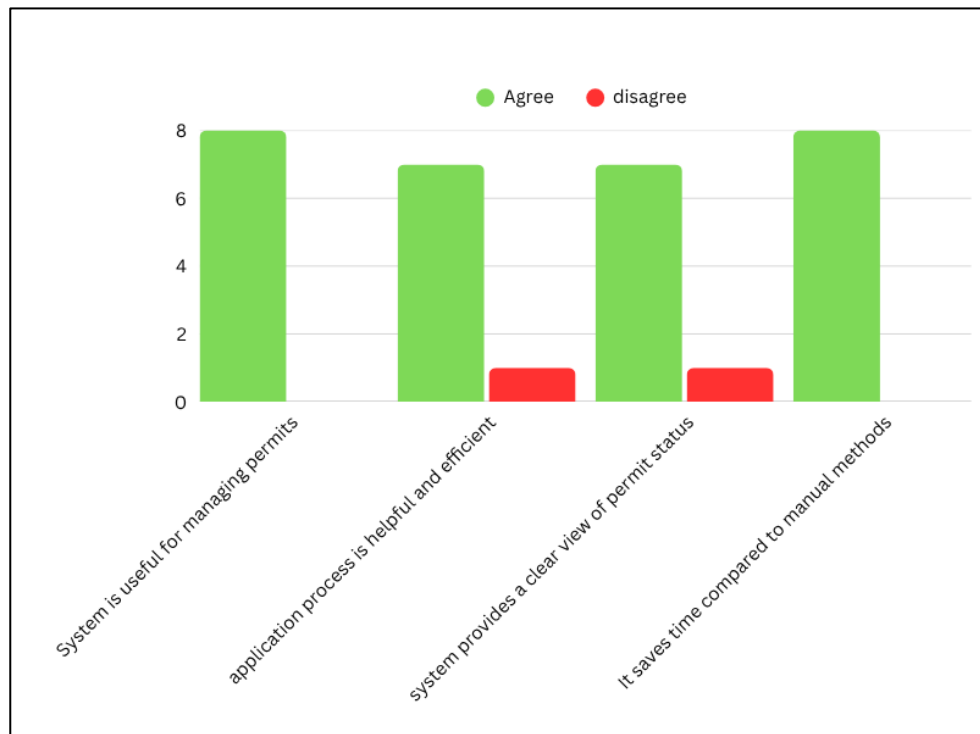


Figure 5.5 Usability testing result

5.4 Chapter 5 summary

In this chapter, I tested the Permit to Work (PTW) system to make sure it works well and meets the needs of users. The testing started with functional testing by checking each feature such as login, permit application, approvals, and report generation. All the test cases passed and the system worked as expected. Next, User Acceptance Testing (UAT) conducted with real users including admin, safety officer, project owner, site owner, and general users. The feedback showed that users were able to complete their tasks easily and found the system useful and efficient. In addition, usability testing was conducted to see how easy the system is to use. Most users stated that the system was simple to navigate, even without training. This chapter has shown the demographic data like age, role, and IT experience level to understand how different users experienced the system. Charts were added to show this information clearly. Overall, the PTW system was well received, and the testing helped confirm that the system is ready for real use, though there are some features that can be improved in the future.

Chapter 6: Conclusion and Future work

6.1 Introduction

This chapter concludes the development and implementation of the Permit to Work (PTW) system. It summarises the key outcomes achieved throughout the project and reflects on how the system addresses the initial objectives, particularly in improving safety, efficiency, and reliability in permit management. The chapter also outlines the significance of the system to the organization and its potential impact on daily operations. In addition, this chapter highlights possible future enhancements that can be considered to further improve the system's functionality, security, and user experience. These recommendations aim to ensure the system remains adaptable and scalable in response to evolving organizational needs and technological advancements.

6.2 Objective Achievement

The PTW system successfully meets its main objective to digitalize and streamline the permit application and approval process at Sarawak Digital Economy Corporation (SDEC). The system provides a user-friendly interface for contractors and safety officers, real time permit tracking, and a centralised, secure database for documentation and reporting. It also introduces automation in validation and approval flows, improving accuracy and reducing the risk of human error. By transitioning from a paper-based to a digital system, SDEC can expect enhanced operational efficiency, improved safety compliance, and better data integrity. Table 6.1 shows the summary of project objectives and achievements.

Table 6.1 Project objectives and achievements

Objectives	Project achievements
To analyse and design an e-Permit to Work (PTW) system that provides safety monitoring on sites	The e-Permit to work has been successfully developed and provide platform for SDEC to conduct site safety monitoring. Admin: <ul style="list-style-type: none">• Site management• View Statistic dashboard

	<p>Safety Officer:</p> <ul style="list-style-type: none"> • View statistic report • View list of MyStaff Application • MyStaff application Approval <p>Site Owners, Project Owner:</p> <ul style="list-style-type: none"> • View statistic dashboard • View list of submitted permit • Permit approval • Generate report <p>User:</p> <ul style="list-style-type: none"> • Apply new permit • View list permit • Create new MyStaff application • View list of staff • View list of sites <p>These features work together to create a seamless workflow, allowing all parties involved to interact with the system according to their role, which promotes accountability, reduces paperwork, and improves real-time monitoring. Overall, the e-Permit to Work system contributes to a safer work environment while enhancing operational transparency and efficiency across all levels.</p>
<p>To create efficient Permit Application Process and approval</p>	<p>This project successfully made the permit application and approval process much easier and faster. Instead of using paper forms, permit can be apply through the system,</p>

	<p>which saves time and reduces mistakes. Users can quickly submit their permits, and approvers can review and respond more efficiently. The system also helps approvers to keep track of permit request in real time, making the whole process smoother and safer.</p>
<p>To develop PTW system with Accurate and Secure Permit Record-Keeping</p>	<p>The system was successfully developed to keep permit records accurate and secure. All data is stored in a centralized database, which makes it easy to access and manage. Records are protected with user access control and validation features to prevent errors or unauthorized changes. This ensures that every permit submitted, approved, or rejected is safely recorded and can be easily reviewed when needed for audits, reporting, or safety checks.</p>

6.3 Project Limitation and constraints

While the e-Permit to Work (PTW) system has achieved its main objectives, there are several limitations and constraints faced during its development and implementation:

1. No Mobile Application

The current version of the system is web-based and not optimized for mobile use. Contractors or staff working on-site may face difficulties accessing the system without a responsive or dedicated mobile version.
2. Internet Dependency

As the system operates fully online, users need a stable internet connection to submit or review permit applications. This could be a challenge in remote areas with poor connectivity.
3. Basic Notification System

The system currently lacks advanced notification features such as push notifications, which could enhance user responsiveness. The system only provide email reminders only when there is pending approvals or expiring permits to user and approval.

4. Limited Document Format Support

Only specific file types (for example, PDF) are accepted during uploads, which may limit flexibility for users submitting supporting documents in other formats.

These limitations highlight areas for improvement in future versions to make the system more robust, accessible, and user friendly in a wider range of working environments.

6.4 Future Work

Although the system achieves its current objectives, several improvements could further enhance its functionality. Developing a mobile version would allow contractors to submit permits and updates onsite. Offline system could be introduced to enable limited permit drafting without an active internet connection, with syncing capabilities once reconnected. Implementing a detailed audit trail would allow tracking of user actions for compliance audits. Future work could also explore more use of AI-based tools for digital watermark for each confidential documents uploaded to the system. Additionally, adding SMS notifications would help inform users about approval updates, deadlines, and safety notices in real-time. These enhancements can make Permit to work system more user friendly and can ease the user experience.

6.5 Chapter 6 summary

In conclusion, this project has helped me understand how to develop a Permit to Work (PTW) system that can be used to manage work permit applications more efficiently. Throughout the development process, I learned how to build a web-based system using CodeIgniter 4 and apply real world features such as user roles, document uploads, and integration with Azure AI to extract information from uploaded ID documents. This not only made the process faster but also reduced human error. Overall, the system is able to simplify the permit application flow by allowing users to submit forms online, and for admins or approvers to review and approve them. I also managed to implement login redirection based on user roles, and provide a clear interface for each type of

user. This project really helped me apply what I have learned in class to a real application and I believe with more time and feedback, the system can be improved further for actual use in organizations.

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Appendices

Appendix A:

List of questions asked during the requirement gathering meetings for the PTW system

No	Questions
1	Can you explain the current Permit to Work (PTW) process from start to finish?
2	How long does it typically take to approve a PTW request?
3	Who are the main user involved in the permit approval process, and what are their roles?
4	Are there any specific approval hierarchies that must be followed?
5	How are urgent PTW applications currently handled?
6	What types of permits are issued, and do they have different approval requirements?
7	What functionalities should the digital PTW system include to improve efficiency?
8	What fields and data must be captured in a PTW request form?
9	How should notifications be sent when a permit is approved, rejected, or requires revisions (email, dashboard alerts)?
10	Should the system generate reports on PTW applications, approvals, and rejections?
11	How long should PTW records be stored in the system?
12	Should there be an audit trail feature to track changes and approvals?
13	What are the expected traffic and user load for the system?
14	How should user training and onboarding be conducted for the new system?

Appendix B: User Acceptance testing sheet



PERMIT TO WORK (ADMIN/STAFF) : USER ACCEPTANCE TEST

No	Module/Testing Criteria	Action By	Result (✓, If successful)	Remarks
1	Account			
	Login using VMS account password and email	SDEC Staff		
	Forgot Password			
2	Dashboard			
	View Statistics	SDEC Staff		
3	My Staff			
4.1	Add New Staff			
	4.1.1 Upload Documents	SDEC Staff		
	4.1.2 Insert 'Other' Designation (Type in text functionality)			
	4.1.3 View Staff Application Details			
<p>Notes: Please Add at least 4 Staffs <i>(Scenario 1:</i> Staff that have WAH documents) <i>(Scenario 2:</i> Staff that have SESP/CAC documents) <i>(Scenario 3:</i> Staff that have CIDB documents) <i>(Scenario 4:</i> Staff that have ALL documents) (OPTIONAL: Scenario 5: Staff that does not contain any document (except passport/IC copy))</p> <p>**Please ensure that all documents expiry date is more than 3 Months.</p> <p>Before apply for new permit, you are required to Login to PTW(STAFF) at https://ttptw.sdec.com.my/admin/login to approve staff under your account. Use account with role "Safety" (Refer Account sheet for account credentials).</p>				

5	Permit to Work Application			
5.1	Apply New Permit			
	5.1.1 Select Region and Working Conditions			
	5.1.2 Add Application Details (Start & end date, Activity category, Scope of work)	SDEC Staff		
	5.1.3 Select Sites			
	Search sites	SDEC Staff		
	Add Sites to permit			
	Remove Sites from permit			
	5.1.4 Select Staff			
	Add Staff	SDEC Staff		
	Remove Staff			
	5.1.5 Upload Permit Attachments			
	Add Compulsory Documents	SDEC Staff		
	Delete Uploaded Documents			
	Preview Uploaded Documents			
	5.1.6 Declaration and Submit			
	Submit Application	SDEC Staff		
	5.1.7 Update Work Status/Close Permit			
	Updating Work Status	SDEC Staff		
6	My Permit List			
	6.1.1 View PTW List	SDEC Staff		
	Preview PTW PDF			

	Print/Save as PTW pdf Copy	SDEC Staff		
	Preview PTW Attachments			
7	Staff Approval			
	7.1 View Staff Application	Safety Officer		
	7.2 Download Staff Attachments			
	7.3 Approving Staff Application (Reject and Approve)			
8	Permit Approval			
	8.1 Permit Details			
	8.1.1 Preview permit PDF & Print Permit copy	Safety Officer, Project Owner, Site Owner, HOD		
	8.1.2 View and Download PTW attachments			
	8.1.3 View List of Staff and documents			
	8.2 Approving PTW			
	8.2.1 Approve/Reject a Permit	Project Owner and Site Owner, HOD		
	8.2.2 Returned a Permit			
	*Once returned the permit, Please login to guest page again at https://tptw/public/loginp and Resubmit the "returned" permit.			
9	Reports			
	9.1 Generate Excel Report	Project Owner and Site Owner, HOD, Safety		
	9.2 Generate CSV Report			

Verified and tested by,

Full Name: Department:

Designation: Test Date:

Appendix C : Signed User Acceptance testing



PERMIT TO WORK (ADMIN/STAFF) : USER ACCEPTANCE TEST

No	Module/Testing Criteria	Action By	Result (✓, If successful)	Remarks
1	Account			
	Login using VMS account password and email	SDEC Staff	✓	
	Forgot Password		✓	
2	Dashboard			
	View Statistics	SDEC Staff	✓	
3	My Staff			
	4.1 Add New Staff			
	4.1.1 Upload Documents	SDEC Staff	✓	
	4.1.2 Insert 'Other' Designation (Type in text functionality)		✓	
	4.1.3 View Staff Application Details		✓	
<p>Notes: Please Add at least 4 Staffs <i>(Scenario 1:</i> Staff that have WAH documents) <i>(Scenario 2:</i> Staff that have SESP/CAC documents) <i>(Scenario 3:</i> Staff that have CIDB documents) <i>(Scenario 4:</i> Staff that have ALL documents) (OPTIONAL: Scenario 5: Staff that does not contain any document (except passport/IC copy))</p> <p>**Please ensure that all documents expiry date is more than 3 Months.</p> <p>Before apply for new permit, you are required to Login to PTW(STAFF) at https://tptw.sdec.com.my/admin/login to approve staff under your account. Use account with role "Safety" (Refer Account sheet for account credentials).</p>				
5	Permit to Work Application			
	5.1 Apply New Permit			
	5.1.1 Select Region and Working Conditions			
	5.1.2 Add Application Details (Start & end date, Activity category, Scope of work)	SDEC Staff	✓	
	5.1.3 Select Sites			
	Search sites	SDEC Staff	✓	
	Add Sites to permit		✓	
	Remove Sites from permit		✓	
	5.1.4 Select Staff			
	Add Staff	SDEC Staff	✓	
	Remove Staff		✓	
	5.1.5 Upload Permit Attachments			
	Add Compulsory Documents	SDEC Staff	✓	
	Delete Uploaded Documents		✓	
	Preview Uploaded Documents		✓	
	5.1.6 Declaration and Submit			
	Submit Application	SDEC Staff	✓	
	5.1.7 Update Work Status/Close Permit			
	Updating Work Status	SDEC Staff	✓	
6	My Permit List			
	6.1.1 View PTW List	SDEC Staff	✓	
	Preview PTW PDF		✓	

	Print/Save as PTW pdf Copy	SDEC Staff	✓	
	Preview PTW Attachments		✓	
7	Staff Approval			
	7.1 View Staff Application	Safety Officer	✓	
	7.2 Download Staff Attachments		✓	
	7.3 Approving Staff Application (Reject and Approve)		✓	
8	Permit Approval			
	8.1 Permit Details			
	8.1.1 Preview permit PDF & Print Permit copy	Safety Officer, Project Owner, Site Owner, HOD	✓	
	8.1.2 View and Download PTW attachments		✓	
	8.1.3 View List of Staff and documents		✓	
	8.2 Approving PTW			
	8.2.1 Approve/Reject a Permit	Project Owner and Site Owner, HOD	✓	
	8.2.2 Returned a Permit		✓	
	*Once returned the permit, Please login to guest page again at https://tptw/public/loginp and Resubmit the "returned" permit.			
9	Reports			
	9.1 Generate Excel Report	Project Owner and Site Owner, HOD, Safety	✓	
	9.2 Generate CSV Report		✓	

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