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# Hazard Identification and Risk Assessment (HIRA) in Maintenance Works: A Case Study in UiTM Cawangan Pulau Pinang, Malaysia

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**ABSTRACT**

*Maintenance is a common activity across all workplaces and sectors, involving personnel at every level. Maintenance is necessary for preserving safe and healthy working conditions; however, poorly managed maintenance may pose significant health and safety hazards. This study was conducted to identify the potential hazards and evaluate the risks in maintenance works. The data were collected through one observation for each maintenance work in the workplace within a period study of six (6) months. The likelihood and severity of the hazards were used to establish the risk assessment, which was then used to determine the risk levels. A total of 35 potential hazards were identified from the 6 different types of maintenance works, with 3 (8.6%) at high risk level, 20 (57.1%) at medium risk, and the remaining 12 (34.3%) at low risk. Most of the maintenance activities were found to be safe. The high-risk level of hazard occurred during maintenance of the lift and water pipe leakage. Therefore, stricter supervision needs to be carried out on both maintenance works to ensure the safety of the workers. Employers must regularly assess and examine all the hazards for the planned safety measures to be successful. Implementing precautionary measures and increasing worker familiarity with the standard operating procedure (SOP) can help prevent an accident.*

***Keywords***: *Hazard, maintenance, risk assessment, risk level, safety.*

## INTRODUCTION

A hazard is a condition or an object that has the potential to cause injury to people, property, or the environment, while a risk is the combination of the likelihood of injury and the severity of that injury (CCPS, 2010). A hazard is a source or condition that has the potential for harm that may cause human injury or ill-health of people, damage to property, damage to the environment or a combination of these in a workplace (NIOSH, 2005). Hazard identification entails a careful evaluation of all actions that pose risks to workers or those impacted by their use of the goods, services, and materials. The severity of hazard, the amount, duration and frequency of exposure to the hazard affect the health and safety of the worker (Shariff, 2018). A risk is the possibility, likelihood, or probability that something bad will happen. The risk increases with the likelihood. Risk to health increases with the severity and duration of exposure to the hazards. Risk is always associated with either high risk, medium risk or low risk in terms of probability (Shariff, 2018).

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The companies that carry out the risk assessment at the workplace will have numerous positive changes in their working practice and working conditions as they develop and can take necessary corrective action (DOSH, 2008). Risk assessments and safe work procedures must be communicated and understood clearly by employers and employees. The identification of any conditions, practices, and human behaviour that may cause hazards such as disease, harm to people, injury or death, environmental impact, and damage to the property and equipment must be included in the hazard identification process (Chee, 2022). Risk assessments give organisations the ability to take the appropriate actions to safeguard the health and safety of both their employees and non-employees at work (DOSH, 2020).

Maintenance is a routine task that affects all workplaces, in every sector, and it concerns everyone at all levels. Maintenance work means any work that involves functional checks, servicing, repairing, or replacing necessary devices, equipment, machinery, building infrastructure, and supporting utilities in industrial, business, governmental, and residential installations (PWD, 2019). Any operation taken on equipment to ensure its reliability in performing its intended function is called maintenance (Said and Shuib, 2023). Most businesses have assets, and effective control of those assets has a significant impact on the performance of the business. Maintenance is an efficient and effective way of asset management where the purpose of maintenance is to maximise an asset's useful lifetime and minimise its cost (TT Club, 2012). It is necessary to identify the causes of accidents during maintenance operations by looking at both potential and actual accident sources as well as probable sequences of events (Moraru, 2024). Risk statistics, accidents, and risk assessments can all yield pertinent information.

Buildings and structures that are not properly maintained can become unsafe for the occupants and passers-by. Machinery that is not adequately maintained or improperly maintained can make working conditions unsafe for operators, pose risks to other employees, and may cause business losses. Maintenance is very important to ensure safe and healthy working conditions. Maintenance work itself can pose serious health and safety risks if not properly managed. Maintenance work may cause additional hazards such as fires, removal of machine guards, slips, and falls, which need to be assessed to eliminate or reduce the risk of injury or ill health (HAS, 2024). Therefore, maintenance work needs to be planned, and the hazards must be identified before the work commences. A risk assessment needs to be done before any maintenance work is started. The workers must be involved in the initial risk assessment (HAS, 2024).

Workers' ability to identify and respond to hazards is crucial to maintaining safety at any facility. Hazard identification is the first step towards risk analysis, and some situations require immediate action if serious incidents are to be avoided. Every workplace has different hazard and risk level. Occupational health and safety knowledge, equipment/material procedures, and personal protective equipment (PPE), adherence to PPE usage, and inadequate supervision are the reasons why workers engage in risky behaviours (Mulia et al., 2025).

There are no Hazard Identification and Risk Assessment (HIRA) documents for maintenance work at Universiti Teknologi MARA cawangan Pulau Pinang (UiTMCPP) Malaysia, only occupational safety and health guidelines. In that regard, this study presents the identification of hazards and risk assessment of the maintenance works in UiTMCPP. Therefore, the study will determine the level of risk in several maintenance works, and relevant departments can use the results as a reference source.

## METHODOLOGY

This study was conducted at the Permatang Pauh campus, Universiti Teknologi MARA, Pulau Pinang, Malaysia. Hazard identification was obtained through one observation for each maintenance work at the site where the maintenance work was carried out. During the six (6) months study period, six (6) different maintenance works were carried out. There were (i) repair of a lift – figure 1; ii) repair of a spotlight – figure 2; iii) repair of a leaking water pipe – figure 3; iv) electrical control panel inspection – figure 4; v) fire hydrant inspection – figure 5; and vi) fire extinguisher replacement – figure 6. Figures

1 through 5 depict the maintenance work being performed. Discussions with workers were also conducted to obtain detailed information about their work.

**Figure 1: Repair of a Lift**

**Figure 2: Repair of a Spotlight**

**Figure 3: Repair of a Leaking Water Pipe**

**Figure 4: Electrical Control Panel Inspection**

**Figure 5: Fire Hydrant Inspection**

**Figure 6: Fire Extinguisher Replacement**

The guidelines released by the Department of Occupational Safety and Health Malaysia serve as the basis for carrying out the risk assessment process (DOSH, 2008). The relative risk was calculated based on the likelihood and severity of the risks by using the following formula:

$$\text{Relative Risk (R)} = \text{Likelihood (L)} \times \text{Severity (S)}$$

The values for the likelihood level are shown in Table 1. Likelihood (L) refers to the likelihood of the indicated hazardous event occurring, while severity (S) refers to the consequences if the hazardous event occurs. Likelihood levels range from "most likely" to "inconceivable." The values for the severity categories are shown in Table 2. Severity categories are used to guide the development of a hazard analysis or risk assessment matrix. The relative risk (R) assessment is determined based on the 5 × 5 risk matrix calculation, as shown in Table 3, and is used to determine whether the level of risk is high, medium, or low. Table 4 shows the definition of risk level, in which the risk value for each threat is calculated by likelihood and severity values. The given rating value of likelihood and severity will be checked by the UiTMCPP Safety and Health Officer (SHO).

**Table 1: Likelihood Rating**

| Likelihood | Example | Rating |
|---|---|---|
| Most likely | The most likely result of the hazard/event being realised | 5 |
| Possible | Has a good chance of occurring and is not unusual | 4 |
| Conceivable | It might occur sometimes in the future | 3 |
| Remote | Has not been known to occur after many years | 2 |
| Inconceivable | It is practically impossible and has never occurred | 1 |

**Table 2: Severity Categories**

| Severity | Example | Rating |
|---|---|---|
| Catastrophic | Numerous fatalities, irrecoverable property damage, and productivity | 5 |
| Fatal | Approximately one single fatality or major property damage if the hazard is realised | 4 |
| Serious | Non-fatal injury, permanent disability | 3 |
| Minor | Disabling but not permanent injury | 2 |
| Negligible | Minor abrasions, bruises, cuts, and first-aid-type injuries | 1 |

**Table 3: Relative Risk Matrix**

| Likelihood(L) | Severity (S) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 5 | 5 | 10 | 15 | 20 | 25 |
| 4 | 4 | 8 | 12 | 16 | 20 |
| 3 | 3 | 6 | 9 | 12 | 15 |
| 2 | 2 | 4 | 6 | 8 | 10 |
| 1 | 1 | 2 | 3 | 4 | 5 |

**Table 4: Level of risk**

| Risk | Description | Action |
|---|---|---|
| 15-25 | High | A HIGH risk requires immediate action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment form, including the date for completion. |
| 5-12 | Medium | A MEDIUM risk requires a planned approach to controlling the hazard and applies temporary measures if required. Actions taken must be documented on the risk assessment form, including the date for completion. |
| 1-4 | Low | A LOW risk may be considered acceptable, and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implemented and recorded. |

## RESULTS AND DISCUSSION

**Table 5: Repair of a Lift**

| No | Potential hazard | Effect | Likelihood | Severity | Relative risk | Risk level |
|---|---|---|---|---|---|---|
| 1 | Entrapment on the lift car top | Bodily injuries, fatal injuries, crushing injuries | 4 | 4 | 16 | High |
| 2 | Hit by stationary parts in the lift hoistway | Bodily injuries, deep cuts | 3 | 1 | 3 | Low |
| 3 | Contact with electrical connections | Electric shock, burns, fatal injuries | 3 | 4 | 12 | Medium |
| 4 | Fall through a gap between the lift and the hoistway | Bodily injuries, fatal injuries | 4 | 4 | 16 | High |
| 5 | Cramp workspace | Bodily injuries, MSD | 3 | 2 | 6 | Medium |
| 6 | Use of hand tools | Hand injuries, bruises | 2 | 1 | 2 | Low |
| 7 | Awkward working position | Back, neck, and leg pain, MSD | 3 | 3 | 9 | Medium |
| 8 | Dust | Cough, cold, asthma | 3 | 2 | 6 | Medium |

**Table 6: Repair of a Spotlight**

| No | Potential hazard | Effect | Likelihood | Severity | Relative risk | Risk level |
|---|---|---|---|---|---|---|
| 1 | Hot weather | Heat stroke, heat stress | 3 | 3 | 9 | Medium |
| 2 | Use of hand tools | Hand injuries, bruises | 2 | 1 | 2 | Low |
| 3 | Contact with electrical connections | Electric shock, burns, fatal injuries | 3 | 4 | 12 | Medium |
| 4 | Squatting for too long | Back and leg pain, MSD | 3 | 3 | 9 | Medium |

Table 5 above shows the identified hazards and risk levels associated with lift repair. There were eight (8) hazards found in these activities, which are two (2) high risk, four (4) medium risk, and two (2) low risk levels. Entrapment on the lift car top and falling through the gap between the lift and hoistway were identified as the highest relative risk (16), which can cause fatal injury. At the medium risk level, the highest relative risk (12) was associated with contact with electrical connections, which can also cause fatal injury. The hazard of using hand tools, which can cause injuries to the hand and body, has the lowest relative risk (2). Lift-jacking accidents are one of the five most common lift-related accidents, with a high hazard rating (Na et al., 2023). Lifts are machines that have a high safety requirement. Lift faults not only disrupt the operations of other assets but can also result in serious injury or even death. Lift repair and maintenance are potentially hazardous activities that could easily cause accidents and even fatalities among people performing the task (OSH, 2006). Table 6 shows the results of the hazards and risk levels of repairing the spotlight. There were four (4) hazards found in these activities, of which three (3) are at a medium risk level, and one (1) is at a low level. The hazard of contact with electrical connections is the highest relative risk (12), which can cause fatal injury. The hazard of using hand tools, which can cause injuries to the hand and body, has the lowest relative risk (2).

**Table 7: Electrical Control Panel Inspection**

| No | Potential hazard | Effect | Likelihood | Severity | Relative risk | Risk level |
|---|---|---|---|---|---|---|
| 1 | Contact with electrical connections | Electric shock, burns, fatal injuries | 3 | 4 | 12 | Medium |
| 2 | Dust | Cough, cold, asthma | 3 | 2 | 6 | Medium |
| 3 | Awkward working position | Back, neck, and leg pain, MSD | 3 | 3 | 9 | Medium |
| 4 | Slip and trip | Bodily injuries, bruises, falls | 3 | 1 | 3 | Low |
| 5 | Contact with sharp edges | Hand injuries, bruises | 3 | 1 | 3 | Low |

**Table 8: Repair of a Leaking Water Pipe**

| No | Potential hazard | Effect | Likelihood | Severity | Relative risk | Risk level |
|---|---|---|---|---|---|---|
| 1 | Awkward working position | Back, neck, and leg pain, MSD | 3 | 3 | 9 | Medium |
| 2 | Slip and trip | Bodily injuries, bruises, falls | 3 | 1 | 3 | Low |
| 3 | Cramp workspace | Bodily injuries, MSD | 3 | 2 | 6 | Medium |
| 4 | Contact with sharp parts | Bodily injuries, hand injuries, and bruises | 3 | 1 | 3 | Low |
| 5 | Use of hand tools | Hand injuries, bruises | 2 | 1 | 2 | Medium |
| 6 | Dust | Cough, cold, asthma | 3 | 2 | 6 | Medium |
| 7 | Falling debris | Bodily injuries, bruises | 3 | 1 | 3 | Low |
| 8 | Crushed by a backhoe bucket | Bodily injuries, fatal injuries, and head injuries | 4 | 4 | 16 | High |

The outcomes of the hazards and risk levels of electrical control panel inspection are displayed in Table 7. These works contained five (5) hazards, of which two (2) are at a low level, and the other three (3) are at medium risk levels. The hazard of contact with electrical connections is the highest relative risk

(12), which can cause fatal injury. The hazard of using hand tools, which can cause injuries to the hand and body, has the lowest relative risk (2). The outcomes of the hazards and risk levels of repairing a leaking water pipe are displayed in Table 8. These works contained eight (8) hazards, of which one (1) is a high level, four (4) are at a medium level, and three (3) are at a low level. Being crushed by a backhoe bucket represents the highest relative risk (16), which can cause fatal injury. The awkward working position hazard is the highest relative risk (9), which can cause Musculoskeletal Disorders (MSDs), while the lowest relative risk (2) is the use of hand tools.

**Table 9: Fire Hydrant Inspection**

| No | Potential hazard | Effect | Likelihood | Severity | Relative risk | Risk level |
|---|---|---|---|---|---|---|
| 1 | Dust | Cough, cold, asthma | 3 | 2 | 6 | Medium |
| 2 | Awkward working position | Back, neck, and leg pain, MSD | 3 | 3 | 9 | Medium |
| 3 | Contact with electrical connections | Electric shock, burns, fatal injuries | 3 | 4 | 12 | Medium |
| 4 | Contact with sharp parts | Bodily injuries, hand injuries, and bruises | 3 | 1 | 3 | Low |
| 5 | Cramp workspace | Bodily injuries, MSD | 3 | 2 | 6 | Medium |
| 6 | Slip and trip | Bodily injuries, bruises, falls | 3 | 1 | 3 | Low |
| 7 | Use of hand tools | Hand injuries, bruises | 2 | 1 | 2 | Low |

**Table 10: Fire Extinguisher Replacement**

| No | Potential hazard | Effect | Likelihood | Severity | Relative risk | Risk level |
|---|---|---|---|---|---|---|
| 1 | Awkward working position | Back, neck, and leg pain, MSD | 3 | 3 | 9 | Medium |
| 2 | Contact with sharp edges | Hand injuries, bruises | 3 | 1 | 3 | Low |
| 3 | Mid-heavy lifting | Back pain, falls, bruises, | 3 | 2 | 6 | Medium |

Table 9 shows the results of the hazards and risk levels of fire hydrant inspection. There were seven (7) hazards found in these activities, which are four (4) medium risk and three (3) low risk levels. The medium risk level, where the higher relative risk of 12 is contact with electrical connections, which can also cause fatal injury. The hazard of using hand tools, which can cause injuries to the hand and body, has the lowest relative risk (2). Table 10 shows the results of the hazards and risk levels of fire extinguisher replacement. There were three (3) hazards found in these activities, of which two (2) are at a medium risk level, and one (1) is at a low level. The awkward working position hazard is the highest relative risk (9), which can cause Musculoskeletal Disorders (MSDs), while the lowest relative risk (3) is contact with sharp edges, which can cause hand injury.

**Table 11: Summary of Risk Level**

| No | Task | Hazard | Low | Medium | High |
|---|---|---|---|---|---|
| 1 | Repair the lift | 8 | 2 | 4 | 2 |
| 2 | Repair the spotlight | 4 | 1 | 3 | 0 |
| 3 | Electrical control panel inspection | 5 | 2 | 3 | 0 |
| 4 | Repair the leaking water pipe | 8 | 3 | 4 | 1 |
| 5 | Fire hydrant inspection | 7 | 3 | 4 | 0 |
| 6 | Fire extinguisher replacement | 3 | 1 | 2 | 0 |
| | Total | 35 | 12(34.3%) | 20(57.1%) | 3(8.6%) |

A total of 35 potential hazards were identified, and Table 11 summarises the risk level for each maintenance work in this study. It was discovered that there were three (3) high-risk levels contributed 8.6%, twelve (12) low-risk levels contributed 34.3%, and twenty (20) medium-risk levels accounted for 57.1% of the total hazards. The potential hazards with high-risk status must be given serious attention by the worker and employer. More than 65% of maintenance works were classified as medium and high risk. This shows that some of the maintenance work is dangerous and risky work, with accidents easily occurring in the workplace. Keep in mind that medium-risk hazards could turn into high-risk hazards if the employer and employees are ignorant about workplace safety and hazards. A previous study by Ahmad et al. (2016) showed that all the highway maintenance work hazards are within an extreme and high-risk level, where the extreme risks are work involving scaffolding, electricity, cranes, and heavy equipment. While hazards involving vehicles and machinery, excavation, installation, and welding are at high-risk levels. The hazard risk level of high-rise apartment facilities in Johor, Malaysia, that can cause hazards, was identified as 17.05% high, 65.9% medium, and 17.05% low (Ramlee and Rahim, 2023).

High risks must be reduced to medium risks, and medium risks must be reduced to low risks. This can be done by controlling the risk. Controlling risk means reducing the likelihood of an unwanted event or minimising its consequences. Administrative controls must be strengthened, such as Standard Operating Procedures (SOP), safe work instructions, training and signage. Engineering controls are made as much as possible, such as using barriers to separate workers from excavators and cranes. If possible, eliminate the hazard, such as removing unnecessary obstacles that workers may trip over. The workers must always be careful and adhere to the safety rules, so they can avoid any injuries in the workplace.

## CONCLUSION

Efforts to reduce and avoid workplace accidents will be made easier with the help of systematic risk assessment and hazard identification. Every employee level must be able to see the most hazardous part of every maintenance work. The severity rate, likelihood, and risk level of the maintenance work through observation in the workplace in Universiti Teknologi MARA Cawangan Pulau Pinang, Malaysia, are shown in this study. The hazards and risk assessment in this study are identified and classified as having high (8.6% - 3 hazards), medium (57.1% - 20 hazards), and low (34.3% - 12 hazards) levels of risk. The high potential hazards of risk status must be given serious attention by the worker and employer. Remember that if the employer and employees are not aware of workplace safety and hazards, medium-risk hazards may become high-risk hazards. Risks can be controlled and reduced by elimination, substitution, engineering controls, administrative controls, and Personal Protective Equipment (PPE). An effective risk management strategy can help manage risk effectively and productively. Training on safe work practices and workplace safety must be provided to the employees. The development of a workplace safety culture depends on employers and employees having effective communication about health and safety issues. Hazard and safety awareness must become a priority in the workplace, and everyone must take responsibility for it.

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## AUTHORS' CONTRIBUTION

Rosley Jaafar conceived and planned the experiments. Lutfil Hakim Abdul Hadi carried out experiments and data preparation. Rosley Jaafar contributed to the interpretation of the results. Rosley Jaafar took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis, and manuscript.

## CONFLICT OF INTEREST DECLARATION

We certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This manuscript has not been submitted for publication, nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity, and legitimacy of the data and its interpretation for submission to Jurnal Intelek.

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