

Hazard Risk Assessment on The Maintenance of Facilities and Infrastructure in ITK Campus Using JSA Method

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ABSTRACT

Applying Occupational Safety and Health culture is very important for workers, including facilities and infrastructure maintenance workers. Facilities and infrastructure maintenance activities at Institut Teknologi Kalimantan have varying levels of risk, ranging from low to high. This study aims to identify and determine the level of work risk, then analyze the risks and hazards of each stage of work and how to control them. This study uses several steps, such as determining the work to be explored, describing the results from the preparatory stage to the implementation of the work, identifying hazards and risks by looking at the severity and likelihood of accidents and occupational diseases occurring in each job, and providing an overview of workplace controls. The analysis results show that the highest risk value is grass cutting at the grass cutting stage using a machine, namely scratches, bruises, and cut legs, with a risk value of 16. This risk is controlled by replacing the blades of the grass cutter, protecting the engine cover, making and implementing Standard Operating Procedure (SOP), and using PPE such as safety shoes.

Keywords: Campus, job safety analysis, hazard, risk, safety behavior

INTRODUCTION

According to Law No. 1 of 1970, paragraph 1 explains the scope for the enactment of the law is determined based on three elements, namely the place where work is carried out for a business, the presence of workers working there, the presence of a hazard in the workplace.¹ Workplaces or companies referred to in the law do not always have an economic or profit motive but can be social enterprises such as vocational schools, recreational businesses, and hospitals, which use dangerous electrical and mechanical installations. Institut Teknologi Kalimantan (ITK) is a tertiary institution that focuses on Education and technology to support the needs of the industrial world. Therefore, facilities and infrastructure are important factors in achieving Institut Teknologi Kalimantan's goals.

Obviously, all academic and non-academic activities require infrastructure and facilities to support them. Therefore, it is necessary to maintain facilities and infrastructure so that actions can run optimally. Facilities maintenance in universities encompasses a wide range of activities, from

routine cleaning and repairs to more complex projects such as renovations or new construction. Instead, this activity has the potential risk of incidents or accidents with various levels of each officer's job, such as slips, trips, falls, exposure to hazardous materials, electrical hazards, and fire hazards. The level of safety risk is determined by the type of work performed and the various factors that exist.² Unsafe behavior accounts for approximately 80% - 90% of the causes of workplace accidents. Working without permission outside of working hours, ignoring work safety, and using non-standard equipment are all examples of unsafe behavior in the college environment.³ Work accidents in higher education institutions can occur due to errors and negligence in the use of machines and equipment, a lack of understanding of work procedures, a lack of job training, and a lack of safety equipment.⁴

Hazard risk assessment is a necessary process that universities undertake to identify, evaluate, and control potential risks associated

with their facility maintenance. This assessment aims to ensure that university buildings and equipment are maintained and operated safely and that any hazards are minimized or eliminated to protect the health and safety of the university community. The process of hazard risk assessment typically involves several steps, such as identifying the hazards, assessing their likelihood and severity, and evaluating the existing controls in place.

In addition to protecting the health and safety of the university community, hazard risk assessments of facility maintenance can also have other benefits. For example, they can help universities identify areas for improvement in their facility's maintenance processes, optimize resource allocation, and reduce costs associated with accidents and incidents.⁵

According to Arumsari's research in 2017, the level of danger in university buildings ranged from safe to warning. Implementing the Occupational Safety and Health program and work accident mitigation, the availability of Occupational Safety and Health facilities, and monitoring and evaluation efforts were all influencing factors.⁶

Research by Putri in 2019 described safety risk assessment in universities located near factories. According to the potential hazard assessment findings in the higher education institution, 87% of the hazard sources were categorized as medium risk. Hazard factors that have been identified such as not wearing full personal protective equipment during practicum, hazards from practicum materials, hazards from practicum machines, and environmental hazards such as noise, smoke, and dust.⁷

In line with Citra's research in 2017, the results of a review and assessment of university education risks showed that 78% of the risks from a safety and health aspect such as burns from chemical spills, restrictive areas, and limited space for a movement that can hit objects around it, ergonomics, and working weather (air temperature and humidity).⁸

As mentioned above, several studies on hazard risk assessment in Higher Education have been conducted. In general, tertiary institutions are known to have a hazard risk value in the moderate risk range. However, research that specializes in hazard risk assessment regarding the maintenance of campus facilities and infrastructure is still not widely published. In addition, so far hazard risk assessments in ITK have never been carried out, especially in physical activities such as maintenance of facilities and infrastructure. Based on these problems, it is deemed necessary to conduct research on hazard risk

assessment by focusing on activities to maintain facilities and infrastructure on the ITK campus. The purpose of this study is to identify and further examine the risks of hazards in the work of maintaining facilities and infrastructure on the ITK campus. The findings of this study are expected to assist ITK leaders in making occupational health and safety plans to prevent work accidents on the ITK Campus.

METHOD

This research is qualitative observational research. The method used to identify and analyze risks is job safety analysis (JSA). JSA implementation is an effort to prevent and minimize work accidents.⁹ The location of research and data collection was carried out at the ITK Campus. The study was conducted for six months. This study uses primary and secondary data. Preliminary data were obtained by conducting direct observations, interviews, and documentation related to work carried out by facility and infrastructure maintenance officers.

Observations and interviews were conducted to obtain some data such as the appropriateness of the steps of work implementation; the suitability of work tools; the number of incidents and accidents; and the potential hazard. The informants in this study are four permanent workers in the facilities and infrastructure division and two contract workers in the cleaning service section.

At the same time, secondary data such as documentation of work incidents and accidents, Standard Operating Procedures (SOP) for each job, work schedule, and the number of workers is needed as supporting data.

Figure 1 depicts the research flow diagram. The JSA method begins with data collection related to the steps and types of work from facility and infrastructure maintenance. At this stage, we conducted observations and interviews with all of members of the facilities and infrastructure division (One member is the section chief and the other three is the daily executive member) and two members of cleaning service group. Due to there is no SOP data for each maintenance work thus we have taken a noted and documented every step of the work.

In the next stage, we identified the potential hazards of each type of work stage. In this step, each work stage will be assigned a level of hazard based on the frequency of accidents, accidents that result in injuries, jobs with high potential losses, and new jobs that may result in work accidents. At this stage, coordination is also needed with the section

chief and all facilities and infrastructure division members to ensure data work can potentially cause high losses. We have asked about the experiences of all members in doing their jobs.

The third stage analyzes the risk of harm. In this step, the hazard risk is assessed

by considering the severity and likelihood of an accident occurring. Assessment requires the opinion and experience of all members of the risks that have been experienced. In addition, we also use similar literature in determining the level of risk.

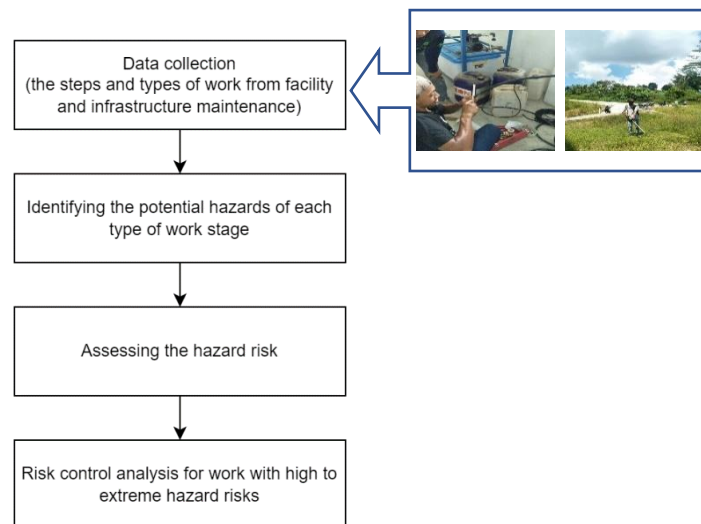


Figure 1. Research Flow Diagram

Table 1. Relation Between Severity And Likelihood

Likelihood	Severity				
	1	2	3	4	5
5	H	H	E	E	E
4	M	H	H	E	E
3	L	M	H	E	E
2	L	L	M	H	E
1	L	L	M	H	H

Table 1 explains the information, E is an extreme risk, and action is needed as soon as possible. H is a high risk, and it is required from top management. M is medium risk; management responsibility must be specific. L is low-risk, dealing with routine procedures.¹⁰

Once risks have been identified and assessed, steps can be taken to mitigate the risk. This could involve implementing controls to reduce the likelihood of the risk occurring or the impact if it does occur. The risk control analysis for work with high-to-hazard risks. The risk control hierarchy begins with substitution, elimination, engineering, and administration and ends with personal protective equipment.

RESULT AND DISCUSSION

Based on observations, interviews, and documentation, facility and infrastructure officers routinely carried out six main types of

work: electrical installation, garden maintenance, indoor maintenance, outdoor maintenance, generator maintenance, and cleaning service.

Each of these jobs has a specific type of work and stages of work that must be completed. For example, the following stages of work were involved in the type of electrical installation work known as Air Conditioner switch repair work: bringing ladders and equipment to the work site, climbing stairs, opening sockets or switches, repairing switches, reinstalling switches, going downstairs, and carrying ladders and equipment back.

After completing the description of the type of work, a form of work and stages of work, hazard identification was carried out for each stage of work from all forms of work carried out. An example can be seen in Table 2. In the Air Conditioner switch repair work, there were several potential hazards, such as being hit by equipment, tripping, slipping, scratched hands, being caught falling from a height of more than 1 meter, being hit by a ladder, and being electrocuted. In addition, because of this hazard, there were potential risks in Air Conditioner switch repair, such as sprains, bruises, injured hands, broken bones, burns, and death. Air Conditioner switches are an essential part of electrical systems, and their failure can use serious harm to people and

property damage.¹¹

Air conditioner switches are connected to an electrical power supply, which can cause electric shock if the button is not disconnected correctly before repair work begins. According to the Occupational Safety and Health Administration (OSHA), electric shock can cause severe injury or even death.¹²

Following identifying the hazards of electrical, indoor, and outdoor work, generators, and cleaning services. The next step was to conduct a risk assessment for each

stage of work. Using the standard AS/NZS 4360 Australian/New Zealand, 2004 to calculate the likelihood and severity at each stage of the work. The assessment of the level of likelihood begins with level 1, which states that work accident incidents may have occurred under certain conditions. Up to level 5, it is possible to predict that the incident will happen.

Overall, the results of hazard and risk identification for six types of work, namely there are 40 types of potential hazards and 19 types of potential risks (Figure 2a).

Table 2. Example of Hazard Identification in Air Conditioner Switch Repair Work at the ITK Campus

Type of work	The specific type of work	Stages of work	Potential hazard	Potential Risk
Electrical installation	Air Conditioner switch repair	Bringing ladders and equipment to the work site	Crushed by tools, tripped, slipped	Sprains, bruising
		climbing stairs	Fall from a height > 1 m, hit by a ladder	Sprains, bruises, broken bones
		opening sockets or switches	Dropped from a height of >1 m, electrocuted	Sprains, bruises, broken bones, burns, death
		repairing switches	Dropped from a height of >1 m, electrocuted	Sprains, bruises, broken bones, burns, death
		reinstalling switches	Dropped from a height of >1 m, electrocuted	Sprains, bruises, broken bones, burns, death
		going downstairs	Fall from a height > 1 m, hit by a ladder	Sprains, bruises, broken bones
		carrying ladders and equipment back	Crushed by tools, tripped, slipped	Sprains, bruising

Source: Primary Data, 2021

Determine the severity level on each job after determining the level of possibility. Severity level was described from level 1 of an incident with no injury and small financial loss to level 5 of an incident with death, the effect affecting and harming the surrounding environment, and very large financial losses. The likelihood and severity values are derived from field observations, officer interviews, and work accident data collected on the ITK campus.

After obtaining an assessment of the level of likelihood and severity at each stage of the work, the level of risk associated with each hazard is assessed based on the combination of its likelihood and potential consequences.

This can be done using risk matrices, decision trees, or other quantitative or qualitative methods. The amount of risk can be seen in Figure 2a.

Figure 2b illustrated the results of the risk assessment that the number of jobs that have low risk: 65, medium risk: 38, high risk: 11, and extreme risk: 5. Indoor maintenance work is the type of work that has the most activities in the low-risk category of 17 jobs. While the type of cleaning service work has the most jobs in the medium-risk category, with 9 jobs. The type of garden maintenance work is the type of work that has the most high-risk category jobs, namely 5 jobs. The type of electrical installation work is the type of work that has the most jobs

in the extreme risk category, namely 4 jobs.

Extreme levels of hazardous occupation can occur from a variety of factors, including the nature of the job, inadequate safety protocols, and a lack of adequate training for employees.^{13,14} Work involving hazardous chemicals, high-voltage electricity, or heavy machinery carries an elevated risk of injury or fatality. Workers operating lawnmowers, for instance, are susceptible to wounds, bruises, and leg cuts. Inadequate safety protocols or a lack of sufficient training can increase the likelihood of accidents and injuries.^{15,16} For

instance, if employees are not properly trained to use personal protective equipment, they may be exposed to excessive noise levels, resulting in long-term health issues.

Following a risk assessment. In the next stage, determine risk management for high and extreme risk levels in ITK's facilities and infrastructure work to reduce and prevent risks. Refer to the risk control hierarchy when providing risk control, starting with elimination, substitution, engineering/technique, administration, and personal protective equipment (PPE).

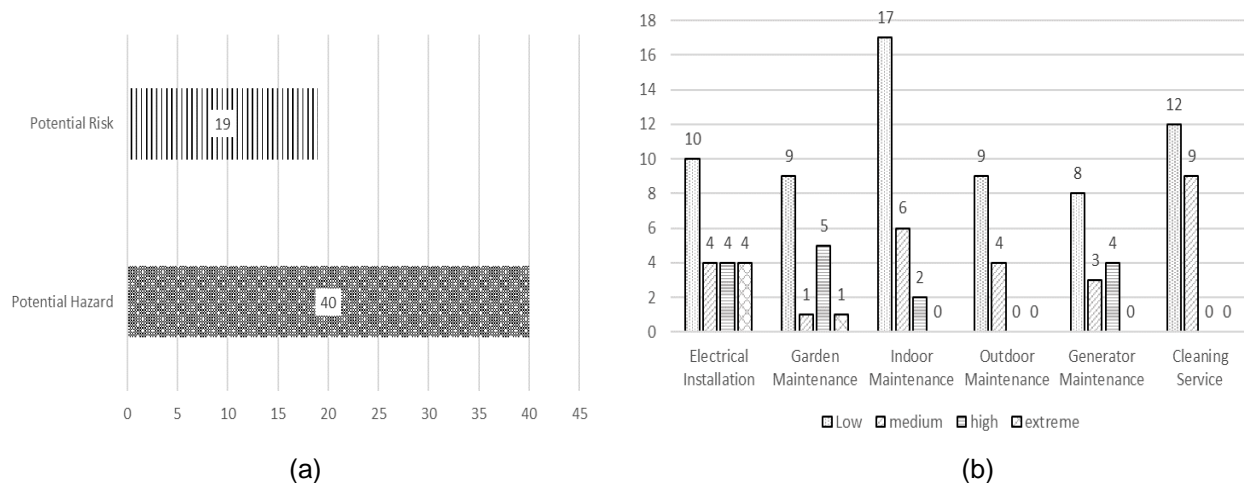


Figure 2. (a) The number of potential hazard and risk on each main type of work; (b) The amount of risk level per type of work

Table 4. Risk Control at High and Extreme Risk

Type of work	Stage of work with high and extreme risk	Risk Level	Risk Control
Electrical installation work	Turn off the Power Switch	5 (High)	Do not step on or place your foot more than the third rung from the top. Replace the anti-slip outer sole, and replace the portable ladder as needed. Use rubber coatings or anti-slip materials on the feet of stairs made of iron/metal, always use three points of contact (Three-point contact). Create and implement work SOPs, electrical safety training, and safety briefings, regularly inspected and tested. Wear safety shoes or non-conductive footwear, safety gloves
	Removing and reinstalling with new lamp	10(extreme)	
	Open and replace new lamp housing	10(extreme)	
	Open, repair and reinstall the socket	10(extreme)	
	Turn off the electricity meter	5 (High)	
	Drilling walls	8(High)	
	Connect the wires to the electricity meter	5(High)	
Garden maintenance work	Go up and down the stairs	9(High)	Ladders should not be used. Aerial scaffolding can be used in place of ladders. Make use of a safety net system.

Type of work	Stage of work with high and extreme risk	Risk Level	Risk Control
	Cut tree branches	9(High)	Create and implement standard operating procedures, safety briefings, and safety training. Use a full-body harness, safety shoes, gloves, and a face shield. Replacing the lawnmower blade, for example, with a cable tie. Putting safeguards in place. Create and implement SOPs, as well as a safety briefing.
	Sharpen the cutting blade with a grinder	4(High)	Wear safety shoes, glasses, safety shoes, face shields, and helmets.
	Turn on the lawn mower	4(High)	
	Cut the grass	16(Extreme)	
Indoor work	Grinding tool inspection	4(High)	Use a protective cover on the grinding machine. Maintaining the tool in safe working condition Create and implement work SOPs, safety training, safety briefings. Use safety glasses, mask, safety gloves, safety shoes
	Type cutter with grinder	4(High)	
Generator maintenance	Disconnect the electric generator handle by turning the main switch electric handle	5(High)	Making use of a grounding system. An exhaust is being used in the room. Create and implement work procedures, as well as warning signs. Wear safety gloves and shoes.

Source: Primary Data, 2021

Hazard risk control is an essential aspect in electrical installation work, garden maintenance, indoor work, and generator maintenance to ensure the safety of people, property, and equipment.

Based on Table 4, the number of hazard risks in electrical installation is the highest compared to other types of work. The hazards associated with electrical installation work can include electric shock, fire, explosion, and other types of electrical accidents. The risk of these hazards occurring can be reduced by implementing control measures such as using Personal Protective Equipment (PPE) such as insulated gloves, safety glasses, and non-conductive footwear to protect themselves from electric shock. Proper training and supervision are also essential to keep workers safe. Workers should be trained and supervised on safe work practices to avoid accidents. Safe working practices should be established and followed to avoid electrical hazards, such as lockout procedures and grounding and bonding techniques. In addition, electrical equipment should be installed and maintained by industry standards and manufacturer's instructions to

ensure safe operation. While the electrical equipment and installations should be regularly inspected and tested to ensure they are safe and in good working condition.¹⁷⁻¹⁹

In garden maintenance, the grass-cutting stage is the stage with the most hazardous risk or is dangerous for workers. Cutting grass can be dangerous for workers due to various hazards associated with the activity. Some of the potential hazards include contact with sharp blades. Lawnmowers use sharp blades to cut grass, which can cause cuts, lacerations, and even amputations if they come into contact with a worker's hands, feet, or other body parts. Therefore, Hazard risk control is critical to ensuring safe gardening maintenance. This can be achieved through PPE, safe use of power tools, working at heights with appropriate fall protection equipment, regular equipment maintenance, proper signage, and proper storage of equipment and materials.^{20,21}

In the type of indoor work, using a grinder is a stage of work with a high risk of danger because it has a large-scale impact, so it has a high risk. Potential hazards include contact with the cutting blade, flying debris, and

noise exposure. Like other types of work, using a tile cutter with a grinder attachment can be dangerous for workers if appropriate safety measures are not followed. By using the appropriate personal protective equipment, following safe operating procedures, and maintaining the tool in safe working conditions, workers can reduce the risk of injury or illness while using this tool.

Generator maintenance has potential hazards and risks that can cause injuries or fatalities to workers. Some of the hazards associated with generator maintenance include electrical hazards that can cause electrocution or shock if workers come into contact with live wires or other energized components. Generators can produce heat, flammable gases, and combustible materials, which can cause fires or explosions if not properly maintained or operated. Generators emit carbon monoxide, a toxic gas that can cause illness or death if inhaled in high concentrations. Workers can be exposed to carbon monoxide if they work in enclosed spaces or if the generator is not properly ventilated.^{17,22,23}

CONCLUSION

We can conclude the result of hazard identification from six main types of work (electrical installation, garden maintenance, indoor maintenance, outdoor maintenance, generator maintenance, and cleaning service) that reveal 40 potential hazards and 19 potential risks on each step of work. While the results of the risk assessment obtained the number of risk level namely, Low risks: 65, Medium risk: 38, High risk: 11, and Extreme risk: 5. Indoor maintenance work had the most activities among the 17 jobs in the low-risk category. While there are 9 occupations in the medium risk category for cleaning service workers. Garden maintenance work is the sort of employment with the highest risk category jobs, specifically 5 jobs. Electrical installation work is the type of work with the most occupations in the extreme risk category, with four jobs. According to the result of the risk control analysis, using the appropriate personal protective equipment, following safe work practices in safe working condition, maintaining equipment, create standard operating procedure and safety training can be used to reduce the risk of injury or illness. Besides that, employers are responsible for ensuring that their workers are safe and protected from harm and failure.

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