

# A Web-Based Application for Managing Contractor Work Permits in Compliance with ISO 45001:2018

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## Abstract

Adding occupational health and safety practices into software development is becoming more important, especially in places where digital systems are used to manage daily work and safety rules. This research shows how a web-based application was designed and developed to help organizations follow the ISO 45001:2018 standard. The system includes features to help prevent accidents by identifying possible hazards and enforcing assessment controls before work begins. It also uses a proper approval process to make sure only the right people can do the work under safe conditions. The system was built using the Agile method, with PHP as the programming language and HeidiSQL as the database, which helps make the system flexible and keeps data safe. Overall, the system follows many important parts of the ISO 45001:2018 standard, helping to improve health and safety management at PSMZA.

**Key Words:** *Permit to Work, ISO 45001:2018, Permits, Mapping*

## 1. Introduction

Online management systems are very important nowadays in all sectors including industry sectors, recently many systems have been designed in this field to help the users to communicate online. The web-based application known as Permit To Work (PTW) System is developed to help Politeknik Sultan Mizan Zainal Abidin (PSMZA) for managing contractor work permits in the institution. In this study, the implementation of the system would compliance with Malaysian Standard ISO 45001:2018.

### 1.1 Permit to Work (PTW)

The PTW system was created to make work processes safer and more efficient by handling work permits online. With this system, contractors can request permits, check the status of ongoing work, and get approval or rejection updates through the online platform. The system uses a secure login, so only authorized contractors can register and send permit requests. These requests will then be checked and approved by the admin. There is also a map in the system that shows where the work is going. Overall, this system helps reduce the risks and delays that come with the old manual method.

### 1.2 MS ISO 45001:2018

MS ISO 45001:2018 is an international standard that helps organizations manage health and safety at the workplace. It gives a clear guide on how to set up, run, and improve a safety management system. This standard has replaced the older OHSAS 18001. Any organization can use this standard, no matter how big or small it is, or what kind of work they do. The main goal is to prevent workplace accidents and health problems, and to make the working environment safer and healthier (Department of Standards Malaysia, 2018).

## 2. Importance of The System

The PTW system is critical components for risk and safety management. The main purpose of this system is to prevent accidents by identifying possible hazards and enforcing assessment controls before work begins. This system also has a systematic approval process, to ensure that only authorized people perform the work in a safe condition. It will encourage compliance with

the organization's internal procedure and regulatory requirements. The function of the interactive map and dashboards in this system is to display which areas have work permits and are currently in operation to help avoid overlapping work and to make it easier for PSMZA security to easily identify active areas. Besides that, the system also will help organization meet requirements from MS ISO 45001:2018.

**Table 1: Benefit of PTW System**

| <b>Benefit</b> | <b>How PTW System Helps</b>                |
|----------------|--------------------------------------------|
| Control        | Standardizations work authorization        |
| Accountability | Tracks who, what, when, and where          |
| Visibility     | Real-time view of ongoing operations       |
| Communication  | Streamlines contractor-staff collaboration |
| Compliance     | Supports ISO 45001 and legal obligations   |
| Efficiency     | Speeds up planning and coordination        |

### 3. Literature Review

Before this, several existing systems were developed and met the functionality as same as PTW web based. This chapter would compare the new system to know what they lack in their current business management and try to find ways to improve their management system for better performance.

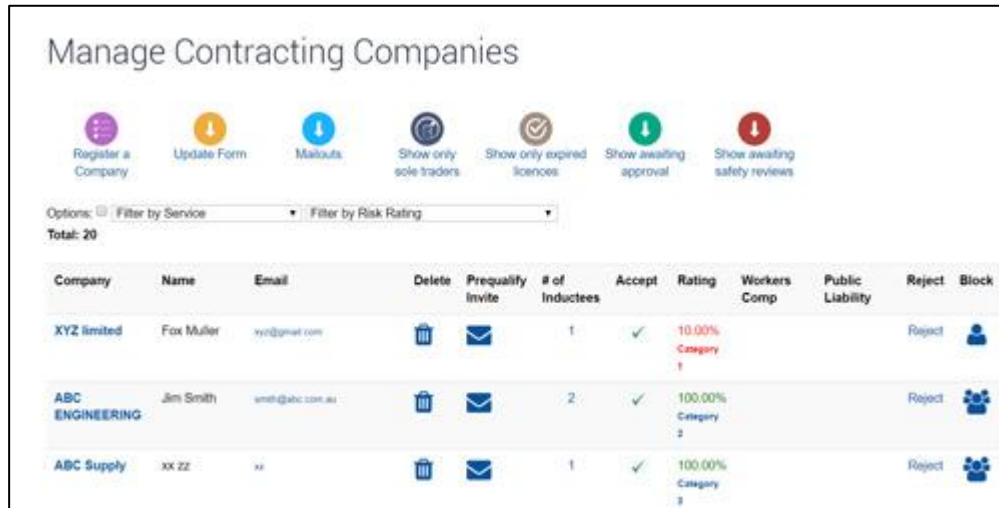
#### 3.1 Standard PSMZA Form

The Standard PSMZA form is a traditional paper-based system used at PSMZA to manage work permits and control access to certain areas. This form is filled out by hand and processed manually, which makes it more suitable for small-scale or non-urgent permit requests. The form is simple and easy to understand, so users and administrators can complete it without needing special training or computer skills. Since it does not require internet or digital devices, it can still be used in remote places or areas with limited technology. This simplicity is helpful for basic permit requests that do not need strict security or complicated processes. However, there are also some disadvantages. Because it is paper based, the form can be lost, damaged, or misplaced easily, which may affect the accuracy and safety of the records. It also takes more time to process, especially if the information needs to be shared between many departments. Without a digital system, it is hard to track active permits or get real-time updates, which can make it difficult for staff to manage urgent situations quickly.

#### 3.2 Contractor Management System

The Contractor Management System is divided into several parts to make sure that contractors and their workers are prepared to work in a safe environment. This system includes useful functions such as automatically managing the contractor's schedule, checking the progress of their work, collecting important documents, monitoring live activities, and generating reports.

However, the system also has some disadvantages. For example, it may experience performance issues, especially when many users are using it at the same time, which can cause the system to lag. In addition, some contractors or staff may find it difficult to switch from a manual system to a digital one, as it may take time to learn and get used to the new system.

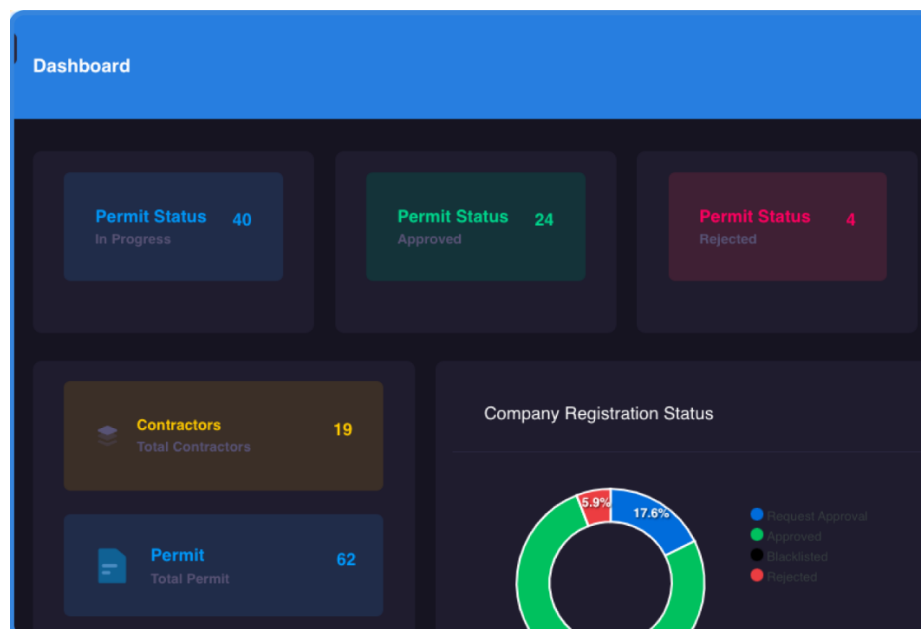


**Figure 1: List of Status Application in Contractor Management System**

### 3.3 ePermit System

The ePermit System was developed especially for educational institutions to help manage contractor involvement, employee permits, and approval processes. The main functions of this system include creating contractor accounts, handling multiple levels of permit approval, generating permits in PDF format, and sending email notifications to update users on their application status. It offers a complete solution for managing permits and contractor workflows.

However, the system also has some weaknesses. One of the main issues is its limited flexibility. Some users have reported that it is difficult to adjust the system to match specific needs of their organization.



**Figure 2: List of Permit Status in ePermit System**

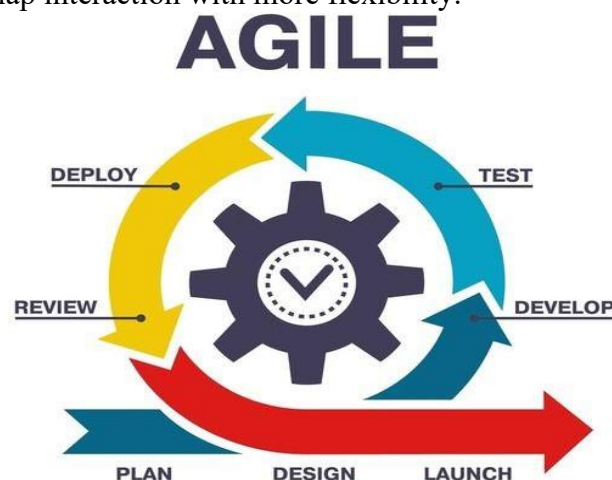
**Table 2** below is a comparison table that outlines the key functions of the Standard PSMZA Form, Contractor Management System, ePermit System and PTW System. The table is organized based on their relevant functions, such as user authentication, OTP validation, permit management, notifications and interactive mapping/ visualization.

**Table 2:** Comparison of the system

| Function                          | Standard PSMZA Form      | Contractor Management System | ePermit System                                        | PTW System                                                             |
|-----------------------------------|--------------------------|------------------------------|-------------------------------------------------------|------------------------------------------------------------------------|
| User Authentication               | Manual signature         | Login system                 | Login and email-based notification                    | Login and email-based notification                                     |
| OTP Validation                    | Not applicable           | Not implemented              | Not implemented                                       | Auto email alerts                                                      |
| Permit Management                 | Manual paper-based forms | Contractor and job request   | Online submission, approval and PDF permit generation | Online submission, systematic approval process                         |
| Notifications                     | Manual                   | In-app notifications         | Email notification                                    | Email notification                                                     |
| Interactive Mapping/Visualization | None                     | None                         | None                                                  | Interactive map displaying contractor activities and operational zones |

#### 4. System Design

In this study, the developer uses Agile development and Scrum because they help teams work faster. These methods cut down on too much paperwork and high-level decision-making, so the work becomes simpler, more flexible, and focused on getting results (Andy et al., 2021; Hoy & Xu, 2023; Srisura et al., 2022). The Agile Scrum method helps break the PTW system into smaller parts, so we can build and test each function at the end of every stage. This method also makes it easier for us to handle complex features like secure contractor registration, permit requests, and real-time map interaction with more flexibility.



**Figure 3:** Agile Methodology Phases

In the planning phase, the team identifies the main goals and needs of the PTW system. Research is done to learn about the best ways to manage work permits so the system can be safe and efficient for use in PSMZA. After that, the team creates a project plan with clear steps and goals. This includes important features such as contractor registration, submitting permit requests, and setting up security measures.

During the development phase, the team builds the main parts of the PTW system. This includes creating user interfaces for submitting permits, setting up a database using HeidiSQL to store contractor and permit data, and adding login and registration functions with secure encryption. The system is developed step by step in sprints, making sure each part works well before moving to the next one. In this phase, the current system is also studied carefully.

Next, testing is done to make sure the PTW system works correctly, keeps data safe, and is easy for users to use. Security tests help protect user information, while usability tests check if the system is simple and efficient. There is also user acceptance testing, where feedback is collected to improve the system if needed.

After all testing is done, the PTW system is officially launched and made available for use in the organization. Contractors can now request permits online, and administrators can easily manage approvals and control access.

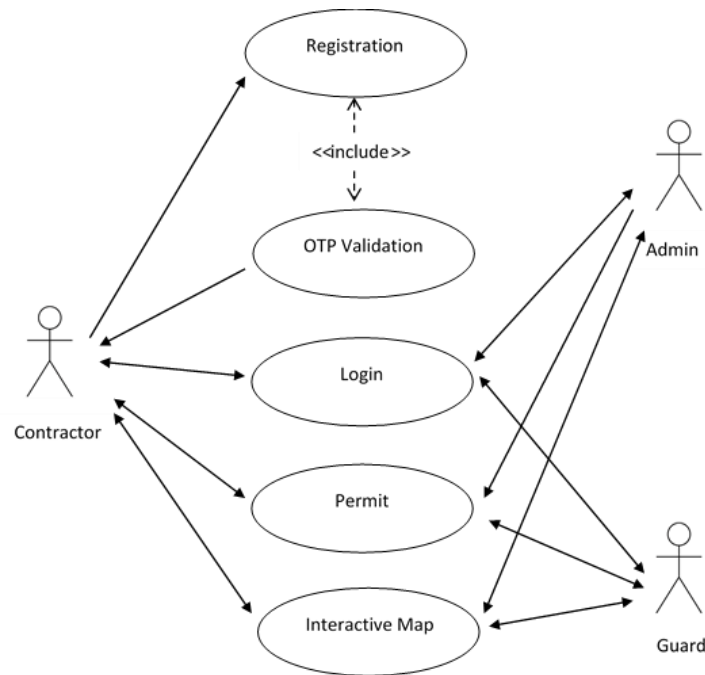
In the final review phase, feedback from users such as administrators and contractors is collected to understand how well the system works. This feedback is studied and used to make improvements in future updates, so the system becomes more reliable and effective over time.

**Table 3:** Use Case Description Table

| Use Case       | Description                                                                                                                                                                    | Pre-Condition                                                    | Post-Condition                                                                                                            | Actors                      |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Registration   | Contractor need to enter the valid credentials: company name and email address in order to get the OTP code.<br><br>Contractors enters OTP to complete registration.           | Registration page is accessible                                  | Contractor account is successfully created and redirected to the Login page.                                              | Contractor, System          |
| OTP Validation | Wait for the OTP to be sent.<br>Verify the OTP is sent successfully.                                                                                                           | Email server is configured, and Contractor enters a valid email. | OTP code is sent to the provided email.                                                                                   | Contractor, System          |
| Login          | Contractor, admin and guard log in with valid credentials.<br>System redirects to the <b>Home</b> page.                                                                        | Contractor, admin and guard account exists.                      | Contractor, admin and guard successfully login and directly to the <b>Home</b> page.                                      | Contractor, admin and guard |
| Permit         | Contractor navigates to the <b>Request Permit</b> page.<br><br>Adds/removes dynamic fields (for related fields such as worker involved).<br>Fills out the form and submits it. | Contractor is logged in.                                         | Dynamic fields are added/removed successfully, and the permit request is saved in the database with all relevant details. | Contractor                  |

|                                                           |                                                                                                                                                                          |                                                          |                                                                                                                             |                              |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Permit (Contractor Permit Request and Admin Notification) | Contractor submits a permit request.<br>Admin receives a notification email about the new request.                                                                       | Contractor submits a permit request successfully.        | Admin receives an email notification with details of the Contractor's permit request.                                       | Contractor and Admin         |
| Permit (Admin Approve Permit and Update Map Integration)  | Admin approves a permit request.<br>The area on the <b>Interactive Map</b> changes to red (indicating operation).                                                        | Permit request is submitted and pending approval.        | The approved permit updates the map area to red and marks the permit status as "accepted" in the database.                  | Admin                        |
| Permit (Admin Reject Permit and Email Notification)       | Admin rejects a permit request.<br>System displays a popup for the rejection reason.<br>Admin enters the reason.<br>Click reject button<br>Contractor receives an email. | Permit request is submitted and pending approval.        | Rejection reason is stored in the database, and the Contractor receives an email with the rejection status and reason.      | Admin                        |
| Permit (Guard Verifies Contractor Permit)                 | Guard verifies the contractor permit by check the permit number and status.                                                                                              | Contractor submits a permit request successfully.        | Contractor check-in and begins work                                                                                         | Contractor and guard         |
| Interactive Map with Request Permit                       | Contractor selects a work location from the <b>Interactive Map</b> dropdown in the <b>Request Permit</b> page.<br>Submits the request.                                   | Interactive Map is connected to the permit request page. | The selected work location is stored in the permit request, and the information is displayed correctly in the admin portal. | Contractor and admin         |
| Interactive Map Click and Zoom Integration                | Navigate to the <b>Interactive Map</b> page.<br>Click on an area.                                                                                                        | Area exists on the map.                                  | Map zooms in on the selected area, and its operation details are displayed.                                                 | Contractor, admin and guard. |

Table 3 shows the use case description table while Figure IV shows the use case diagram that shows the interaction between system and actors involved in this PTW System.



**Figure 4:** Use Case Diagram

## 5. Findings

The development of the web-based PTW System follows the important parts of the ISO 45001:2018 standard. This helps improve health and safety at the workplace, especially at PSMZA. Under Clause 6: Planning, the system supports 6.1.2 by allowing real-time tracking of contractor activities. This helps identify possible dangers early and supports proper risk assessments before a permit is given. For Clause 7: Support, the system follows 7.4 by improving communication between staff and contractors through automatic notifications. It also meets 7.5 by keeping safe and complete records of all permit actions, making it easy to trace back any activity. Under Clause 8: Operation, the system follows 8.1.1 by controlling contractor work and only allowing approved tasks to be done. It also supports 8.1.2 by using a live map to avoid overlapping jobs and dangerous work zones. Finally, in Clause 8.2, the system helps improve emergency response by giving a clear view of all active work happening on-site. Overall, the PTW system follows ISO 45001:2018 guidelines and helps make the workplace safer and more organized.

**Table 4:** Compliance with ISO 45001:2018

| ISO 45001 Clause | How PTW System Supports It                          |
|------------------|-----------------------------------------------------|
| 6.1.2            | Hazard identification                               |
| 7.4              | Real-time contractor-staff communication            |
| 7.5              | Documentation of work permits and activities        |
| 8.1.1, 8.1.2     | Operational control, hazard elimination             |
| 8.2              | Supports emergency response by locating contractors |
| 9.1.1, 9.2       | Enables monitoring, and performance tracking        |

## 6. Limitations of the System

Even though the web-based PTW system brings many benefits in terms of safety and following rules, there are still some problems to consider. If there is a technical issue or system maintenance, the system may stop working for a while. This can delay the permit process and affect the work schedule. During the setup stage, the system might need extra resources, such

as money, new hardware, and training for staff. Also, since the system depends on a good internet connection, it may be hard to use in places with weak or no internet, which can affect access and real-time updates. If there is no proper technical support, unexpected errors or system failures could happen. This can cause more delays and reduce users' trust in the system. This system still does not support all the parts of the ISO 45001:2018 standard. There are many features that need to be added to meet the full requirements. For example, Clause 9.1 needs functions like monitoring, auditing, and tracking performance.

## 7. Future Enhancements

To make sure the PTW system works well and meets the needs of all users, several suggestions should be considered. First, the current system features do not fully meet the ISO 45001 standard. So, the system should be improved to follow all the rules in the standard. Second, users such as contractors, admin staff, and security guards need proper training to understand how to use the system. This will help reduce problems when changing from a manual system to a digital one. Third, the system should be updated and checked regularly to fix technical issues, improve security, and follow new requirements. Next, adding data backup features is important to protect important information in case the system crashes or faces a cyberattack. This will help users keep working without losing access to the system. Also, giving users offline access can make the system more useful in places with weak internet connections. Lastly, regular reviews and collecting feedback from users can help find new ways to improve the system and make sure it stays easy to use and effective.

## 8. Conclusion

In conclusion, the PTW system is a big step forward in improving how PSMZA manages work permits. It replaces the old paper-based method with a faster, safer, and more modern digital system. With real-time updates, automatic processes, and clear data tracking, the system helps reduce mistakes, missing documents, and delays. It also improves communication between contractors, administrators, and security staff, creating a more organized and safer working environment. This web-based PTW system also follows many important parts of the ISO 45001:2018 standard, especially in areas like identifying risks, controlling operations, sharing information, and making continuous improvements. By allowing real-time monitoring, automatic risk checks, and proper approval steps, the system improves safety and efficiency at PSMZA. Useful features like digital records, interactive maps, and emergency tools help meet ISO requirements in planning and support. Overall, this PTW system is not just a better version of the paper-based process — it is a complete and reliable platform that supports workplace safety and meets international standards.

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