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HIRARC METHOD APPROACH (HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL) AS ANALYSIS TOOLS IN FORMING OCCUPATIONAL SAFETY AND HEALTH CULTURE (CASE ON CONSTRUCTION PROJECTS)

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ABSTRACT

The purpose of this study is to observe and analyze the potential hazards that can cause accidents in the activity of lifting building materials using Tower Crane on a construction project. The method used in this research is Hazard Identification, Risk Assessment and Risk Control (HIRARC). By using this method, it is hoped that it can reduce the number of accidents that occur, find out the causes of accidents, and establish control measures. The results of the study indicate that there are 11 risks in activities that have the potential to cause accidents. Where 2 risks have an "Extreme" level of danger, namely an accident with more than one person and the status is "Urgent" so that it needs immediate treatment, 4 risks are classified as "High" which need serious attention and 2 risks are "Medium" which requires special attention. The conclusion of the research is that companies must establish and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using earplugs, making SOPs, using scaffolding, installing covers, holes, put up warning signs, cut metal out of the floor, used personnel protective equipment (PPE), and provided a first aid kit. It is recommended that the company immediately recruit HSE experts on each project so that the company's Quality Health Safety Environment (QHSE) Department only receives reports and proposals which will later be used as SOPs for the next construction project..

Key words: Hazard, Risk, Accident, HIRARC, HSE

PENDEKATAN METODE HIRARC (HAZARD IDENTIFICATION, RISK ASSESSMENT DAN RISK CONTROL) SEBAGAI ALAT ANALISIS DALAM MEMBENTUK BUDAYA KESELAMATAN DAN KESEHATAN KERJA (KASUS PADA PROYEK KONSTRUKSI)

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ABSTRAK

Tujuan dari penelitian ini adalah untuk mengamati dan menganalisis potensi bahaya yang dapat menyebabkan terjadinya kecelakaan pada aktivitas pengangkatan material bangunan menggunakan Tower Crane pada suatu proyek konstruksi. Metode yang digunakan dalam penelitian ini adalah Hazard Identification, Risk Assessment and Risk Control (HIRARC). Dengan menggunakan metode ini diharapkan dapat menekan angka kecelakaan yang terjadi, mengetahui penyebab kecelakaan, dan menetapkan tindakan pengendalian. Hasil penelitian menunjukkan bahwa terdapat 11 risiko pada aktivitas yang berpotensi terjadinya kecelakaan. Dimana 2 risiko memiliki tingkat bahaya "Extreme" yaitu kecelakaan lebih dari satu orang dan berstatus "Urgent" sehingga memerlukan penanganan segera, 4 risiko tergolong "High" yang memerlukan perhatian khusus. Kesimpulan penelitian adalah perusahaan harus membuat dan memelihara prosedur untuk melakukan identifikasi bahaya, penilaian risiko, dan pengendalian risiko sesuai kebutuhan dengan cara membuang air di basement, menggiling pasangan pelindung, menggunakan penyumbat telinga, membuat SOP, menggunakan perancah, memasang penutup lubang, memasang tanda peringatan, memotong logam yang keluar dari lantai, menggunakan Alat Pelindung Diri (APD), dan menyediakan kotak P3K. Disarankan agar perusahaan segera merekrut tenaga ahli K3 pada setiap proyek sehingga Departemen Quality Health Safety Environment (QHSE) perusahaan hanya menerima laporan dan proposal yang nantinya akan digunakan sebagai SOP pada proyek konstruksi selanjutnya..

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Kata kunci: Bahaya, Risiko, Kecelakaan, HIRARC, K3

INTRODUCTION

In 2021, BPJS Employment or BPJS Kesehatan recorded around 65.89 percent of work accident cases claimed by participants, occurred at work locations. The first sequence of work accidents is in the work location, and most occur in the morning. A total of 65.89 percent of work accidents occur in the work location, then 25.77 percent of accidents in traffic, and only 8.33 percent outside the work location.

OSH is Occupational Safety and Health with the understanding of providing protection to everyone in the workplace, which is related to the transfer of raw materials, use of construction work equipment,

production processes and the environment around the workplace. Construction activities are an important element in development which in carrying out these construction activities cause various unwanted impacts, including those concerning aspects of occupational safety and health.

Purohit, et al (2018) states that construction is a high hazard industry that comprises a widerange of activities involving construction, alteration or repair. Examples include residential construction, bridge erection, excavations, demolitions and large scale painting jobs. Hazard identification and risk analysis is carried for identification of undesirable events that can leads to a hazard. The analysis

of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects.

Therefore, research on the identification of potential hazards is still a very interesting study, especially if it is extended to the full management of HSE.

The research was conducted at one of the largest state-owned companies in the construction sector where the construction sector is one area that has the potential to cause work accidents and the potential for accidents is high in the activity of lifting building materials using Tower Cranes on construction projects. Because this process determines the speed of construction of a construction project and often time is running out to complete the apartment, it puts the operator under pressure, which results in miscommunication to the workers below to bind the building materials to be brought up. So that the fastening is not tight because in a hurry there is a potential hazard that has an impact on workers who are in the Tower Crane activity area.

So to protect workers in doing their jobs, companies need to implement an integrated Occupational Health and Safety (OHS) Management System program aimed at reducing and preventing the possibility of accidents and occupational diseases. The construction sector is one sector that has a high potential for danger and a lot of work accidents occur in this sector. Health, Safety and Environment (HSE) is very important for employees and companies in order to achieve a high and optimal level of work productivity. The research was conducted with a qualitative descriptive approach. The data used in the study were obtained from the results of worker interviews. After the data was obtained, data analysis was carried out using the HIRARC method. Based on the background of the HSE problem above, the formulation of the problem in this study is as follows:

1. Knowing the HSE program that has been implemented by the company
2. How to identify and analyze occupational accident hazards using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method.
3. How to do good risk management to achieve Zero Accident in construction projects.

METHOD

HIRARC performed on all activities to determine activities which contain potential hazards and have a serious impact on occupational safety and health (Indragiri & Yuttya, 2020)

This study uses the Hazard Identification Risk Assessment and Risk Control (HIRARC) approach, which is a method to prevent or minimize work accidents. HIRARC is a method that starts from determining the type of work activity which then

identifies the source of the hazard so that the risk is obtained.

HIRARC is a process of identifying hazards (Hazard Identification) that can occur in all company activities, then conducting a risk assessment (Risk Assessment) of the hazards that occur, then making hazard control (Risk Control) in order to minimize high risk levels to low (Sitepu & Simanungkalit, 2020).

This whole process is also called management risk (risk management). HIRARC is a key element in the system occupational safety and health management which is directly related to prevention and control of hazards. Besides, HIRARC too is part of the risk management system (risk management). according to OHSAS 18001, HIRARC should be carried out in all organizational activities to determine organizational activities that contain potential hazards and have a serious impact on occupational safety and health.

Furthermore, the results of HIRARC become input for the preparation of objectives and HSE targets to be achieved, which are outlined in the work program. From the groove in below it can be seen that HIRARC is the starting point for OHS management. If HIRARC is not carried out properly then the application of HSE will be in the wrong direction (misguided), random or virtual because they are not able to handle the main issue at hand within the organization.

The HIRARC method follows the following steps:

1. Hazard Identification :

Hazard identification is the process of identifying all hazards in the workplace. There is no set method for grouping agricultural injury and illness hazard (Chauhan & Siddiqui, 2018).

Hazard identification can be done through the following steps:

- a) Make a list of all objects of machines, work equipment, materials, work processes, work systems, working conditions that exist in the workplace.
- b) Check all objects in the workplace and its surroundings.
- c) Conduct interviews with workers who work in the workplace related to these objects.
- d) Accident review, first aid records and other information.
- e) Record all identified hazards.

2. Risk Assessment :

Risk assessment involves determining the impact level and recurrence of risk using available information. Moreover, in the risk analysis process, different factors, such as effects of recognized risks on project objectives, manageability, timing, the probability of occurrence, and relationship to other risks, must be considered. All these factors provide a better understanding of each risk type and increase the capacity for adoption of an

adequate and appropriate approach to mitigating such risks (Jaber, 2019)

Risk is the possibility of an accident or loss in a certain period of time or a certain operating cycle. The level of risk is the multiplication between the level of frequency (Likelihood) and the severity (consequence) of an event that can cause losses. At this risk assessment stage, the assessment follows:

A. Frequency Level (Likelihood)

That is how often workers are exposed to potential hazards. To be able to make the best estimate, we must consider the following:

1. Often the value is 5, the probability of exposure is between 90-100%.
2. Often the score is 4, the probability of exposure is between 60-89%.
3. While the score is 3, the probability of exposure is between 40-39%.
4. Rarely the value is 2, the probability of exposure is between 10-39%.
5. Rarely the value is 1, the probability of exposure is between <10%.

B. Severity Level (Consequence)

The level of impact (consequence or severity) of an accident or illness can be categorized into 5 (five) categories as follows:

1. Extreme is an accident that causes the death of more than 1 person and is given a value of 5.
2. Fatal is an accident that causes a single death given a value of 4.
3. Serious Injury is an accident that causes serious injury or illness for a long time unable to work so that you are rushed to the hospital or cause permanent disability, which is given a score of 3.
4. Minor injuries are near-miss events that do not result in disability and only minor injuries are given a score of 2.
5. Near Injury is a near miss event that does not result in injury or does not require medical treatment given a value of 1.

C. Risk Matrix

Then perform calculations on the Risk Matrix table to find out the level of risk in these activities. Risk measurement to analyze and evaluate hazards. measurement is carried out by identifying how severe and when the hazard is likely to be. In other words, risk assessment is an in-depth look to determine situations, processes and other hazardous activities or hazards in the workplace. Risks are presented in a variety of ways to communicate the distribution of risk across areas of the workplace. The results of the risk

assessment presented in the risk matrix are very important for making decisions about risk control. Risk can be calculated using the following formula:

$$Risk\ Level\ (R) = Likelihood\ (L) \times Impact\ (C)$$

3. Risk Control

That is, implementing the control that has been selected and fulfilling all the provisions that have been set by means of a control hierarchy. The stages of preparing Risk Control are carried out after getting the level of risk (level of risk), then the control efforts are arranged based on risk. Risk control is a stage hierarchy used in prevention and risk control that may occur (Tarwaka, 2017)

RESULTS AND DISCUSSION

The results of the risk assessment using the HIRARC method can be seen in table 1 below:

Table 1. Risk Assessment

RISK ASSESSMENT					
No	Hazards Identified	Risk Assessment		Risk Value L x C	Risk Level
		Possible	Consequences		
1 (Puddle of water on the basement stairs/ ground floor)	Fall	2	2	4	MEDIUM
	Slip	3	2	6	MEDIUM
	Bump	2	3	6	MEDIUM
2 (1st Floor: Cutting activity with Grinding machine)	Bounced	3	3	9	HIGH
	Scratched grinding machine	3	3	9	HIGH
	Noise	4	2	8	HIGH
3 (2nd Floor: Scattered building materials)	Hit by nails	3	3	9	HIGH
	Stumble	4	2	8	HIGH
4 (3rd Floor : Activities at height still use wooden scaffolding)	Fall	4	3	12	HIGH
	Hit by nails	3	3	9	HIGH
	Dropping work tools	4	2	8	HIGH
5 (4th Floor: There are holes from the construction)	Fell into the hole	3	2	6	MEDIUM
	Fall	3	2	6	MEDIUM
	Dropping things	3	2	6	MEDIUM
6 (5th Floor : Workers throw unused building materials)	Hit by a throw	2	2	4	MEDIUM
	Dusty	4	2	8	HIGH
7 (6th Floor : Floor Uncut iron from construction)	Stabbed	3	4	12	HIGH
8 (7th Floor : Improper placement of building materials)	Struck by raw material	3	5	15	URGENT
9 (Evacuation Stairs on floors 1-7)	Fall	3	3	9	HIGH
	Bump	3	3	9	HIGH
10 (No first aid kit)	Unable to perform first aid	3	4	12	HIGH

11 (Not using personal protective equipment)	Object fall Exposed to iron/ building materials	4	5	20	URGENT
		4	4	16	URGENT

Source: Data Processing

From the results of the risk assessment in table 1 above, then the hazard identification is carried out in each activity to determine the potential hazard and then analyzed and then determined how to control it. The result is as follows:

1. *Activity 1 (Puddle of water on the basement stairs/ground floor):*

The first potential hazard in puddles on the basement stairs can cause workers to "fall" due to the presence of moss in the puddles as a result of water deposition that is too long and not exposed to sunlight. The second potential hazard is "slipping", one of which is caused by some workers not wearing safety shoes, so they can slip when they go straight through puddles of water.

The third potential hazard can be "colliding" with objects around due to the absence of lighting so workers cannot clearly see what objects are around the basement stairs. To control these three potential hazards, immediately remove the water and then make a temporary water flow/channel so that when it rains it does not stagnate and does not pose a potential hazard.

2. *Activity 2 (1st Floor: Cutting activity with Grinding machine):*

The first potential hazard in activities that use a grinding machine is being "bounced" from the cutting iron due to the absence of a guard on the grinding machine so that when cutting the pieces can bounce off towards the workers. The second potential hazard is "scratch" the grinding machine if the worker is not focused or in an unhealthy condition can be hit by the grinding wheel (cutting iron) because the rotating power of the machine is quite large and requires high focus. The third potential danger is that workers can experience permanent "deafness" due to noise from activities using a grinding machine due to the closed condition of the room on the ground floor (basement) and workers do not wear ear plugs. In order to control the first and second potential hazards, it is necessary to install protective equipment on the grinding machine, and to control the third potential hazard is to ensure that all workers use earplugs obediently.

3. *Activity 3 (2nd Floor: Scattered building materials):*

The first potential hazard in work activities on the second floor is "taken nails" from

building materials scattered on the access road. The first way to control this potential hazard is to make SOPs about the problem and install warning signs on the main floor.

The second potential hazard is that workers can "stumble" because the scattered building materials block the worker's access road to the 3rd floor. The second way to control this potential hazard is to tidy up the building materials before carrying out further activities so as not to disturb them.

4. *Activity 4 (3rd Floor : Activities at height still use wooden scaffolding):*

The first potential hazard in work activities on the 3rd floor is "falling" of workers at a height due to the use of wooden scaffolding that is not strong because the manufacture of this wooden scaffold uses used wood.

The second potential hazard is that the "nails" from the scaffold made of used wood can still be seen with nails coming out of the wooden scaffolding which could cause workers to hit the nails. The third potential hazard is that workers "drop work tools" so that nearby workers are hit by the falling object due to the absence of a barrier on the wooden scaffolding base that is useful as a barrier to objects placed on the scaffolding floor. To control these three potential hazards by replacing wooden scaffolding with iron scaffolding in accordance with safety standards and always using personnel protective equipment (PPE).

5. *Activity 5 (4th Floor: There are holes from the construction):*

The first potential danger in working activities on the first 4th floor is that workers "fall" due to the holes from the construction which are only covered by thin fiber material and are not given warning signs. The second potential hazard is workers "falling over" due to lack of attention to road access on the 4th floor. The third potential hazard is that workers can "drop the workpiece" because there are parts of the holes that are not tightly closed so that objects can fall through the cracks of the holes and have an impact on workers who are below. To control the three potential hazards, make sure the manhole cover is completely covered or use an iron plate

6. *Activity 6 (5th Floor : Workers throw unused building materials):*

The first potential hazard in work activities on the 5th floor is "throwing" due to workers not paying attention to safety so that workers throwing unused building materials can hit other workers. To control

this first potential hazard, install warning signs about raw materials that are no longer used. The second potential hazard is "respiratory disorders" because the dust generated by workers often throws unused building materials so that dust can fly and be easily inhaled. To control the second potential hazard by placing used building materials carefully.

7. *Activity 7 (6th Floor : Floor Uncut iron from construction):*

The first potential hazard in work activities on the 6th floor workers can be punctured by the iron that is below because of the worker's lack of attention to safety so that the iron from the construction has not been cut. The potential danger of further tripping is due to the uncut iron from the construction and the absence of warning signs in the area, so the possibility is quite high. In order to control these potential hazards, the uncut iron must be cut/removed immediately so that the potential hazards are also lost.

8. *Activity 8 (7th Floor : Improper placement of building materials):*

The potential hazard in work activities on the 7th floor is "stripped by raw materials" due to the inappropriate placement of materials and the condition is right in front of the elevator aisle which is only limited to polynet while the building material is higher than polynet so that it has an impact on the workers below. To control these potential hazards, signs must be installed regarding the placement of raw materials and the raw materials are immediately transferred to the safest place.

9. *Activity 9 (Evacuation Stairs on floors 1-7):*

The potential danger from work activities from floors 1 to 7 is on the evacuation route (emergency stairs), the first is the potential for workers to "fall" on the emergency stairs due to the absence of railings as a handrail when climbing stairs while the emergency stairs are the main access to go up or down. to the next floor. To control it, immediately install railings on each staircase. The second is that workers can "hit" when they fall due to not being able to support their body weight when using the railing as a holding tool on the ladder. The way to control it is to make sure workers always use PPE when working.

10. *Activity 10 (No first aid kit):*

The next potential hazard in the workplace is the absence of a first aid kit in the workplace so that the impact is that workers cannot perform first aid on other workers who are experiencing minor accidents. The way to control this potential

hazard is to immediately provide a first aid kit that is placed in an area that is easy to see and reach and put up signs regarding the presence of a first aid kit.

11. *Activity 11 (Not using personal protective equipment):*

The potential hazard in the work environment is the lack of self-awareness about the importance of using PPE in this activity, workers are seen not using safety shoes and helmets, while their activities have high potential hazards, for example falling building materials. To control it, it is necessary to install warning signs about the importance of using PPE and the company is obliged to provide complete PPE which is maintained at all times.

Tiwari, etal (2021) conclude that HIRAC provides a little advantage over the conventional HIRA approach by including the criteria specific control measures providing a holistic and comprehensive approach to safer and healthier working.

In this study using the HIRAC approach, it was found that the results of the risk assessment as listed in table 1 above, it can be seen that there are 24 types of potential hazards in 11 identified work activities and of the 24 potential hazards there are 3 potential hazards with a risk level of "Urgent" (12.5%), 14 potential hazards with a risk level of "High" (58.3%) and 7 potential hazards with a risk level of "Medium" (29.2%), meaning that the level of risk that can become a potential hazard on the project is very high and most of them require urgent attention. attention (category "Urgent" and "High" = 70.8%). In general the hazard risk category "Low" must be carried out with Routine actions, "Medium" with Special Attention measures, "High" with Serious Caution measures and "Urgent" with Immediate actions. By categorizing the potential hazards based on the existing hazard risk categories, it is necessary to take action to be used as control by using a Control Hierarchy based on the hazard risk category.

From the results of the identification of HIRARC on 11 work activities which show there are 24 potential hazards that may occur in each activity, namely on activities from floors 1 to 7 where the potential hazards that may occur are caused by human factors (workers do not carry out activities properly such as throwing unused materials, not using PPE, etc.), safety facilities (railing, PPE, first aid kit) and the work environment (puddles, building materials, etc.). Of the 24 potential hazards, the factors causing the potential hazards have been analyzed and how to control them to eliminate or at least reduce potential hazards that may occur. However, a more in-depth study of the 24 potential hazards is needed in order to identify the root of the problem.

Hazards must be controlled at the source (where the problem occurs). The closer the control to the source of the hazard is, the better. This method is

often referred to as applying engineering control. If this does not work, the hazard can often be controlled all the way to the worker, between source and worker. This method can be referred to as applying administrative controls. If this is not possible, the hazard should be controlled at the worker level through the use of personal protective equipment (PPE), although this is the least desirable control.

Hazard control is an effort in risk management to produce a safe, healthy and safe condition in the work environment. The benefits of risk management are ensuring business continuity by reducing the risk of any hazardous activity, reducing costs for handling unwanted events, creating a sense of security among shareholders regarding the sustainability and safety of their investments, increasing understanding and awareness of operational risks for each element in the organization/company, and meet the requirements of the applicable laws environment (Darwis, et al, 2021).

Choosing a potential hazard control method can be done by:

1. Evaluate and select short-term and long-term controls
2. Implement short-term measures to protect workers until permanent controls can be placed
3. Implement long-term controls where reasonably practicable. For example, suppose a noise hazard is identified. Short-term control may require workers to wear hearing protection.

Long term, permanent control may remove or isolate the noise source.

Proper management of continuously identified hazards in the workplace can be carried out through an effective process. Ultimately, the individual or team identifying the hazard must ensure proper communication of the hazard to the appropriate workplace authority (project manager, department head, or designated person). Every HIRARC must be fully documented.

A special department/section responsible for hazards and controls is required to maintain all assessment records for a minimum of 3 years. This special section is more appropriate for every project/work carried out by the company because construction projects have their own unique characteristics depending on the type of work, location and other matters related to the project/work. In some cases, requirements under company management policy will specify a minimum time to keep records) which ensures there is an appropriate authority responsible for ensuring that effective and timely controls are in place for the hazard and communicating the results back to the originator. The manager or employer must support and approve the HIRARC results. Company management must communicate all HIRARC to employees, monitor follow-up and keep records.

Accuracy in risk management can affect overall HSE management which must later be described in the company's HSE program plan. Good management of the HSE program starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company. Good management of HSE programs starting from planning, structuring and implementing them will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

From the results of this study, it can be seen that companies engaged in construction work must have an Occupational Health and Safety Management System. The part of the overall management system includes organizational structure, planning, responsibilities, implementation, procedures, processes and resources needed for the development of implementation, achievement, review and maintenance of occupational safety and health policies in order to create a safe, secure, efficient workplace. and productive.

The success of the Occupational Health and Safety Management System program in construction projects cannot be separated from the role of various parties who are involved, interact and work together. This should be a major consideration in the implementation of construction project development carried out by the project team and all management from various parties involved in it. Each party has a shared responsibility that supports each other for the successful implementation of a construction project which is marked by a positive evaluation of the implementation of the occupational safety and health program.

Kabul (2020) states that good HSE management starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

HSE is one of the functions of Human Resource Management. HSE requires commitment from top management and in its implementation requires a special program that includes hazard identification, risk control and assessment, information and data storage and training. In addition, HSE also requires active participation from all elements of the organization in order to build a safety culture as the main pillar of HSE. At the heart of HSE management is an organizational commitment to a comprehensive HSE effort. This effort must be coordinated from top management to include all members of the organization and must also be reflected in managerial actions. Kabul, (2020) explicitly states that the HSE management system is part of the overall management which includes organizational structure, planning, responsibilities, implementation, procedures, processes, and other resources needed for

development, implementation, achievement, assessment and maintenance. K3 policy in the context of controlling risks related to work activities in order to create a safe, efficient, and productive workplace.

In relation to HSE in construction projects, of course, the management of human resources in the construction sector also has a very important role like other fields. work. Moreover, earlier in the introduction it was stated that the construction sector is a field of work that is very risky to potential hazards in the workplace.

The presence of HSE experts, work procedures related to HSE, strict enforcement of rules and workers trained in HSE will ultimately shape a culture of safety and health in the workplace. With the development of a culture of safety and health in a company, it will have an impact on the company's overall performance.

CONCLUSION

The conclusions of this study are as follows:

1. The OSH program implemented by the company is carried out through the QHSE Department, which twice a week, a representative from the QHSE Department comes to the project site to carry out routine inspections in the first week related to OHS from the work by conducting routine inspections. And the results of this inspection will be brought into discussion at the Implementation meeting which is held every Friday. The QHSE department will discuss the activities or objects that have the potential to have risks in order to obtain repair or control solutions so that these risks can be reduced or eliminated.
2. Identifying the dangers of using the HIRARC method in construction projects is by looking at the potentials that will cause hazards that lead to accidents, such as iron cutting activities using unprotected grinding machines, activities at heights using non-standard K3 scaffolding, workers throwing building materials, placement of building materials that are not appropriate and activities of lifting raw materials using Tower Crane with workers who do not use PPE. Of these potential hazards, there are some that have the highest impact, namely Extreme which leads to the accident of more than one person. So from the results of this identification, researchers can do calculations with the Risk Matrix which will later show the level of risk in the potential hazard.
3. In carrying out a risk management must include planning, hazard identification, risk assessment, and risk control. From the results of observations about the possible risk of accidents using the HIRARC method above, the company must create and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by

removing water in the basement, grinding protective pairs, using ear plugs, making SOPs, use standard K3 scaffolding, install manhole covers, install warning signs, cut metal that comes out of the floor, use PPE, and provide a first aid kit. After that, the next step is to communicate and consult with all relevant parties with a focus on how workers recognize this hazard, the risks, what they are facing and how to overcome them..

Based on the results of the research that has been done, the researchers would like to provide some suggestions for the company as follows:

1. The company as the owner of the building must immediately employ HSE experts on each project so that the company's QHSE Department only accepts reports and proposals which will later be used as SOPs in the next construction project.
2. It is necessary to carry out Safety Induction, Fire and Earthquake Simulations at least once a month in order to always remind workers of the importance of Occupational Safety Health Environment is a shared task.
3. The company, in this case the QHSE team, must conduct socialization on routine work safety rules so that workers also understand HSE and know what dangers or sanctions will be received by workers and the company.
4. The company must further equip sufficient PPE and adapt it to its work as a form of responsibility as the organizer of this construction project
5. Companies need to give rewards or sanctions so that workers in carrying out their actions are better or more careful and get the results of their actions.

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HIRARC METHOD APPROACH (HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL) AS ANALYSIS TOOLS IN FORMING OCCUPATIONAL SAFETY AND HEALTH CULTURE (CASE ON CONSTRUCTION PROJECTS)

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ABSTRACT

The purpose of this study is to observe and analyze the potential hazards that can cause accidents in the activity of lifting building materials using Tower Crane on a construction project. The method used in this research is Hazard Identification, Risk Assessment and Risk Control (HIRARC). By using this method, it is hoped that it can reduce the number of accidents that occur, find out the causes of accidents, and establish control measures. The results of the study indicate that there are 11 risks in activities that have the potential to cause accidents. Where 2 risks have an "Extreme" level of danger, namely an accident with more than one person and the status is "Urgent" so that it needs immediate treatment, 4 risks are classified as "High" which need serious attention and 2 risks are "Medium" which requires special attention. The conclusion of the research is that companies must establish and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using earplugs, making SOPs, using scaffolding, installing covers on holes, put up warning signs, cut metal out of the floor, used personnel protective equipment (PPE), and provided a first aid kit. It is recommended that the company immediately recruit HSE experts on each project so that the company's Quality Health Safety Environment (QHSE) Department only receives reports and proposals which will later be used as SOPs for the next construction project.

Key words: Hazard, Risk, Accident, HIRARC, HSE

PENDEKATAN METODE HIRARC (HAZARD IDENTIFICATION, RISK ASSESSMENT DAN RISK CONTROL) SEBAGAI ALAT ANALISIS DALAM MEMBENTUK BUDAYA KESELAMATAN DAN KESEHATAN KERJA (KASUS PADA PROYEK KONSTRUKSI)

ABSTRAK

Tujuan dari penelitian ini adalah untuk mengamati dan menganalisis potensi bahaya yang dapat menyebabkan terjadinya kecelakaan pada aktivitas pengangkatan material bangunan menggunakan *Tower Crane* pada suatu proyek konstruksi. Metode yang digunakan dalam penelitian ini adalah *Hazard Identification, Risk Assessment and Risk Control (HIRARC)*. Dengan menggunakan metode ini diharapkan dapat menekan angka kecelakaan yang terjadi, mengetahui penyebab kecelakaan, dan menetapkan tindakan pengendalian. Hasil penelitian menunjukkan bahwa terdapat 11 risiko pada aktivitas yang berpotensi terjadinya kecelakaan. Dimana 2 risiko memiliki tingkat bahaya "Extreme" yaitu kecelakaan lebih dari satu orang dan berstatus "Urgent" sehingga perlu penanganan segera, 4 risiko tergolong "High" yang perlu mendapat perhatian serius dan 2 risiko berstatus "Medium" yang memerlukan perhatian khusus. Kesimpulan penelitian adalah perusahaan harus membuat dan memelihara prosedur untuk melakukan identifikasi bahaya, penilaian risiko, dan pengendalian risiko sesuai kebutuhan dengan cara membuang air di basement, menggiling pasangan pelindung, menggunakan penyumbat telinga, membuat SOP, menggunakan perancah, memasang penutup lubang, memasang tanda peringatan, memotong logam yang keluar dari lantai, menggunakan Alat Pelindung Diri (APD), dan menyediakan kotak P3K. Disarankan agar perusahaan segera merekrut tenaga ahli K3 pada setiap proyek sehingga Departemen *Quality Health Safety Environment (QHSE)* perusahaan hanya menerima laporan dan proposal yang nantinya akan digunakan sebagai SOP pada proyek konstruksi selanjutnya.

Kata kunci: Bahaya, Risiko, Kecelakaan, HIRARC, K3

INTRODUCTION

In 2021, BPJS Employment or BPJamsostek recorded around 65.89 percent of work accident cases claimed by participants, occurred at work locations. The first sequence of work accidents is in the work location, and most occur in the morning. A total of 65.89 percent of work accidents occur in the work location, then 25.77 percent of accidents in traffic, and only 8.33 percent outside the work location.

OSH is Occupational Safety and Health with the understanding of providing protection to everyone in the workplace, which is related to the transfer of raw materials, use of construction work equipment, production processes and the environment around the workplace. Construction activities are an important element in development which in carrying out these construction activities cause various unwanted impacts, including those concerning aspects of occupational safety and health.

Purohit, et al (2018) states that construction is a high hazard industry that comprises a wide range of

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activities involving construction, alteration or repair. Examples include residential construction, bridge erection, excavations, demolitions and large scale painting jobs. Hazard identification and risk analysis is carried for identification of undesirable events that can lead to a hazard. The analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects.

Therefore, research on the identification of potential hazards is still a very interesting study, especially if it is extended to the full management of HSE.

The research was conducted at one of the largest state-owned companies in the construction sector where the construction sector is one area that has the potential to cause work accidents and the potential for accidents is high in the activity of lifting building materials using Tower Cranes on construction projects. Because this process determines the speed of construction of a construction project and often time is running out to complete the apartment, it puts the operator under pressure, which results in miscommunication to the workers below to bind the building materials to be brought up. So that the fastening is not tight because in a hurry there is a potential hazard that has an impact on workers who are in the Tower Crane activity area.

So to protect workers in doing their jobs, companies need to implement an integrated Occupational Health and Safety (OHS) Management System program aimed at reducing and preventing the possibility of accidents and occupational diseases. The construction sector is one sector that has a high potential for danger and a lot of work accidents occur in this sector. Health, Safety and Environment (HSE) is very important for employees and companies in order to achieve a high and optimal level of work productivity. The research was conducted with a qualitative descriptive approach. The data used in the study were obtained from the results of worker interviews. After the data was obtained, data analysis was carried out using the HIRARC method. Based on the background of the HSE problem above, the formulation of the problem in this study is as follows:

1. Knowing the HSE program that has been implemented by the company
2. How to identify and analyze occupational accident hazards using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method.
3. How to do good risk management to achieve Zero Accident in construction projects.

METHOD

HIRARC performed on all activities to determine activities which contain potential hazards and have a serious impact on occupational safety and health (Indragiri & Yuttya, 2020)

This study uses the Hazard Identification Risk Assessment and Risk Control (HIRARC) approach,

which is a method to prevent or minimize work accidents. HIRARC is a method that starts from determining the type of work activity which then identifies the source of the hazard so that the risk is obtained.

HIRARC is a process of identifying hazards (Hazard Identification) that can occur in all company activities, then conducting a risk assessment (Risk Assessment) of the hazards that occur, then making hazard control (Risk Control) in order to minimize high risk levels to low (Sitepu & Simanungkalit, 2020).

This whole process is also called management risk (risk management). HIRARC is a key element in the system occupational safety and health management which is directly related to prevention and control of hazards. Besides, HIRARC too is part of the risk management system (risk management). according to OHSAS 18001, HIRARC should be carried out in all organizational activities to determine organizational activities that contain potential hazards and have a serious impact on occupational safety and health.

Furthermore, the results of HIRARC become input for the preparation of objectives and HSE targets to be achieved, which are outlined in the work program. From the groove in below it can be seen that HIRARC is the starting point for OHS management. If HIRARC is not carried out properly then the application of HSE will be in the wrong direction (misguided), random or virtual because they are not able to handle the main issue at hand within the organization.

The HIRARC method follows the following steps:

1. Hazard Identification :

Hazard identification is the process of identifying all hazards in the workplace. There is no set method for grouping agricultural injury and illness hazard (Chauhan & Siddiqui, 2018).

Hazard identification can be done through the following steps:

- a) Make a list of all objects of machines, work equipment, materials, work processes, work systems, working conditions that exist in the workplace.
- b) Check all objects in the workplace and its surroundings.
- c) Conduct interviews with workers who work in the workplace related to these objects.
- d) Accident review, first aid records and other information.
- e) Record all identified hazards.

2. Risk Assessment :

Risk assessment involves determining the impact level and recurrence of risk using available information. Moreover, in the risk analysis process, different factors, such as effects of recognized risks on project objectives, manageability, timing, the probability of occurrence, and relationship to other risks, must be considered. All these factors provide a better

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understanding of each risk type and increase the capacity for adoption of an adequate and appropriate approach to mitigating such risks (Jaber, 2019)

Risk is the possibility of an accident or loss in a certain period of time or a certain operating cycle. The level of risk is the multiplication between the level of frequency (Likelihood) and the severity (consequence) of an event that can cause losses. At this risk assessment stage, the assessment follows:

A. Frequency Level (Likelihood)

That is how often workers are exposed to potential hazards. To be able to make the best estimate, we must consider the following:

1. Often the value is 5, the probability of exposure is between 90-100%.
2. Often the score is 4, the probability of exposure is between 60-89%.
3. While the score is 3, the probability of exposure is between 40-39%.
4. Rarely the value is 2, the probability of exposure is between 10-39%
5. Rarely the value is 1, the probability of exposure is between <10%.

B. Severity Level (Concequence)

The level of impact (consequence or severity) of an accident or illness can be categorized into 5 (five) categories as follows:

1. Extreme is an accident that causes the death of more than 1 person and is given a value of 5.
2. Fatal is an accident that causes a single death given a value of 4.
3. Serious Injury is an accident that causes serious injury or illness for a long time unable to work so that you are rushed to the hospital or cause permanent disability, which is given a score of 3.
4. Minor injuries are near-miss events that do not result in disability and only minor injuries are given a score of 2.
5. Near Injury is a near miss event that does not result in injury or does not require medical treatment given a value of 1.

C. Risk Matrix

Then perform calculations on the Risk Matrix table to find out the level of risk in these activities. Risk measurement to analyze and evaluate hazards. measurement is carried out by identifying how severe and when the hazard is likely to be. In other words, risk assessment is an in-depth look to determine situations, processes and other hazardous activities or hazards in the workplace. Risks are presented in a variety of ways to communicate the

distribution of risk across areas of the workplace. The results of the risk assessment presented in the risk matrix are very important for making decisions about risk control. Risk can be calculated using the following formula:

$$Risk\ Level\ (R) = Likelihood\ (L) \times Impact\ (C)$$

3. Risk Control

That is, implementing the control that has been selected and fulfilling all the provisions that have been set by means of a control hierarchy. The stages of preparing Risk Control are carried out after getting the level of risk (level of risk), then the control efforts are arranged based on risk. Risk control is a stage hierarchy used in prevention and risk control that may occur (Tarwaka, 2017)

RESULTS AND DISCUSSION

The results of the risk assessment using the HIRARC method can be seen in table 1 below:

Table 1. Risk Assessment

No	Hazards Identified	Risk Assessment		Risk Value L x C	Risk Level
		Possible	Consequences		
1 (Puddle of water on the basement stairs/ ground floor)	Fall	2	2	4	MEDIUM
	Slip	3	2	6	MEDIUM
	Bump	2	3	6	MEDIUM
2 (1st Floor: Cutting activity with Grinding machine)	Bounced	3	3	9	HIGH
	Scratched grinding machine	3	3	9	HIGH
3 (2nd Floor: Scattered building materials)	Noise	4	2	8	HIGH
	Hit by nails	3	3	9	HIGH
4 (3rd Floor : Activities at height still use wooden scaffolding)	Stumble	4	2	8	HIGH
	Fall	4	3	12	HIGH
5 (4th Floor: There are holes from the construction)	Hit by nails	3	3	9	HIGH
	Dropping work tools	4	2	8	HIGH
	Fell into the hole	3	2	6	MEDIUM
6 (5th Floor : Workers throw unused building materials)	Fall	3	2	6	MEDIUM
	Dropping things	3	2	6	MEDIUM
	Hit by a throw	2	2	4	MEDIUM
7 (6th Floor : Floor Uncut iron from construction)	Dusty	4	2	8	HIGH
	Stabbed	3	4	12	HIGH
8 (7th Floor : Improper placement of building materials)	Struck by raw material	3	5	15	URGENT
9 (Evacuation Stairs on floors 1-7)	Fall	3	3	9	HIGH
	Bump	3	3	9	HIGH

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10 (No first aid kit)	Unable to perform first aid	3	4	12	HIGH
11 (Not using personal protective equipment)	Object fall	4	5	20	URGENT
	Exposed to iron/building materials	4	4	16	URGENT

Source: Data Processing

From the results of the risk assessment in table 1 above, then the hazard identification is carried out in each activity to determine the potential hazard and then analyzed and then determined how to control it. The result is as follows:

1. *Activity 1 (Puddle of water on the basement stairs/ground floor):*

The first potential hazard in puddles on the basement stairs can cause workers to "fall" due to the presence of moss in the puddles as a result of water deposition that is too long and not exposed to sunlight. The second potential hazard is "slipping", one of which is caused by some workers not wearing safety shoes, so they can slip when they go straight through puddles of water. The third potential hazard can be "colliding" with objects around due to the absence of lighting so workers cannot clearly see what objects are around the basement stairs. To control these three potential hazards, immediately remove the water and then make a temporary water flow/channel so that when it rains it does not stagnate and does not pose a potential hazard.

2. *Activity 2 (1st Floor: Cutting activity with Grinding machine):*

The first potential hazard in activities that use a grinding machine is being "bounced" from the cutting iron due to the absence of a guard on the grinding machine so that when cutting the pieces can bounce off towards the workers. The second potential hazard is "scratch" the grinding machine if the worker is not focused or in an unhealthy condition can be hit by the grinding wheel (cutting iron) because the rotating power of the machine is quite large and requires high focus. The third potential danger is that workers can experience permanent "deafness" due to noise from activities using a grinding machine due to the closed condition of the room on the ground floor (basement) and workers do not wear ear plugs. In order to control the first and second potential hazards, it is necessary to install protective equipment on the grinding machine, and to control the third potential hazard is to ensure that all workers use earplugs obediently.

3. *Activity 3 (2nd Floor: Scattered building materials):*

The first potential hazard in work activities on the second floor is "taken nails" from

building materials scattered on the access road. The first way to control this potential hazard is to make SOPs about the problem and install warning signs on the main floor. The second potential hazard is that workers can "stumble" because the scattered building materials block the worker's access road to the 3rd floor. The second way to control this potential hazard is to tidy up the building materials before carrying out further activities so as not to disturb them.

4. *Activity 4 (3rd Floor : Activities at height still use wooden scaffolding):*

The first potential hazard in work activities on the 3rd floor is "falling" of workers at a height due to the use of wooden scaffolding that is not strong because the manufacture of this wooden scaffold uses used wood. The second potential hazard is that the "nails" from the scaffold made of used wood can still be seen with nails coming out of the wooden scaffolding which could cause workers to hit the nails. The third potential hazard is that workers "drop work tools" so that nearby workers are hit by the falling object due to the absence of a barrier on the wooden scaffolding base that is useful as a barrier to objects placed on the scaffolding floor. To control these three potential hazards by replacing wooden scaffolding with iron scaffolding in accordance with safety standards and always using personnel protective equipment (PPE).

5. *Activity 5 (4th Floor: There are holes from the construction):*

The first potential danger in working activities on the first 4th floor is that workers "fall" due to the holes from the construction which are only covered by thin fiber material and are not given warning signs. The second potential hazard is workers "falling over" due to lack of attention to road access on the 4th floor. The third potential hazard is that workers can "drop the workpiece" because there are parts of the holes that are not tightly closed so that objects can fall through the cracks of the holes and have an impact on workers who are below. To control the three potential hazards, make sure the manhole cover is completely covered or use an iron plate

6. *Activity 6 (5th Floor : Workers throw unused building materials):*

The first potential hazard in work activities on the 5th floor is "throwing" due to workers not paying attention to safety so that workers throwing unused building materials can hit other workers. To control this first potential hazard, install warning signs about raw materials that are no longer

used. The second potential hazard is "respiratory disorders" because the dust generated by workers often throws unused building materials so that dust can fly and be easily inhaled. To control the second potential hazard by placing used building materials carefully.

7. *Activity 7 (6th Floor : Floor Uncut iron from construction):*

The first potential hazard in work activities on the 6th floor workers can be punctured by the iron that is below because of the worker's lack of attention to safety so that the iron from the construction has not been cut. The potential danger of further tripping is due to the uncut iron from the construction and the absence of warning signs in the area, so the possibility is quite high. In order to control these potential hazards, the uncut iron must be cut/removed immediately so that the potential hazards are also lost.

8. *Activity 8 (7th Floor : Improper placement of building materials):*

The potential hazard in work activities on the 7th floor is "stripped by raw materials" due to the inappropriate placement of materials and the condition is right in front of the elevator aisle which is only limited to polynet while the building material is higher than polynet so that it has an impact on the workers below. To control these potential hazards, signs must be installed regarding the placement of raw materials and the raw materials are immediately transferred to the safest place.

9. *Activity 9 (Evacuation Stairs on floors 1–7):*

The potential danger from work activities from floors 1 to 7 is on the evacuation route (emergency stairs), the first is the potential for workers to "fall" on the emergency stairs due to the absence of railings as a handrail when climbing stairs while the emergency stairs are the main access to go up or down. to the next floor. To control it, immediately install railings on each staircase. The second is that workers can "hit" when they fall due to not being able to support their body weight when using the railing as a holding tool on the ladder. The way to control it is to make sure workers always use PPE when working.

10. *Activity 10 (No first aid kit):*

The next potential hazard in the workplace is the absence of a first aid kit in the workplace so that the impact is that workers cannot perform first aid on other workers who are experiencing minor accidents. The way to control this potential hazard is to immediately provide a first aid kit that is placed in an area that is easy to see and

reach and put up signs regarding the presence of a first aid kit.

11. *Activity 11 (Not using personal protective equipment):*

The potential hazard in the work environment is the lack of self-awareness about the importance of using PPE in this activity, workers are seen not using safety shoes and helmets, while their activities have high potential hazards, for example falling building materials. To control it, it is necessary to install warning signs about the importance of using PPE and the company is obliged to provide complete PPE which is maintained at all times.

Tiwari, etal (2021) conclude that HIRAC provides a little advantage over the conventional HIRA approach by including the criteria specific control measures providing a holistic and comprehensive approach to safer and healthier working.

In this study using the HIRAC approach, it was found that the results of the risk assessment as listed in table 1 above, it can be seen that there are 24 types of potential hazards in 11 identified work activities and of the 24 potential hazards there are 3 potential hazards with a risk level of "Urgent" (12.5%), 14 potential hazards with a risk level of "High" (58.3%) and 7 potential hazards with a risk level of "Medium" (29.2%), meaning that the level of risk that can become a potential hazard on the project is very high and most of them require urgent attention. attention (category "Urgent" and "High" = 70.8%). In general the hazard risk category "Low" must be carried out with Routine actions, "Medium" with Special Attention measures, "High" with Serious Caution measures and "Urgent" with Immediate actions. By categorizing the potential hazards based on the existing hazard risk categories, it is necessary to take action to be used as control by using a Control Hierarchy based on the hazard risk category.

From the results of the identification of HIRARC on 11 work activities which show there are 24 potential hazards that may occur in each activity, namely on activities from floors 1 to 7 where the potential hazards that may occur are caused by human factors (workers do not carry out activities properly such as throwing unused materials, not using PPE, etc.), safety facilities (railing, PPE, first aid kit) and the work environment (puddles, building materials, etc.). Of the 24 potential hazards, the factors causing the potential hazards have been analyzed and how to control them to eliminate or at least reduce potential hazards that may occur. However, a more in-depth study of the 24 potential hazards is needed in order to identify the root of the problem.

Hazards must be controlled at the source (where the problem occurs). The closer the control to the source of the hazard is, the better. This method is often referred to as applying engineering control. If this does not work, the hazard can often be controlled all the way to the worker, between source and

worker. This method can be referred to as applying administrative controls. If this is not possible, the hazard should be controlled at the worker level through the use of personal protective equipment (PPE), although this is the least desirable control.

Hazard control is an effort in risk management to produce a safe, healthy and safe condition in the work environment. The benefits of risk management are ensuring business continuity by reducing the risk of any hazardous activity, reducing costs for handling unwanted events, creating a sense of security among shareholders regarding the sustainability and safety of their investments, increasing understanding and awareness of operational risks for each element in the organization/company, and meet the requirements of the applicable laws environment (Darwis, et al, 2021).

Choosing a potential hazard control method can be done by:

1. Evaluate and select short-term and long-term controls
2. Implement short-term measures to protect workers until permanent controls can be placed
3. Implement long-term controls where reasonably practicable. For example, suppose a noise hazard is identified. Short-term control may require workers to wear hearing protection.

Long term, permanent control may remove or isolate the noise source.

Proper management of continuously identified hazards in the workplace can be carried out through an effective process. Ultimately, the individual or team identifying the hazard must ensure proper communication of the hazard to the appropriate workplace authority (project manager, department head, or designated person). Every HIRARC must be fully documented.

A special department/section responsible for hazards and controls is required to maintain all assessment records for a minimum of 3 years. This special section is more appropriate for every project/work carried out by the company because construction projects have their own unique characteristics depending on the type of work, location and other matters related to the project/work. In some cases, requirements under company management policy will specify a minimum time to keep records) which ensures there is an appropriate authority responsible for ensuring that effective and timely controls are in place for the hazard and communicating the results back to the originator. The manager or employer must support and approve the HIRARC results. Company management must communicate all HIRARC to employees, monitor follow-up and keep records.

Accuracy in risk management can affect overall HSE management which must later be described in the company's HSE program plan. Good management of the HSE program starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety

culture in the company. Good management of HSE programs starting from planning, structuring and implementing them will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

From the results of this study, it can be seen that companies engaged in construction work must have an Occupational Health and Safety Management System. The part of the overall management system includes organizational structure, planning, responsibilities, implementation, procedures, processes and resources needed for the development of implementation, achievement, review and maintenance of occupational safety and health policies in order to create a safe, secure, efficient workplace. and productive.

The success of the Occupational Health and Safety Management System program in construction projects cannot be separated from the role of various parties who are involved, interact and work together. This should be a major consideration in the implementation of construction project development carried out by the project team and all management from various parties involved in it. Each party has a shared responsibility that supports each other for the successful implementation of a construction project which is marked by a positive evaluation of the implementation of the occupational safety and health program.

Kabul (2020) states that good HSE management starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

HSE is one of the functions of Human Resource Management. HSE requires commitment from top management and in its implementation requires a special program that includes hazard identification, risk control and assessment, information and data storage and training. In addition, HSE also requires active participation from all elements of the organization in order to build a safety culture as the main pillar of HSE. At the heart of HSE management is an organizational commitment to a comprehensive HSE effort. This effort must be coordinated from top management to include all members of the organization and must also be reflected in managerial actions. Kabul, (2020) explicitly states that the HSE management system is part of the overall management which includes organizational structure, planning, responsibilities, implementation, procedures, processes, and other resources needed for development, implementation, achievement, assessment and maintenance. K3 policy in the context of controlling risks related to work activities in order to create a safe, efficient, and productive workplace.

In relation to HSE in construction projects, of course, the management of human resources in the construction sector also has a very important role like other fields. work. Moreover, earlier in the introduction it was stated that the construction sector

is a field of work that is very risky to potential hazards in the workplace.

The presence of HSE experts, work procedures related to HSE, strict enforcement of rules and workers trained in HSE will ultimately shape a culture of safety and health in the workplace. With the development of a culture of safety and health in a company, it will have an impact on the company's overall performance.

CONCLUSION

The conclusions of this study are as follows:

1. The OSH program implemented by the company is carried out through the QHSE Department, which twice a week, a representative from the QHSE Department comes to the project site to carry out routine inspections in the first week related to OHS from the work by conducting routine inspections. And the results of this inspection will be brought into discussion at the Implementation meeting which is held every Friday. The QHSE department will discuss the activities or objects that have the potential to have risks in order to obtain repair or control solutions so that these risks can be reduced or eliminated.
2. Identifying the dangers of using the HIRARC method in construction projects is by looking at the potentials that will cause hazards that lead to accidents, such as iron cutting activities using unprotected grinding machines, activities at heights using non-standard K3 scaffolding, workers throwing building materials, placement of building materials that are not appropriate and activities of lifting raw materials using Tower Crane with workers who do not use PPE. Of these potential hazards, there are some that have the highest impact, namely Extreme which leads to the accident of more than one person. So from the results of this identification, researchers can do calculations with the Risk Matrix which will later show the level of risk in the potential hazard.
3. In carrying out a risk management must include planning, hazard identification, risk assessment, and risk control. From the results of observations about the possible risk of accidents using the HIRARC method above, the company must create and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using ear plugs, making SOPs, use standard K3 scaffolding, install manhole covers, install warning signs, cut metal that comes out of the floor, use PPE, and provide a first aid kit. After that, the next step is to communicate and consult with all relevant parties with a focus on how workers recognize this hazard, the risks, what they are facing and how to overcome them..

Based on the results of the research that has been done, the researchers would like to provide some suggestions for the company as follows:

1. The company as the owner of the building must immediately employ HSE experts on each project so that the company's QHSE Department only accepts reports and proposals which will later be used as SOPs in the next construction project.
2. It is necessary to carry out Safety Induction, Fire and Earthquake Simulations at least once a month in order to always remind workers of the importance of Occupational Safety Health Environment is a shared task.
3. The company, in this case the QHSE team, must conduct socialization on routine work safety rules so that workers also understand HSE and know what dangers or sanctions will be received by workers and the company.
4. The company must further equip sufficient PPE and adapt it to its work as a form of responsibility as the organizer of this construction project
5. Companies need to give rewards or sanctions so that workers in carrying out their actions are better or more careful and get the results of their actions.

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HIRARC METHOD APPROACH (HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL) AS ANALYSIS TOOLS IN FORMING OCCUPATIONAL SAFETY AND HEALTH CULTURE (CASE ON CONSTRUCTION PROJECTS)

ABSTRACT

The purpose of this study is to observe and analyze the potential hazards that can cause accidents in the activity of lifting building materials using Tower Crane on a construction project. The method used in this research is Hazard Identification, Risk Assessment and Risk Control (HIRARC). By using this method, it is hoped that it can reduce the number of accidents that occur, find out the causes of accidents, and establish control measures. The results of the study indicate that there are 11 risks in activities that have the potential to cause accidents. Where 2 risks have an "Extreme" level of danger, namely an accident with more than one person and the status is "Urgent" so that it needs immediate treatment, 4 risks are classified as "High" which need serious attention and 2 risks are "Medium" which requires special attention. The conclusion of the research is that companies must establish and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using earplugs, making SOPs, using scaffolding, installing covers, holes, put up warning signs, cut metal out of the floor, used personnel protective equipment (PPE), and provided a first aid kit. It is recommended that the company immediately recruit HSE experts on each project so that the company's Quality Health Safety Environment (QHSE) Department only receives reports and proposals which will later be used as SOPs for the next construction project..

Key words: Hazard, Risk, Accident, HIRARC, HSE

PENDEKATAN METODE HIRARC (HAZARD IDENTIFICATION, RISK ASSESSMENT DAN RISK CONTROL) SEBAGAI ALAT ANALISIS DALAM MEMBENTUK BUDAYA KESELAMATAN DAN KESEHATAN KERJA (KASUS PADA PROYEK KONSTRUKSI)

ABSTRAK

Tujuan dari penelitian ini adalah untuk mengamati dan menganalisis potensi bahaya yang dapat menyebabkan terjadinya kecelakaan pada aktivitas pengangkatan material bangunan menggunakan Tower Crane pada suatu proyek konstruksi. Metode yang digunakan dalam penelitian ini adalah *Hazard Identification, Risk Assessment and Risk Control (HIRARC)*. Dengan menggunakan metode ini diharapkan dapat menekan angka kecelakaan yang terjadi, mengetahui penyebab kecelakaan, dan menetapkan tindakan pengendalian. Hasil penelitian menunjukkan bahwa terdapat 11 risiko pada aktivitas yang berpotensi terjadinya kecelakaan. Dimana 2 risiko memiliki tingkat bahaya "Extreme" yaitu kecelakaan lebih dari satu orang dan berstatus "Urgent" sehingga memerlukan penanganan segera, 4 risiko tergolong "High" yang perlunya mendapat perhatian serius dan 2 risiko berstatus "Medium" yang memerlukan perhatian khusus. Kesimpulan penelitian adalah perusahaan harus membuat dan memelihara prosedur untuk melakukan identifikasi bahaya, penilaian risiko, dan pengendalian risiko sesuai kebutuhan dengan cara membuang air di basement, menggiling pasangan pelindung, menggunakan penyumbat telinga, membuat SOP, menggunakan perancah, memasang penutup lubang, memasang tanda peringatan, memotong logam yang keluar dari lantai, menggunakan Alat Pelindung Diri (APD), dan menyediakan kotak P3K. Disarankan agar perusahaan segera merekrut tenaga ahli K3 pada setiap proyek sehingga Departemen *Quality Health Safety Environment (QHSE)* perusahaan hanya menerima laporan dan proposal yang nantinya akan digunakan sebagai SOP pada proyek konstruksi selanjutnya..

Kata kunci: Bahaya, Risiko, Kecelakaan, HIRARC, K3

INTRODUCTION

In 2021, BPJS Employment or BPJS Kesehatan recorded around 65.89 percent of work accident cases claimed by participants, occurred at work locations. The first sequence of work accidents is in the work location, and most occur in the morning. A total of 65.89 percent of work accidents occur in the work location, then 25.77 percent of accidents in traffic, and only 8.33 percent outside the work location.

OSH is Occupational Safety and Health with the understanding of providing protection to everyone in the workplace, which is related to the transfer of raw materials, use of construction work equipment,

production processes and the environment around the workplace. Construction activities are an important element in development which in carrying out these construction activities cause various unwanted impacts, including those concerning aspects of occupational safety and health.

Purohit, et al (2018) states that construction is a high hazard industry that comprises a widerange of activities involving construction, alteration or repair. Examples include residential construction, bridge erection, excavations, demolitions and large scale painting jobs. Hazard identification and risk analysis is carried for identification of undesirable events that can leads to a hazard. The analysis

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Identifikasi masalah/pertanyaan penelitian di bawah ini:

1. Knowing the HSE program that has been implemented by the company
2. How to identify and analyze occupational accident hazards using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method.
3. How to do good risk management to achieve Zero Accident in construction projects.

Pada bagian pembahasan belum terjawab sama sekali, meskiun dibagian kesimpulan sudah ada. Kesimpulan tersebut berasal dari penjelasan atau diskusi yang mana?

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of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects.

Therefore, research on the identification of potential hazards is still a very interesting study, especially if it is extended to the full management of HSE.

The research was conducted at one of the largest state-owned companies in the construction sector where the construction sector is one area that has the potential to cause work accidents and the potential for accidents is high in the activity of lifting building materials using Tower Cranes on construction projects. Because this process determines the speed of construction of a construction project and often time is running out to complete the apartment, it puts the operator under pressure, which results in miscommunication to the workers below to bind the building materials to be brought up. So that the fastening is not tight because in a hurry there is a potential hazard that has an impact on workers who are in the Tower Crane activity area.

So to protect workers in doing their jobs, companies need to implement an integrated Occupational Health and Safety (OHS) Management System program aimed at reducing and preventing the possibility of accidents and occupational diseases. The construction sector is one sector that has a high potential for danger and a lot of work accidents occur in this sector. Health, Safety and Environment (HSE) is very important for employees and companies in order to achieve a high and optimal level of work productivity. The research was conducted with a qualitative descriptive approach. The data used in the study were obtained from the results of worker interviews. After the data was obtained, data analysis was carried out using the HIRARC method. Based on the background of the HSE problem above, the formulation of the problem in this study is as follows:

1. Knowing the HSE program that has been implemented by the company
2. How to identify and analyze occupational accident hazards using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method.
3. How to do good risk management to achieve Zero Accident in construction projects.

METHOD

HIRARC performed on all activities to determine activities which contain potential hazards and have a serious impact on occupational safety and health (Indragiri & Yuttya, 2020)

This study uses the Hazard Identification Risk Assessment and Risk Control (HIRARC) approach, which is a method to prevent or minimize work accidents. HIRARC is a method that starts from determining the type of work activity which then

identifies the source of the hazard so that the risk is obtained.

HIRARC is a process of identifying hazards (Hazard Identification) that can occur in all company activities, then conducting a risk assessment (Risk Assessment) of the hazards that occur, then making hazard control (Risk Control) in order to minimize high risk levels to low (Sitepu & Simanungkalit, 2020).

This whole process is also called management risk (risk management). HIRARC is a key element in the system occupational safety and health management which is directly related to prevention and control of hazards. Besides, HIRARC too is part of the risk management system (risk management). according to OHSAS 18001, HIRARC should be carried out in all organizational activities to determine organizational activities that contain potential hazards and have a serious impact on occupational safety and health.

Furthermore, the results of HIRARC become input for the preparation of objectives and HSE targets to be achieved, which are outlined in the work program. From the groove in below it can be seen that HIRARC is the starting point for OHS management. If HIRARC is not carried out properly then the application of HSE will be in the wrong direction (misguided), random or virtual because they are not able to handle the main issue at hand within the organization.

The HIRARC method follows the following steps:

1. Hazard Identification :

Hazard identification is the process of identifying all hazards in the workplace. There is no set method for grouping agricultural injury and illness hazard (Chauhan & Siddiqui, 2018).

Hazard identification can be done through the following steps:

- a) Make a list of all objects of machines, work equipment, materials, work processes, work systems, working conditions that exist in the workplace.
- b) Check all objects in the workplace and its surroundings.
- c) Conduct interviews with workers who work in the workplace related to these objects.
- d) Accident review, first aid records and other information.
- e) Record all identified hazards.

2. Risk Assessment :

Risk assessment involves determining the impact level and recurrence of risk using available information. Moreover, in the risk analysis process, different factors, such as effects of recognized risks on project objectives, manageability, timing, the probability of occurrence, and relationship to other risks, must be considered. All these factors provide a better understanding of each risk type and increase the capacity for adoption of an

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adequate and appropriate approach to mitigating such risks (Jaber, 2019)

Risk is the possibility of an accident or loss in a certain period of time or a certain operating cycle. The level of risk is the multiplication between the level of frequency (Likelihood) and the severity (consequence) of an event that can cause losses. At this risk assessment stage, the assessment follows:

A. Frequency Level (Likelihood)

That is how often workers are exposed to potential hazards. To be able to make the best estimate, we must consider the following:

1. Often the value is 5, the probability of exposure is between 90-100%.
2. Often the score is 4, the probability of exposure is between 60-89%.
3. While the score is 3, the probability of exposure is between 40-39%.
4. Rarely the value is 2, the probability of exposure is between 10-39%.
5. Rarely the value is 1, the probability of exposure is between <10%.

B. Severity Level (Consequence)

The level of impact (consequence or severity) of an accident or illness can be categorized into 5 (five) categories as follows:

1. Extreme is an accident that causes the death of more than 1 person and is given a value of 5.
2. Fatal is an accident that causes a single death given a value of 4.
3. Serious Injury is an accident that causes serious injury or illness for a long time unable to work so that you are rushed to the hospital or cause permanent disability, which is given a score of 3.
4. Minor injuries are near-miss events that do not result in disability and only minor injuries are given a score of 2.
5. Near Injury is a near miss event that does not result in injury or does not require medical treatment given a value of 1.

C. Risk Matrix

Then perform calculations on the Risk Matrix table to find out the level of risk in these activities. Risk measurement to analyze and evaluate hazards. measurement is carried out by identifying how severe and when the hazard is likely to be. In other words, risk assessment is an in-depth look to determine situations, processes and other hazardous activities or hazards in the workplace. Risks are presented in a variety of ways to communicate the distribution of risk across areas of the workplace. The results of the risk

assessment presented in the risk matrix are very important for making decisions about risk control. Risk can be calculated using the following formula:

$$Risk\ Level\ (R) = Likelihood\ (L) \times Impact\ (C)$$

3. Risk Control

That is, implementing the control that has been selected and fulfilling all the provisions that have been set by means of a control hierarchy. The stages of preparing Risk Control are carried out after getting the level of risk (level of risk), then the control efforts are arranged based on risk. Risk control is a stage hierarchy used in prevention and risk control that may occur (Tarwaka, 2017)

RESULTS AND DISCUSSION

The results of the risk assessment using the HIRARC method can be seen in table 1 below:

Table 1. Risk Assessment

RISK ASSESSMENT					
No	Hazards Identified	Risk Assessment		Risk Value L x C	Risk Level
		Possible	Consequences		
1 (Puddle of water on the basement stairs/ ground floor)	Fall	2	2	4	MEDIUM
	Slip	3	2	6	MEDIUM
	Bump	2	3	6	MEDIUM
2 (1st Floor: Cutting activity with Grinding machine)	Bounced	3	3	9	HIGH
	Scratched grinding machine	3	3	9	HIGH
	Noise	4	2	8	HIGH
3 (2nd Floor: Scattered building materials)	Hit by nails	3	3	9	HIGH
	Stumble	4	2	8	HIGH
4 (3rd Floor : Activities at height still use wooden scaffolding)	Fall	4	3	12	HIGH
	Hit by nails	3	3	9	HIGH
	Dropping work tools	4	2	8	HIGH
5 (4th Floor: There are holes from the construction)	Fell into the hole	3	2	6	MEDIUM
	Fall	3	2	6	MEDIUM
	Dropping things	3	2	6	MEDIUM
6 (5th Floor : Workers throw unused building materials)	Hit by a throw	2	2	4	MEDIUM
	Dusty	4	2	8	HIGH
7 (6th Floor : Floor Uncut iron from construction)	Stabbed	3	4	12	HIGH
8 (7th Floor : Improper placement of building materials)	Struck by raw material	3	5	15	URGENT
9 (Evacuation Stairs on floors 1-7)	Fall	3	3	9	HIGH
	Bump	3	3	9	HIGH
10 (No first aid kit)	Unable to perform first aid	3	4	12	HIGH

11 (Not using personal protective equipment)	Object fall Exposed to iron/ building materials	4	5	20	URGENT
		4	4	16	URGENT

Source: Data Processing

From the results of the risk assessment in table 1 above, then the hazard identification is carried out in each activity to determine the potential hazard and then analyzed and then determined how to control it. The result is as follows:

1. *Activity 1 (Puddle of water on the basement stairs/ground floor):*

The first potential hazard in puddles on the basement stairs can cause workers to "fall" due to the presence of moss in the puddles as a result of water deposition that is too long and not exposed to sunlight. The second potential hazard is "slipping", one of which is caused by some workers not wearing safety shoes, so they can slip when they go straight through puddles of water.

The third potential hazard can be "colliding" with objects around due to the absence of lighting so workers cannot clearly see what objects are around the basement stairs. To control these three potential hazards, immediately remove the water and then make a temporary water flow/channel so that when it rains it does not stagnate and does not pose a potential hazard.

2. *Activity 2 (1st Floor: Cutting activity with Grinding machine):*

The first potential hazard in activities that use a grinding machine is being "bounced" from the cutting iron due to the absence of a guard on the grinding machine so that when cutting the pieces can bounce off towards the workers. The second potential hazard is "scratch" the grinding machine if the worker is not focused or in an unhealthy condition can be hit by the grinding wheel (cutting iron) because the rotating power of the machine is quite large and requires high focus. The third potential danger is that workers can experience permanent "deafness" due to noise from activities using a grinding machine due to the closed condition of the room on the ground floor (basement) and workers do not wear ear plugs. In order to control the first and second potential hazards, it is necessary to install protective equipment on the grinding machine, and to control the third potential hazard is to ensure that all workers use earplugs obediently.

3. *Activity 3 (2nd Floor: Scattered building materials):*

The first potential hazard in work activities on the second floor is "taken nails" from

building materials scattered on the access road. The first way to control this potential hazard is to make SOPs about the problem and install warning signs on the main floor.

The second potential hazard is that workers can "stumble" because the scattered building materials block the worker's access road to the 3rd floor. The second way to control this potential hazard is to tidy up the building materials before carrying out further activities so as not to disturb them.

4. *Activity 4 (3rd Floor : Activities at height still use wooden scaffolding):*

The first potential hazard in work activities on the 3rd floor is "falling" of workers at a height due to the use of wooden scaffolding that is not strong because the manufacture of this wooden scaffold uses used wood.

The second potential hazard is that the "nails" from the scaffold made of used wood can still be seen with nails coming out of the wooden scaffolding which could cause workers to hit the nails. The third potential hazard is that workers "drop work tools" so that nearby workers are hit by the falling object due to the absence of a barrier on the wooden scaffolding base that is useful as a barrier to objects placed on the scaffolding floor. To control these three potential hazards by replacing wooden scaffolding with iron scaffolding in accordance with safety standards and always using personnel protective equipment (PPE).

5. *Activity 5 (4th Floor: There are holes from the construction):*

The first potential danger in working activities on the first 4th floor is that workers "fall" due to the holes from the construction which are only covered by thin fiber material and are not given warning signs. The second potential hazard is workers "falling over" due to lack of attention to road access on the 4th floor. The third potential hazard is that workers can "drop the workpiece" because there are parts of the holes that are not tightly closed so that objects can fall through the cracks of the holes and have an impact on workers who are below. To control the three potential hazards, make sure the manhole cover is completely covered or use an iron plate

6. *Activity 6 (5th Floor : Workers throw unused building materials):*

The first potential hazard in work activities on the 5th floor is "throwing" due to workers not paying attention to safety so that workers throwing unused building materials can hit other workers. To control

this first potential hazard, install warning signs about raw materials that are no longer used. The second potential hazard is "respiratory disorders" because the dust generated by workers often throws unused building materials so that dust can fly and be easily inhaled. To control the second potential hazard by placing used building materials carefully.

7. *Activity 7 (6th Floor : Floor Uncut iron from construction):*

The first potential hazard in work activities on the 6th floor workers can be punctured by the iron that is below because of the worker's lack of attention to safety so that the iron from the construction has not been cut. The potential danger of further tripping is due to the uncut iron from the construction and the absence of warning signs in the area, so the possibility is quite high. In order to control these potential hazards, the uncut iron must be cut/removed immediately so that the potential hazards are also lost.

8. *Activity 8 (7th Floor : Improper placement of building materials):*

The potential hazard in work activities on the 7th floor is "stripped by raw materials" due to the inappropriate placement of materials and the condition is right in front of the elevator aisle which is only limited to polynet while the building material is higher than polynet so that it has an impact on the workers below. To control these potential hazards, signs must be installed regarding the placement of raw materials and the raw materials are immediately transferred to the safest place.

9. *Activity 9 (Evacuation Stairs on floors 1–7):*

The potential danger from work activities from floors 1 to 7 is on the evacuation route (emergency stairs), the first is the potential for workers to "fall" on the emergency stairs due to the absence of railings as a handrail when climbing stairs while the emergency stairs are the main access to go up or down. to the next floor. To control it, immediately install railings on each staircase. The second is that workers can "hit" when they fall due to not being able to support their body weight when using the railing as a holding tool on the ladder. The way to control it is to make sure workers always use PPE when working.

10. *Activity 10 (No first aid kit):*

The next potential hazard in the workplace is the absence of a first aid kit in the workplace so that the impact is that workers cannot perform first aid on other workers who are experiencing minor accidents. The way to control this potential

hazard is to immediately provide a first aid kit that is placed in an area that is easy to see and reach and put up signs regarding the presence of a first aid kit.

11. *Activity 11 (Not using personal protective equipment):*

The potential hazard in the work environment is the lack of self-awareness about the importance of using PPE in this activity, workers are seen not using safety shoes and helmets, while their activities have high potential hazards, for example falling building materials. To control it, it is necessary to install warning signs about the importance of using PPE and the company is obliged to provide complete PPE which is maintained at all times.

Tiwari, etal (2021) conclude that HIRAC provides a little advantage over the conventional HIRA approach by including the criteria specific control measures providing a holistic and comprehensive approach to safer and healthier working.

In this study using the HIRAC approach, it was found that the results of the risk assessment as listed in table 1 above, it can be seen that there are 24 types of potential hazards in 11 identified work activities and of the 24 potential hazards there are 3 potential hazards with a risk level of "Urgent" (12.5%), 14 potential hazards with a risk level of "High" (58.3%) and 7 potential hazards with a risk level of "Medium" (29.2%), meaning that the level of risk that can become a potential hazard on the project is very high and most of them require urgent attention. attention (category "Urgent" and "High" = 70.8%). In general the hazard risk category "Low" must be carried out with Routine actions, "Medium" with Special Attention measures, "High" with Serious Caution measures and "Urgent" with Immediate actions. By categorizing the potential hazards based on the existing hazard risk categories, it is necessary to take action to be used as control by using a Control Hierarchy based on the hazard risk category.

From the results of the identification of HIRARC on 11 work activities which show there are 24 potential hazards that may occur in each activity, namely on activities from floors 1 to 7 where the potential hazards that may occur are caused by human factors (workers do not carry out activities properly such as throwing unused materials, not using PPE, etc.), safety facilities (railing, PPE, first aid kit) and the work environment (puddles, building materials, etc.). Of the 24 potential hazards, the factors causing the potential hazards have been analyzed and how to control them to eliminate or at least reduce potential hazards that may occur. However, a more in-depth study of the 24 potential hazards is needed in order to identify the root of the problem.

Hazards must be controlled at the source (where the problem occurs). The closer the control to the source of the hazard is, the better. This method is

often referred to as applying engineering control. If this does not work, the hazard can often be controlled all the way to the worker, between source and worker. This method can be referred to as applying administrative controls. If this is not possible, the hazard should be controlled at the worker level through the use of personal protective equipment (PPE), although this is the least desirable control.

Hazard control is an effort in risk management to produce a safe, healthy and safe condition in the work environment. The benefits of risk management are ensuring business continuity by reducing the risk of any hazardous activity, reducing costs for handling unwanted events, creating a sense of security among shareholders regarding the sustainability and safety of their investments, increasing understanding and awareness of operational risks for each element in the organization/company, and meet the requirements of the applicable laws environment (Darwis, et al, 2021).

Choosing a potential hazard control method can be done by:

1. Evaluate and select short-term and long-term controls
2. Implement short-term measures to protect workers until permanent controls can be placed
3. Implement long-term controls where reasonably practicable. For example, suppose a noise hazard is identified. Short-term control may require workers to wear hearing protection.

Long term, permanent control may remove or isolate the noise source.

Proper management of continuously identified hazards in the workplace can be carried out through an effective process. Ultimately, the individual or team identifying the hazard must ensure proper communication of the hazard to the appropriate workplace authority (project manager, department head, or designated person). Every HIRARC must be fully documented.

A special department/section responsible for hazards and controls is required to maintain all assessment records for a minimum of 3 years. This special section is more appropriate for every project/work carried out by the company because construction projects have their own unique characteristics depending on the type of work, location and other matters related to the project/work. In some cases, requirements under company management policy will specify a minimum time to keep records) which ensures there is an appropriate authority responsible for ensuring that effective and timely controls are in place for the hazard and communicating the results back to the originator. The manager or employer must support and approve the HIRARC results. Company management must communicate all HIRARC to employees, monitor follow-up and keep records.

Accuracy in risk management can affect overall HSE management which must later be described in the company's HSE program plan. Good management of the HSE program starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company. Good management of HSE programs starting from planning, structuring and implementing them will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

From the results of this study, it can be seen that companies engaged in construction work must have an Occupational Health and Safety Management System. The part of the overall management system includes organizational structure, planning, responsibilities, implementation, procedures, processes and resources needed for the development of implementation, achievement, review and maintenance of occupational safety and health policies in order to create a safe, secure, efficient workplace. and productive.

The success of the Occupational Health and Safety Management System program in construction projects cannot be separated from the role of various parties who are involved, interact and work together. This should be a major consideration in the implementation of construction project development carried out by the project team and all management from various parties involved in it. Each party has a shared responsibility that supports each other for the successful implementation of a construction project which is marked by a positive evaluation of the implementation of the occupational safety and health program.

Kabul (2020) states that good HSE management starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

HSE is one of the functions of Human Resource Management. HSE requires commitment from top management and in its implementation requires a special program that includes hazard identification, risk control and assessment, information and data storage and training. In addition, HSE also requires active participation from all elements of the organization in order to build a safety culture as the main pillar of HSE. At the heart of HSE management is an organizational commitment to a comprehensive HSE effort. This effort must be coordinated from top management to include all members of the organization and must also be reflected in managerial actions. Kabul, (2020) explicitly states that the HSE management system is part of the overall management which includes organizational structure, planning, responsibilities, implementation, procedures, processes, and other resources needed for

development, implementation, achievement, assessment and maintenance. K3 policy in the context of controlling risks related to work activities in order to create a safe, efficient, and productive workplace.

In relation to HSE in construction projects, of course, the management of human resources in the construction sector also has a very important role like other fields. work. Moreover, earlier in the introduction it was stated that the construction sector is a field of work that is very risky to potential hazards in the workplace.

The presence of HSE experts, work procedures related to HSE, strict enforcement of rules and workers trained in HSE will ultimately shape a culture of safety and health in the workplace. With the development of a culture of safety and health in a company, it will have an impact on the company's overall performance.

CONCLUSION

The conclusions of this study are as follows:

1. The OSH program implemented by the company is carried out through the QHSE Department, which twice a week, a representative from the QHSE Department comes to the project site to carry out routine inspections in the first week related to OHS from the work by conducting routine inspections. And the results of this inspection will be brought into discussion at the Implementation meeting which is held every Friday. The QHSE department will discuss the activities or objects that have the potential to have risks in order to obtain repair or control solutions so that these risks can be reduced or eliminated.
2. Identifying the dangers of using the HIRARC method in construction projects is by looking at the potentials that will cause hazards that lead to accidents, such as iron cutting activities using unprotected grinding machines, activities at heights using non-standard K3 scaffolding, workers throwing building materials, placement of building materials that are not appropriate and activities of lifting raw materials using Tower Crane with workers who do not use PPE. Of these potential hazards, there are some that have the highest impact, namely Extreme which leads to the accident of more than one person. So from the results of this identification, researchers can do calculations with the Risk Matrix which will later show the level of risk in the potential hazard.
3. In carrying out a risk management must include planning, hazard identification, risk assessment, and risk control. From the results of observations about the possible risk of accidents using the HIRARC method above, the company must create and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by

removing water in the basement, grinding protective pairs, using ear plugs, making SOPs, use standard K3 scaffolding, install manhole covers, install warning signs, cut metal that comes out of the floor, use PPE, and provide a first aid kit. After that, the next step is to communicate and consult with all relevant parties with a focus on how workers recognize this hazard, the risks, what they are facing and how to overcome them..

Based on the results of the research that has been done, the researchers would like to provide some suggestions for the company as follows:

1. The company as the owner of the building must immediately employ HSE experts on each project so that the company's QHSE Department only accepts reports and proposals which will later be used as SOPs in the next construction project.
2. It is necessary to carry out Safety Induction, Fire and Earthquake Simulations at least once a month in order to always remind workers of the importance of Occupational Safety Health Environment is a shared task.
3. The company, in this case the QHSE team, must conduct socialization on routine work safety rules so that workers also understand HSE and know what dangers or sanctions will be received by workers and the company.
4. The company must further equip sufficient PPE and adapt it to its work as a form of responsibility as the organizer of this construction project
5. Companies need to give rewards or sanctions so that workers in carrying out their actions are better or more careful and get the results of their actions.

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HIRARC METHOD APPROACH AS ANALYSIS TOOLS IN FORMING SAFETY CULTURE (CASE ON CONSTRUCTION PROJECTS)

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ABSTRACT

The purpose of this study is to observe and analyze the potential hazards that can cause accidents in the activity of lifting building materials using Tower Crane on a construction project. The method used in this research is Hazard Identification, Risk Assessment and Risk Control (HIRARC). By using this method, it is hoped that it can reduce the number of accidents that occur, find out the causes of accidents, and establish control measures. The results of the study indicate that there are 11 risks in activities that have the potential to cause accidents. Where 2 risks have an "Extreme" level of danger, namely an accident with more than one person and the status is "Urgent" so that it needs immediate treatment, 4 risks are classified as "High" which need serious attention and 2 risks are "Medium" which requires special attention. The conclusion of the research is that companies must establish and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using earplugs, making SOPs, using scaffolding, installing covers, holes, put up warning signs, cut metal out of the floor, used personnel protective equipment (PPE), and provided a first aid kit. It is recommended that the company immediately recruit HSE experts on each project so that the company's Quality Health Safety Environment (QHSE) Department only receives reports and proposals which will later be used as SOPs for the next construction project..

Key words: Hazard, Risk, Accident, HIRARC, HSE

PENDEKATAN METODE HIRARC SEBAGAI ALAT ANALISIS DALAM MEMBENTUK BUDAYA K3 (KASUS PADA PROYEK KONSTRUKSI)

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ABSTRAK

Tujuan dari penelitian ini adalah untuk mengamati dan menganalisis potensi bahaya yang dapat menyebabkan terjadinya kecelakaan pada aktivitas pengangkatan material bangunan menggunakan *Tower Crane* pada suatu proyek konstruksi. Metode yang digunakan dalam penelitian ini adalah *Hazard Identification, Risk Assessment and Risk Control (HIRARC)*. Dengan menggunakan metode ini diharapkan dapat menekan angka kecelakaan yang terjadi, mengetahui penyebab kecelakaan, dan menetapkan tindakan pengendalian. Hasil penelitian menunjukkan bahwa terdapat 11 risiko pada aktivitas yang berpotensi terjadinya kecelakaan. Dimana 2 risiko memiliki tingkat bahaya "Extreme" yaitu kecelakaan lebih dari satu orang dan berstatus "Urgent" sehingga perlu penanganan segera, 4 risiko tergolong "High" yang perlu mendapat perhatian serius dan 2 risiko berstatus "Medium" yang memerlukan perhatian khusus. Kesimpulan penelitian adalah perusahaan harus membuat dan memelihara prosedur untuk melakukan identifikasi bahaya, penilaian risiko, dan pengendalian risiko sesuai kebutuhan dengan cara membuang air di basement, memasang pelindung pada mesin gerinda, menggunakan penyumbat telinga, membuat SOP, menggunakan perancah besi, memasang penutup, lubang, memasang tanda peringatan, memotong logam yang keluar dari lantai, menggunakan Alat Pelindung Diri (APD), dan menyediakan kotak P3K. Disarankan agar perusahaan segera merekrut tenaga ahli K3 pada setiap proyek sehingga Departemen *Quality Health Safety Environment (QHSE)* perusahaan nantinya hanya menerima laporan dan proposal yang nantinya akan digunakan sebagai SOP pada proyek konstruksi selanjutnya..

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Kata kunci: Bahaya, Risiko, Kecelakaan, HIRARC, K3

INTRODUCTION

In 2021, BPJS Employment or BPJamsostek recorded around 65.89 percent of work accident cases claimed by participants, occurred at work locations. The first sequence of work accidents is in the work location, and most occur in the morning. A total of 65.89 percent of work accidents occur in the work location, then 25.77 percent of accidents in traffic, and only 8.33 percent outside the work location.

OSH is Occupational Safety and Health with the understanding of providing protection to everyone in the workplace, which is related to the transfer of raw materials, use of construction work equipment, production processes and the environment around the workplace. Construction activities are an important element in development which in carrying out these construction activities cause various

unwanted impacts, including those concerning aspects of occupational safety and health.

Purohit, et al (2018) states that construction is a high hazard industry that comprises a widerange of activities involving construction, alteration or repair. Examples include residential construction, bridge erection, excavations, demolitions and large scale painting jobs. Hazard identification and risk analysis is carried for identification of undesirable events that can leads to a hazard. The analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects.

Therefore, research on the identification of potential hazards is still a very interesting study, especially if it is extended to the full management of HSE.

The research was conducted at one of the largest state-owned companies in the construction sector

where the construction sector is one area that has the potential to cause work accidents and the potential for accidents is high in the activity of lifting building materials using Tower Cranes on construction projects. Because this process determines the speed of construction of a construction project and often time is running out to complete the apartment, it puts the operator under pressure, which results in miscommunication to the workers below to bind the building materials to be brought up. So that the fastening is not tight because in a hurry there is a potential hazard that has an impact on workers who are in the Tower Crane activity area.

So to protect workers in doing their jobs, companies need to implement an integrated Occupational Health and Safety (OHS) Management System program aimed at reducing and preventing the possibility of accidents and occupational diseases. The construction sector is one sector that has a high potential for danger and a lot of work accidents occur in this sector. Health, Safety and Environment (HSE) is very important for employees and companies in order to achieve a high and optimal level of work productivity. The research was conducted with a qualitative descriptive approach. The data used in the study were obtained from the results of worker interviews. After the data was obtained, data analysis was carried out using the HIRARC method. Based on the background of the HSE problem above, the formulation of the problem in this study is as follows;

1. Knowing the HSE program that has been implemented by the company
2. How to identify and analyze occupational accident hazards using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method.
3. How to do good risk management to achieve Zero Accident in construction projects.

METHOD

HIRARC performed on all activities to determine activities which contain potential hazards and have a serious impact on occupational safety and health (Indragiri & Yuttya, 2020)

This study uses the Hazard Identification Risk Assessment and Risk Control (HIRARC) approach, which is a method to prevent or minimize work accidents. HIRARC is a method that starts from determining the type of work activity which then identifies the source of the hazard so that the risk is obtained.

HIRARC is a process of identifying hazards (Hazard Identification) that can occur in all company activities, then conducting a risk assessment (Risk Assessment) of the hazards that occur, then making hazard control (Risk Control) in order to minimize high risk levels to low (Sitepu & Simanungkalit, 2020).

This whole process is also called management risk (risk management). HIRARC is a key element in the system occupational safety and

health management which is directly related to prevention and control of hazards. Besides, HIRARC is part of the risk management system (risk management). According to OHSAS 18001, HIRARC should be carried out in all organizational activities to determine organizational activities that contain potential hazards and have a serious impact on occupational safety and health.

Furthermore, the results of HIRARC become input for the preparation of objectives and HSE targets to be achieved, which are outlined in the work program. From the groove in below it can be seen that HIRARC is the starting point for OHS management. If HIRARC is not carried out properly then the application of HSE will be in the wrong direction (misguided), random or virtual because they are not able to handle the main issue at hand within the organization.

The HIRARC method follows the following steps:

1. Hazard Identification :

Hazard identification is the process of identifying all hazards in the workplace. There is no set method for grouping agricultural injury and illness hazard (Chauhan & Siddiqui, 2018).

Hazard identification can be done through the following steps:

- a) Make a list of all objects of machines, work equipment, materials, work processes, work systems, working conditions that exist in the workplace.
- b) Check all objects in the workplace and its surroundings.
- c) Conduct interviews with workers who work in the workplace related to these objects.
- d) Accident review, first aid records and other information.
- e) Record all identified hazards.

2. Risk Assessment :

Risk assessment involves determining the impact level and recurrence of risk using available information. Moreover, in the risk analysis process, different factors, such as effects of recognized risks on project objectives, manageability, timing, the probability of occurrence, and relationship to other risks, must be considered. All these factors provide a better understanding of each risk type and increase the capacity for adoption of an adequate and appropriate approach to mitigating such risks (Jaber, 2019)

Risk is the possibility of an accident or loss in a certain period of time or a certain operating cycle. The level of risk is the multiplication between the level of frequency (Likelihood) and the severity (consequence) of an event that can cause losses. At this risk assessment stage, the assessment follows:

A. Frequency Level (Likelihood)

That is how often workers are exposed to potential hazards. To be able to make the

best estimate, we must consider the following:

1. Often the value is 5, the probability of exposure is between 90-100%.
2. Often the score is 4, the probability of exposure is between 60-89%.
3. While the score is 3, the probability of exposure is between 40-39%.
4. Rarely the value is 2, the probability of exposure is between 10-39%
5. Rarely the value is 1, the probability of exposure is between <10%.

B. Severity Level (Consequence)

The level of impact (consequence or severity) of an accident or illness can be categorized into 5 (five) categories as follows:

1. Extreme is an accident that causes the death of more than 1 person and is given a value of 5.
2. Fatal is an accident that causes a single death given a value of 4.
3. Serious Injury is an accident that causes serious injury or illness for a long time unable to work so that you are rushed to the hospital or cause permanent disability, which is given a score of 3.
4. Minor injuries are near-miss events that do not result in disability and only minor injuries are given a score of 2.
5. Near Injury is a near miss event that does not result in injury or does not require medical treatment given a value of 1.

C. Risk Matrix

Then perform calculations on the Risk Matrix table to find out the level of risk in these activities. Risk measurement to analyze and evaluate hazards, measurement is carried out by identifying how severe and when the hazard is likely to be. In other words, risk assessment is an in-depth look to determine situations, processes and other hazardous activities or hazards in the workplace. Risks are presented in a variety of ways to communicate the distribution of risk across areas of the workplace. The results of the risk assessment presented in the risk matrix are very important for making decisions about risk control. Risk can be calculated using the following formula:

$$Risk\ Level\ (R) = Likelihood\ (L) \times Impact\ (C)$$

3. Risk Control

That is, implementing the control that has been selected and fulfilling all the provisions that have been set by means of a control hierarchy. The

stages of preparing Risk Control are carried out after getting the level of risk (level of risk), then the control efforts are arranged based on risk. Risk control is a stage hierarchy used in prevention and risk control that may occur (Tarwaka, 2017)

RESULTS AND DISCUSSION

The results of the risk assessment using the HIRARC method can be seen in table 1 below:

Table 1. Risk Assessment

No	Hazards Identified	Risk Assessment		Risk Value L x C	Risk Level
		Possible	Consequences		
1 (Puddle of water on the basement stairs/ ground floor)	Fall	2	2	4	MEDIUM
	Slip	3	2	6	MEDIUM
	Bump	2	3	6	MEDIUM
2 (1st Floor: Cutting activity with Grinding machine)	Bounced	3	3	9	HIGH
	Scratched grinding machine	3	3	9	HIGH
3 (2nd Floor: Scattered building materials)	Noise	4	2	8	HIGH
	Hit by nails	3	3	9	HIGH
4 (3rd Floor : Activities at height still use wooden scaffolding)	Stumble	4	2	8	HIGH
	Fall	4	3	12	HIGH
	Hit by nails	3	3	9	HIGH
5 (4th Floor: There are holes from the construction)	Dropping work tools	4	2	8	HIGH
	Fell into the hole	3	2	6	MEDIUM
	Fall	3	2	6	MEDIUM
6 (5th Floor : Workers throw unused building materials)	Dropping things	3	2	6	MEDIUM
	Hit by a throw	2	2	4	MEDIUM
7 (6th Floor : Floor Ubcut iron from construction)	Dusty	4	2	8	HIGH
	Stabbed	3	4	12	HIGH
8 (7th Floor : Improper placement of building materials)	Struck by raw material	3	5	15	URGENT
	Fall	3	3	9	HIGH
9 (Evacuation Stairs on floors 1-7)	Bump	3	3	9	HIGH
	Unable to perform first aid	3	4	12	HIGH
10 (No first aid kit)	Object fall	4	5	20	URGENT
	Exposed to iron/ building materials	4	4	16	URGENT

Source: Data Processing

From the results of the risk assessment in table 1 above, then the hazard identification is carried out in each activity to determine the potential hazard and then analyzed and then determined how to control it. The result is as follows:

1. Activity 1 (Puddle of water on the basement stairs/ground floor):

The first potential hazard in puddles on the basement stairs can cause workers to "fall" due to the presence of moss in the puddles as a result of water deposition that is too long and not exposed to sunlight. The second potential hazard is "slipping", one of which is caused by some workers not wearing safety shoes, so they can slip when they go straight through puddles of water. The third potential hazard can be "colliding" with objects around due to the absence of lighting so workers cannot clearly see what objects are around the basement stairs. To control these three potential hazards, immediately remove the water and then make a temporary water flow/channel so that when it rains it does not stagnate and does not pose a potential hazard.

2. *Activity 2 (1st Floor: Cutting activity with Grinding machine):*

The first potential hazard in activities that use a grinding machine is being "bounced" from the cutting iron due to the absence of a guard on the grinding machine so that when cutting the pieces can bounce off towards the workers. The second potential hazard is "scratch" the grinding machine if the worker is not focused or in an unhealthy condition can be hit by the grinding wheel (cutting iron) because the rotating power of the machine is quite large and requires high focus. The third potential danger is that workers can experience permanent "deafness" due to noise from activities using a grinding machine due to the closed condition of the room on the ground floor (basement) and workers do not wear ear plugs. In order to control the first and second potential hazards, it is necessary to install protective equipment on the grinding machine, and to control the third potential hazard is to ensure that all workers use earplugs obediently.

3. *Activity 3 (2nd Floor: Scattered building materials):*

The first potential hazard in work activities on the second floor is "taken nails" from building materials scattered on the access road. The first way to control this potential hazard is to make SOPs about the problem and install warning signs on the main floor. The second potential hazard is that workers can "stumble" because the scattered building materials block the worker's access road to the 3rd floor. The second way to control this potential hazard is to tidy up the building materials before carrying out further activities so as not to disturb them.

4. *Activity 4 (3rd Floor : Activities at height still use wooden scaffolding):*

The first potential hazard in work activities on the 3rd floor is "falling" of workers at a height due to the use of wooden scaffolding that is not strong because the manufacture of this wooden scaffold uses used wood.

The second potential hazard is that the "nails" from the scaffold made of used wood can still be seen with nails coming out of the wooden scaffolding which could cause workers to hit the nails. The third potential hazard is that workers "drop work tools" so that nearby workers are hit by the falling object due to the absence of a barrier on the wooden scaffolding base that is useful as a barrier to objects placed on the scaffolding floor. To control these three potential hazards by replacing wooden scaffolding with iron scaffolding in accordance with safety standards and always using personnel protective equipment (PPE).

5. *Activity 5 (4th Floor: There are holes from the construction):*

The first potential danger in working activities on the first 4th floor is that workers "fall" due to the holes from the construction which are only covered by thin fiber material and are not given warning signs. The second potential hazard is workers "falling over" due to lack of attention to road access on the 4th floor. The third potential hazard is that workers can "drop the workpiece" because there are parts of the holes that are not tightly closed so that objects can fall through the cracks of the holes and have an impact on workers who are below. To control the three potential hazards, make sure the manhole cover is completely covered or use an iron plate

6. *Activity 6 (5th Floor : Workers throw unused building materials):*

The first potential hazard in work activities on the 5th floor is "throwing" due to workers not paying attention to safety so that workers throwing unused building materials can hit other workers. To control this first potential hazard, install warning signs about raw materials that are no longer used. The second potential hazard is "respiratory disorders" because the dust generated by workers often throws unused building materials so that dust can fly and be easily inhaled. To control the second potential hazard by placing used building materials carefully.

7. *Activity 7 (6th Floor : Floor Uncut iron from construction):*

The first potential hazard in work activities on the 6th floor workers can be punctured by the iron that is below because of the worker's lack of attention to safety so that the iron from the construction has not been

cut. The potential danger of further tripping is due to the uncut iron from the construction and the absence of warning signs in the area, so the possibility is quite high. In order to control these potential hazards, the uncut iron must be cut/removed immediately so that the potential hazards are also lost.

8. *Activity 8 (7th Floor : Improper placement of building materials):*

The potential hazard in work activities on the 7th floor is "stripped by raw materials" due to the inappropriate placement of materials and the condition is right in front of the elevator aisle which is only limited to polynet while the building material is higher than polynet so that it has an impact on the workers below. To control these potential hazards, signs must be installed regarding the placement of raw materials and the raw materials are immediately transferred to the safest place.

9. *Activity 9 (Evacuation Stairs on floors 1–7):*

The potential danger from work activities from floors 1 to 7 is on the evacuation route (emergency stairs), the first is the potential for workers to "fall" on the emergency stairs due to the absence of railings as a handrail when climbing stairs while the emergency stairs are the main access to go up or down. to the next floor. To control it, immediately install railings on each staircase. The second is that workers can "hit" when they fall due to not being able to support their body weight when using the railing as a holding tool on the ladder. The way to control it is to make sure workers always use PPE when working.

10. *Activity 10 (No first aid kit):*

The next potential hazard in the workplace is the absence of a first aid kit in the workplace so that the impact is that workers cannot perform first aid on other workers who are experiencing minor accidents. The way to control this potential hazard is to immediately provide a first aid kit that is placed in an area that is easy to see and reach and put up signs regarding the presence of a first aid kit.

11. *Activity 11 (Not using personal protective equipment):*

The potential hazard in the work environment is the lack of self-awareness about the importance of using PPE in this activity, workers are seen not using safety shoes and helmets, while their activities have high potential hazards, for example falling building materials. To control it, it is necessary to install warning signs about the importance of using PPE and the company is obliged to provide complete PPE which is maintained at all times.

Tiwari, etal (2021) conclude that HIRAC provides a little advantage over the conventional HIRA approach by including the criteria specific control measures providing a holistic and comprehensive approach to safer and healthier working.

In this study using the HIRAC approach, it was found that the results of the risk assessment as listed in table 1 above, it can be seen that there are 24 types of potential hazards in 11 identified work activities and of the 24 potential hazards there are 3 potential hazards with a risk level of "Urgent" (12.5%), 14 potential hazards with a risk level of "High" (58.3%) and 7 potential hazards with a risk level of "Medium" (29.2%), meaning that the level of risk that can become a potential hazard on the project is very high and most of them require urgent attention. attention (category "Urgent" and "High" = 70.8%). In general the hazard risk category "Low" must be carried out with Routine actions, "Medium" with Special Attention measures, "High" with Serious Caution measures and "Urgent" with Immediate actions. By categorizing the potential hazards based on the existing hazard risk categories, it is necessary to take action to be used as control by using a Control Hierarchy based on the hazard risk category.

From the results of the identification of HIRARC on 11 work activities which show there are 24 potential hazards that may occur in each activity, namely on activities from floors 1 to 7 where the potential hazards that may occur are caused by human factors (workers do not carry out activities properly such as throwing unused materials, not using PPE, etc.), safety facilities (railing, PPE, first aid kit) and the work environment (puddles, building materials, etc.). Of the 24 potential hazards, the factors causing the potential hazards have been analyzed and how to control them to eliminate or at least reduce potential hazards that may occur. However, a more in-depth study of the 24 potential hazards is needed in order to identify the root of the problem.

Hazards must be controlled at the source (where the problem occurs). The closer the control to the source of the hazard is, the better. This method is often referred to as applying engineering control. If this does not work, the hazard can often be controlled all the way to the worker, between source and worker. This method can be referred to as applying administrative controls. If this is not possible, the hazard should be controlled at the worker level through the use of personal protective equipment (PPE), although this is the least desirable control.

Hazard control is an effort in risk management to produce a safe, healthy and safe condition in the work environment. The benefits of risk management are ensuring business continuity by reducing the risk of any hazardous activity, reducing costs for handling unwanted events, creating a sense of security among shareholders regarding the sustainability and safety of their investments, increasing understanding and awareness of operational risks for each element in the organization/company, and meet the

requirements of the applicable laws environment (Darwis, et al, 2021).

Choosing a potential hazard control method can be done by:

1. Evaluate and select short-term and long-term controls
2. Implement short-term measures to protect workers until permanent controls can be placed
3. Implement long-term controls where reasonably practicable. For example, suppose a noise hazard is identified. Short-term control may require workers to wear hearing protection.

Long term, permanent control may remove or isolate the noise source.

Proper management of continuously identified hazards in the workplace can be carried out through an effective process. Ultimately, the individual or team identifying the hazard must ensure proper communication of the hazard to the appropriate workplace authority (project manager, department head, or designated person). Every HIRARC must be fully documented.

A special department/section responsible for hazards and controls is required to maintain all assessment records for a minimum of 3 years. This special section is more appropriate for every project/work carried out by the company because construction projects have their own unique characteristics depending on the type of work, location and other matters related to the project/work. In some cases, requirements under company management policy will specify a minimum time to keep records) which ensures there is an appropriate authority responsible for ensuring that effective and timely controls are in place for the hazard and communicating the results back to the originator. The manager or employer must support and approve the HIRARC results. Company management must communicate all HIRARC to employees, monitor follow-up and keep records.

Accuracy in risk management can affect overall HSE management which must later be described in the company's HSE program plan. Good management of the HSE program starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company. Good management of HSE programs starting from planning, structuring and implementing them will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

From the results of this study, it can be seen that companies engaged in construction work must have an Occupational Health and Safety Management System. The part of the overall management system includes organizational structure, planning, responsibilities, implementation, procedures, processes and resources needed for the development of implementation, achievement, review and maintenance of occupational safety and health policies in order to create a safe, secure, efficient workplace. and productive.

The success of the Occupational Health and Safety Management System program in construction projects cannot be separated from the role of various parties who are involved, interact and work together. This should be a major consideration in the implementation of construction project development carried out by the project team and all management from various parties involved in it. Each party has a shared responsibility that supports each other for the successful implementation of a construction project which is marked by a positive evaluation of the implementation of the occupational safety and health program.

Kabul (2020) states that good HSE management starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

HSE is one of the functions of Human Resource Management. HSE requires commitment from top management and in its implementation requires a special program that includes hazard identification, risk control and assessment, information and data storage and training. In addition, HSE also requires active participation from all elements of the organization in order to build a safety culture as the main pillar of HSE. At the heart of HSE management is an organizational commitment to a comprehensive HSE effort. This effort must be coordinated from top management to include all members of the organization and must also be reflected in managerial actions. Kabul, (2020) explicitly states that the HSE management system is part of the overall management which includes organizational structure, planning, responsibilities, implementation, procedures, processes, and other resources needed for development, implementation, achievement, assessment and maintenance. K3 policy in the context of controlling risks related to work activities in order to create a safe, efficient, and productive workplace.

In relation to HSE in construction projects, of course, the management of human resources in the construction sector also has a very important role like other fields. work. Moreover, earlier in the introduction it was stated that the construction sector is a field of work that is very risky to potential hazards in the workplace.

The presence of HSE experts, work procedures related to HSE, strict enforcement of rules and workers trained in HSE will ultimately shape a culture of safety and health in the workplace. With the development of a culture of safety and health in a company, it will have an impact on the company's overall performance.

CONCLUSION

There are several things that can be concluded from this research. The first is that The OSH program implemented by the company is carried out through the QHSE Department, which twice a week, a representative from the QHSE Department comes to the project site to carry out routine inspections in the

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first week related to OHS from the work by conducting routine inspections. And the results of this inspection will be brought into discussion at the Implementation meeting which is held every Friday. The QHSE department will discuss the activities or objects that have the potential to have risks in order to obtain repair or control solutions so that these risks can be reduced or eliminated.

The second conclusion is identifying the dangers of using the HIRARC method in construction projects is by looking at the potentials that will cause hazards that lead to accidents, such as iron cutting activities using unprotected grinding machines, activities at heights using non-standard K3 scaffolding, workers throwing building materials, placement of building materials that are not appropriate and activities of lifting raw materials using Tower Crane with workers who do not use PPE. Of these potential hazards, there are some that have the highest impact, namely Extreme which leads to the accident of more than one person. So from the results of this identification, researchers can do calculations with the Risk Matrix which will later show the level of risk in the potential hazard.

The third conclusion is in carrying out a risk management must include planning, hazard identification, risk assessment, and risk control. From the results of observations about the possible risk of accidents using the HIRARC method above, the company must create and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using ear plugs, making SOPs, use standard K3 scaffolding, install manhole covers, install warning signs, cut metal that comes out of the floor, use PPE, and provide a first aid kit. After that, the next step is to communicate and consult with all relevant parties with a focus on how workers recognize this hazard, the risks, what they are facing and how to overcome them.

Based on the results of the research that has been done, the researchers would like to provide some suggestions for companies, including that: the company as the owner of the building must immediately employ HSE experts on each project so that the company's QHSE Department only accepts reports and proposals which will later be used as SOPs in the next construction project, it is necessary to carry out Safety Induction, Fire and Earthquake Simulations at least once a month in order to always remind workers of the importance of Occupational Safety Health Environment is a shared task, the company, in this case the QHSE team, must conduct socialization on routine work safety rules so that workers also understand HSE and know what dangers or sanctions will be received by workers and the company, the company must further equip sufficient PPE and adapt it to its work as a form of responsibility as the organizer of this construction project, and it is also suggested that companies need to give rewards or sanctions so that workers in carrying out their actions are better or more careful and get the results of their actions.

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HIRARC METHOD APPROACH AS ANALYSIS TOOLS IN FORMING SAFETY CULTURE (CASE ON CONSTRUCTION PROJECTS)

ABSTRACT

The purpose of this study is to observe and analyze the potential hazards that can cause accidents in the activity of lifting building materials using Tower Crane on a construction project. The method used in this research is Hazard Identification, Risk Assessment and Risk Control (HIRARC). By using this method, it is hoped that it can reduce the number of accidents that occur, find out the causes of accidents, and establish control measures. The results of the study indicate that there are 11 risks in activities that have the potential to cause accidents. Where 2 risks have an "Extreme" level of danger, namely an accident with more than one person and the status is "Urgent" so that it needs immediate treatment, 4 risks are classified as "High" which need serious attention and 2 risks are "Medium" which requires special attention. The conclusion of the research is that companies must establish and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using earplugs, making SOPs, using scaffolding, installing covers, holes, put up warning signs, cut metal out of the floor, used personnel protective equipment (PPE), and provided a first aid kit. It is recommended that the company immediately recruit HSE experts on each project so that the company's Quality Health Safety Environment (QHSE) Department only receives reports and proposals which will later be used as SOPs for the next construction project..

Key words: Hazard, Risk, Accident, HIRARC, HSE

PENDEKATAN METODE HIRARC SEBAGAI ALAT ANALISIS DALAM MEMBENTUK BUDAYA K3 (KASUS PADA PROYEK KONSTRUKSI)

ABSTRAK

Tujuan dari penelitian ini adalah untuk mengamati dan menganalisis potensi bahaya yang dapat menyebabkan terjadinya kecelakaan pada aktivitas pengangkatan material bangunan menggunakan *Tower Crane* pada suatu proyek konstruksi. Metode yang digunakan dalam penelitian ini adalah *Hazard Identification, Risk Assessment and Risk Control (HIRARC)*. Dengan menggunakan metode ini diharapkan dapat menekan angka kecelakaan yang terjadi, mengetahui penyebab kecelakaan, dan menetapkan tindakan pengendalian. Hasil penelitian menunjukkan bahwa terdapat 11 risiko pada aktivitas yang berpotensi terjadinya kecelakaan. Dimana 2 risiko memiliki tingkat bahaya "Extreme" yaitu kecelakaan lebih dari satu orang dan berstatus "Urgent" sehingga perlu penanganan segera, 4 risiko tergolong "High" yang perlu mendapat perhatian serius dan 2 risiko berstatus "Medium" yang memerlukan perhatian khusus. Kesimpulan penelitian adalah perusahaan harus membuat dan memelihara prosedur untuk melakukan identifikasi bahaya, penilaian risiko, dan pengendalian risiko sesuai kebutuhan dengan cara membuang air di basement, pemasangan alat pelindung pada mesin gerinda, menggunakan penyumbat telinga, membuat SOP, menggunakan perancah besi, memasang penutup lubang, memasang tanda peringatan, memotong logam yang keluar dari lantai, menggunakan alat pelindung diri (APD), dan menyediakan kotak P3K. Disarankan agar perusahaan segera merekrut tenaga ahli K3 pada setiap proyek sehingga Departemen *Quality Health Safety Environment (QHSE)* perusahaan hanya menerima laporan dan proposal yang nantinya akan digunakan sebagai SOP pada proyek konstruksi selanjutnya..

Kata kunci: Bahaya, Risiko, Kecelakaan, HIRARC, K3

INTRODUCTION

In 2021, BPJS Employment or BPJamsostek recorded around 65.89 percent of work accident cases claimed by participants, occurred at work locations. The first sequence of work accidents is in the work location, and most occur in the morning. A total of 65.89 percent of work accidents occur in the work location, then 25.77 percent of accidents in traffic, and only 8.33 percent outside the work location.

OSH is Occupational Safety and Health with the understanding of providing protection to everyone in the workplace, which is related to the transfer of raw materials, use of construction work equipment, production processes and the environment around the workplace. Construction activities are an important element in development which in carrying out these construction activities cause

various unwanted impacts, including those concerning aspects of occupational safety and health.

Project construction is a high hazard industry that comprises a widerange of activities involving construction, alteration or repair. Examples include residential construction, bridge erection, excavations, demolitions and large scale painting jobs. Hazard identification and risk analysis is carried for identification of undesirable events that can leads to a hazard. The analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects (Purohit et al., 2018)

Therefore, research on the identification of potential hazards is still a very interesting study, especially if it is extended to the full management of HSE.

The research was conducted at one of the largest state-owned companies in the construction sector where the construction sector is one area that has the potential to cause work accidents and the potential for accidents is high in the activity of lifting building materials using Tower Cranes on construction projects. Because this process determines the speed of construction of a construction project and often time is running out to complete the apartment, it puts the operator under pressure, which results in miscommunication to the workers below to bind the building materials to be brought up. So that the fastening is not tight because in a hurry there is a potential hazard that has an impact on workers who are in the Tower Crane activity area.

So to protect workers in doing their jobs, companies need to implement an integrated Occupational Health and Safety (OHS) Management System program aimed at reducing and preventing the possibility of accidents and occupational diseases. The construction sector is one sector that has a high potential for danger and a lot of work accidents occur in this sector. Health, Safety and Environment (HSE) is very important for employees and companies in order to achieve a high and optimal level of work productivity. The research was conducted with a qualitative descriptive approach. The data used in the study were obtained from the results of worker interviews. After the data was obtained, data analysis was carried out using the HIRARC method. Based on the background of the HSE problem above, the formulation of the problem in this study is as follows;

1. Knowing the HSE program that has been implemented by the company
2. How to identify and analyze occupational accident hazards using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method.
3. How to do good risk management to achieve Zero Accident in construction projects.

METHOD

HIRARC performed on all activities to determine activities which contain potential hazards and have a serious impact on occupational safety and health (Indragiri & Yuttya, 2020)

This study uses the Hazard Identification Risk Assessment and Risk Control (HIRARC) approach, which is a method to prevent or minimize work accidents. HIRARC is a method that starts from determining the type of work activity which then identifies the source of the hazard so that the risk is obtained.

HIRARC is a process of identifying hazards (Hazard Identification) that can occur in all company activities, then conducting a risk assessment (Risk Assessment) of the hazards that occur, then making hazard control (Risk Control) in

order to minimize high risk levels to low (Sitepu & Simanungkalit, 2020)

This whole process is also called management risk (risk management). HIRARC is a key element in the system occupational safety and health management which is directly related to prevention and control of hazards. Besides, HIRARC too is part of the risk management system (risk management). according to OHSAS 18001, HIRARC should be carried out in all organizational activities to determine organizational activities that contain potential hazards and have a serious impact on occupational safety and health.

Furthermore, the results of HIRARC become input for the preparation of objectives and HSE targets to be achieved, which are outlined in the work program. From the groove in below it can be seen that HIRARC is the starting point for OHS management. If HIRARC is not carried out properly then the application of HSE will be in the wrong direction (misguided), random or virtual because they are not able to handle the main issue at hand within the organization.

The HIRARC method follows the following steps:

1. Hazard Identification :

Hazard identification is the process of identifying all hazards in the workplace. There is no set method for grouping agricultural injury and illness hazard (Chauhan & Siddiqui, 2018).

Hazard identification can be done through the following steps:

- a) Make a list of all objects of machines, work equipment, materials, work processes, work systems, working conditions that exist in the workplace.
- b) Check all objects in the workplace and its surroundings.
- c) Conduct interviews with workers who work in the workplace related to these objects.
- d) Accident review, first aid records and other information.
- e) Record all identified hazards.

2. Risk Assessment :

Risk assessment involves determining the impact level and recurrence of risk using available information. Moreover, in the risk analysis process, different factors, such as effects of recognized risks on project objectives, manageability, timing, the probability of occurrence, and relationship to other risks, must be considered. All these factors provide a better understanding of each risk type and increase the capacity for adoption of an adequate and appropriate approach to mitigating such risks (Jaber, 2019)

Risk is the possibility of an accident or loss in a certain period of time or a certain operating cycle. The level of risk is the multiplication between the level of frequency (Likelihood) and the severity (consequence) of

an event that can cause losses. At this risk assessment stage, the assessment follows:

A. Frequency Level (Likelihood)

That is how often workers are exposed to potential hazards. To be able to make the best estimate, we must consider the following:

1. Often the value is 5, the probability of exposure is between 90-100%.
2. Often the score is 4, the probability of exposure is between 60-89%.
3. While the score is 3, the probability of exposure is between 40-39%.
4. Rarely the value is 2, the probability of exposure is between 10-39%.
5. Rarely the value is 1, the probability of exposure is between <10%.

B. Severity Level (Consequence)

The level of impact (consequence or severity) of an accident or illness can be categorized into 5 (five) categories as follows:

1. Extreme is an accident that causes the death of more than 1 person and is given a value of 5.
2. Fatal is an accident that causes a single death given a value of 4.
3. Serious Injury is an accident that causes serious injury or illness for a long time unable to work so that you are rushed to the hospital or cause permanent disability, which is given a score of 3.
4. Minor injuries are near-miss events that do not result in disability and only minor injuries are given a score of 2.
5. Near Injury is a near miss event that does not result in injury or does not require medical treatment given a value of 1.

C. Risk Matrix

Then perform calculations on the Risk Matrix table to find out the level of risk in these activities. Risk measurement to analyze and evaluate hazards. measurement is carried out by identifying how severe and when the hazard is likely to be. In other words, risk assessment is an in-depth look to determine situations, processes and other hazardous activities or hazards in the workplace. Risks are presented in a variety of ways to communicate the distribution of risk across areas of the workplace. The results of the risk assessment presented in the risk matrix are very important for making decisions about risk control. Risk can be calculated using the following formula:

$$Risk\ Level\ (R) = Likelihood\ (L) \times Impact\ (C)$$

3. Risk Control

That is, implementing the control that has been selected and fulfilling all the provisions that have been set by means of a control hierarchy. The stages of preparing Risk Control are carried out after getting the level of risk (level of risk), then the control efforts are arranged based on risk. Risk control is a stage hierarchy used in prevention and risk control that may occur.

RESULTS AND DISCUSSION

The results of the risk assessment using the HIRARC method can be seen in table 1 below:

Table 1. Risk Assessment

RISK ASSESSMENT					
No	Hazards Identified	Risk Assessment		Risk Value L x C	Risk Level
		Possible	Consequences		
1 (Puddle of water on the basement stairs/ ground floor)	Fall	2	2	4	MEDIUM
	Slip	3	2	6	MEDIUM
	Bump	2	3	6	MEDIUM
2 (1st Floor: Cutting activity with Grinding machine)	Bounced	3	3	9	HIGH
	Scratched grinding machine	3	3	9	HIGH
	Noise	4	2	8	HIGH
3 (2nd Floor: Scattered building materials)	Hit by nails	3	3	9	HIGH
	Stumble	4	2	8	HIGH
4 (3rd Floor : Activities at height still use wooden scaffolding)	Fall	4	3	12	HIGH
	Hit by nails	3	3	9	HIGH
	Dropping work tools	4	2	8	HIGH
5 (4th Floor: There are holes from the construction)	Fell into the hole	3	2	6	MEDIUM
	Fall	3	2	6	MEDIUM
	Dropping things	3	2	6	MEDIUM
6 (5th Floor : Workers throw unused building materials)	Hit by a throw	2	2	4	MEDIUM
	Dusty	4	2	8	HIGH
7 (6th Floor : Floor Uncut iron from construction)	Stabbed	3	4	12	HIGH
8 (7th Floor : Improper placement of building materials)	Struck by raw material	3	5	15	URGENT
9 (Evacuation Stairs on floors 1-7)	Fall	3	3	9	HIGH
	Bump	3	3	9	HIGH
10 (No first aid kit)	Unable to perform first aid	3	4	12	HIGH
11 (Not using personal protective equipment)	Object fall	4	5	20	URGENT
	Exposed to iron/ building materials	4	4	16	URGENT

Source: Data Processing

From the results of the risk assessment in table 1 above, then the hazard identification is carried out in each activity to determine the potential hazard and then analyzed and then determined how to control it. The result is as follows:

1. *Activity 1 (Puddle of water on the basement stairs/ground floor):*

The first potential hazard in puddles on the basement stairs can cause workers to "fall" due to the presence of moss in the puddles as a result of water deposition that is too long and not exposed to sunlight. The second potential hazard is "slipping", one of which is caused by some workers not wearing safety shoes, so they can slip when they go straight through puddles of water.

The third potential hazard can be "colliding" with objects around due to the absence of lighting so workers cannot clearly see what objects are around the basement stairs. To control these three potential hazards, immediately remove the water and then make a temporary water flow/channel so that when it rains it does not stagnate and does not pose a potential hazard.

2. *Activity 2 (1st Floor: Cutting activity with Grinding machine):*

The first potential hazard in activities that use a grinding machine is being "bounced" from the cutting iron due to the absence of a guard on the grinding machine so that when cutting the pieces can bounce off towards the workers. The second potential hazard is "scratch" the grinding machine if the worker is not focused or in an unhealthy condition can be hit by the grinding wheel (cutting iron) because the rotating power of the machine is quite large and requires high focus. The third potential danger is that workers can experience permanent "deafness" due to noise from activities using a grinding machine due to the closed condition of the room on the ground floor (basement) and workers do not wear ear plugs. In order to control the first and second potential hazards, it is necessary to install protective equipment on the grinding machine, and to control the third potential hazard is to ensure that all workers use earplugs obediently.

3. *Activity 3 (2nd Floor: Scattered building materials):*

The first potential hazard in work activities on the second floor is "taken nails" from building materials scattered on the access road. The first way to control this potential hazard is to make SOPs about the problem and install warning signs on the main floor.

The second potential hazard is that workers can "stumble" because the scattered building materials block the worker's access road to the 3rd floor. The second way to control this potential hazard is to tidy up the building materials before carrying out further activities so as not to disturb them.

4. *Activity 4 (3rd Floor : Activities at height still use wooden scaffolding):*

The first potential hazard in work activities on the 3rd floor is "falling" of workers at a height due to the use of wooden scaffolding that is not strong because the manufacture of this wooden scaffold uses used wood.

The second potential hazard is that the "nails" from the scaffold made of used wood can still be seen with nails coming out of the wooden scaffolding which could cause workers to hit the nails. The third potential hazard is that workers "drop work tools" so that nearby workers are hit by the falling object due to the absence of a barrier on the wooden scaffolding base that is useful as a barrier to objects placed on the scaffolding floor. To control these three potential hazards by replacing wooden scaffolding with iron scaffolding in accordance with safety standards and always using personnel protective equipment (PPE).

5. *Activity 5 (4th Floor: There are holes from the construction):*

The first potential danger in working activities on the first 4th floor is that workers "fall" due to the holes from the construction which are only covered by thin fiber material and are not given warning signs. The second potential hazard is workers "falling over" due to lack of attention to road access on the 4th floor. The third potential hazard is that workers can "drop the workpiece" because there are parts of the holes that are not tightly closed so that objects can fall through the cracks of the holes and have an impact on workers who are below. To control the three potential hazards, make sure the manhole cover is completely covered or use an iron plate

6. *Activity 6 (5th Floor : Workers throw unused building materials):*

The first potential hazard in work activities on the 5th floor is "throwing" due to workers not paying attention to safety so that workers throwing unused building materials can hit other workers. To control this first potential hazard, install warning signs about raw materials that are no longer used. The second potential hazard is "respiratory disorders" because the dust generated by workers often throws unused

building materials so that dust can fly and be easily inhaled. To control the second potential hazard by placing used building materials carefully.

7. *Activity 7 (6th Floor : Floor Uncut iron from construction):*

The first potential hazard in work activities on the 6th floor workers can be punctured by the iron that is below because of the worker's lack of attention to safety so that the iron from the construction has not been cut. The potential danger of further tripping is due to the uncut iron from the construction and the absence of warning signs in the area, so the possibility is quite high. In order to control these potential hazards, the uncut iron must be cut/removed immediately so that the potential hazards are also lost.

8. *Activity 8 (7th Floor : Improper placement of building materials):*

The potential hazard in work activities on the 7th floor is "stripped by raw materials" due to the inappropriate placement of materials and the condition is right in front of the elevator aisle which is only limited to polynet while the building material is higher than polynet so that it has an impact on the workers below. To control these potential hazards, signs must be installed regarding the placement of raw materials and the raw materials are immediately transferred to the safest place.

9. *Activity 9 (Evacuation Stairs on floors 1–7):*

The potential danger from work activities from floors 1 to 7 is on the evacuation route (emergency stairs), the first is the potential for workers to "fall" on the emergency stairs due to the absence of railings as a handrail when climbing stairs while the emergency stairs are the main access to go up or down. to the next floor. To control it, immediately install railings on each staircase. The second is that workers can "hit" when they fall due to not being able to support their body weight when using the railing as a holding tool on the ladder. The way to control it is to make sure workers always use PPE when working.

10. *Activity 10 (No first aid kit):*

The next potential hazard in the workplace is the absence of a first aid kit in the workplace so that the impact is that workers cannot perform first aid on other workers who are experiencing minor accidents. The way to control this potential hazard is to immediately provide a first aid kit that is placed in an area that is easy to see and reach and put up signs regarding the presence of a first aid kit.

11. *Activity 11 (Not using personal protective equipment):*

The potential hazard in the work environment is the lack of self-awareness about the importance of using PPE in this activity, workers are seen not using safety shoes and helmets, while their activities have high potential hazards, for example falling building materials. To control it, it is necessary to install warning signs about the importance of using PPE and the company is obliged to provide complete PPE which is maintained at all times.

HIRARC provides a little advantage over the conventional HIRA approach by including the criteria specific control measures providing a holistic and comprehensive approach to safer and healthier working (Tiwari et al., 2021)

In this study using the HIRAC approach, it was found that the results of the risk assessment as listed in table 1 above, it can be seen that there are 24 types of potential hazards in 11 identified work activities and of the 24 potential hazards there are 3 potential hazards with a risk level of "Urgent" (12.5%), 14 potential hazards with a risk level of "High" (58.3%) and 7 potential hazards with a risk level of "Medium" (29.2%), meaning that the level of risk that can become a potential hazard on the project is very high and most of them require urgent attention. attention (category "Urgent" and "High" = 70.8%). In general the hazard risk category "Low" must be carried out with Routine actions, "Medium" with Special Attention measures, "High" with Serious Caution measures and "Urgent" with Immediate actions. By categorizing the potential hazards based on the existing hazard risk categories, it is necessary to take action to be used as control by using a Control Hierarchy based on the hazard risk category.

From the results of the identification of HIRARC on 11 work activities which show there are 24 potential hazards that may occur in each activity, namely on activities from floors 1 to 7 where the potential hazards that may occur are caused by human factors (workers do not carry out activities properly such as throwing unused materials, not using PPE, etc.), safety facilities (railing, PPE, first aid kit) and the work environment (puddles, building materials, etc.). Of the 24 potential hazards, the factors causing the potential hazards have been analyzed and how to control them to eliminate or at least reduce potential hazards that may occur. However, a more in-depth study of the 24 potential hazards is needed in order to identify the root of the problem.

Hazards must be controlled at the source (where the problem occurs). The closer the control to the source of the hazard is, the better. This method is often referred to as applying engineering control. If this does not work, the hazard can often be controlled all the way to the worker, between source and worker. This method can be referred to as applying administrative controls. If this is not

possible, the hazard should be controlled at the worker level through the use of personal protective equipment (PPE), although this is the least desirable control.

Hazard control is an effort in risk management to produce a safe, healthy and safe condition in the work environment. The benefits of risk management are ensuring business continuity by reducing the risk of any hazardous activity, reducing costs for handling unwanted events, creating a sense of security among shareholders regarding the sustainability and safety of their investments, increasing understanding and awareness of operational risks for each element in the organization/company, and meet the requirements of the applicable laws environment.

Choosing a potential hazard control method can be done by:

1. Evaluate and select short-term and long-term controls
2. Implement short-term measures to protect workers until permanent controls can be placed
3. Implement long-term controls where reasonably practicable. For example, suppose a noise hazard is identified. Short-term control may require workers to wear hearing protection.

Long term, permanent control may remove or isolate the noise source.

Proper management of continuously identified hazards in the workplace can be carried out through an effective process. Ultimately, the individual or team identifying the hazard must ensure proper communication of the hazard to the appropriate workplace authority (project manager, department head, or designated person). Every HIRARC must be fully documented.

A special department/section responsible for hazards and controls is required to maintain all assessment records for a minimum of 3 years. This special section is more appropriate for every project/work carried out by the company because construction projects have their own unique characteristics depending on the type of work, location and other matters related to the project/work. In some cases, requirements under company management policy will specify a minimum time to keep records) which ensures there is an appropriate authority responsible for ensuring that effective and timely controls are in place for the hazard and communicating the results back to the originator. The manager or employer must support and approve the HIRARC results. Company management must communicate all HIRARC to employees, monitor follow-up and keep records.

Accuracy in risk management can affect overall HSE management which must later be described in the company's HSE program plan. Good management of the HSE program starting from planning, structuring and implementing it will give positive results in the form of increasing

productivity and have an impact on the realization of a safety culture in the company. Good management of HSE programs starting from planning, structuring and implementing them will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company.

From the results of this study, it can be seen that companies engaged in construction work must have an Occupational Health and Safety Management System. The part of the overall management system includes organizational structure, planning, responsibilities, implementation, procedures, processes and resources needed for the development of implementation, achievement, review and maintenance of occupational safety and health policies in order to create a safe, secure, efficient workplace. and productive.

The success of the Occupational Health and Safety Management System program in construction projects cannot be separated from the role of various parties who are involved, interact and work together. This should be a major consideration in the implementation of construction project development carried out by the project team and all management from various parties involved in it. Each party has a shared responsibility that supports each other for the successful implementation of a construction project which is marked by a positive evaluation of the implementation of the occupational safety and health program.

The good HSE management starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company (Kabul & Madiistriyatno, 2021).

HSE is one of the functions of Human Resource Management.. HSE requires commitment from top management and in its implementation requires a special program that includes hazard identification, risk control and assessment, information and data storage and training. In addition, HSE also requires active participation from all elements of the organization in order to build a safety culture as the main pillar of HSE. At the heart of HSE management is an organizational commitment to a comprehensive HSE effort. This effort must be coordinated from top management to include all members of the organization and must also be reflected in managerial actions (Kabul, 2020)

The HSE management system is part of the overall management which includes organizational structure, planning, responsibilities, implementation, procedures, processes, and other resources needed for development, implementation, achievement, assessment and maintenance. HSE policy in the context of controlling risks related to work activities in order to create a safe, efficient, and productive workplace (Kabul, 2020).

In relation to HSE in construction projects, of course, the management of human resources in the

construction sector also has a very important role like other fields. work. Moreover, earlier in the introduction it was stated that the construction sector is a field of work that is very risky to potential hazards in the workplace.

The presence of HSE experts, work procedures related to HSE, strict enforcement of rules and workers trained in HSE will ultimately shape a culture of safety and health in the workplace. With the development of a culture of safety and health in a company, it will have an impact on the company's overall performance.

CONCLUSION

The first conclusion from this research is that the OSH program implemented by the company is carried out through the QHSE Department where twice a week representatives from the QHSE Department come to the project site to carry out routine inspections in the first week related to HSE from work by conducting routine checks. And the results of this examination will be brought into discussion at the Implementation meeting which is held every Friday. The QHSE department will discuss activities or objects that have the potential to have risks to obtain repair or control solutions so that these risks can be reduced or eliminated..

The second conclusion, the dangers of using HIRARC in construction projects is to look at the potentials that will cause hazards that can lead to accidents, such as the use of unprotected grinding machines, height activities using non-standard OSH scaffolding, workers using building materials, placement of building materials. that are not appropriate and use raw materials using Tower Crane with workers who do not use PPE. Of these potential hazards, there are some that have the highest impact, namely "Extreme", which results in more than one person being involved in an accident. So from the results of the researchers can perform calculations with the Risk Matrix which will later show the level of risk in the potential hazard.

And the third conclusion, that in carrying out risk management must include planning, risk, risk, and risk. From the results of observations about the possible risk of accidents using the HIRARC method above, the company must create and maintain procedures to carry out hazards, risks, and risks as needed by exhaling air in the basement, creating protective pairs, using earplugs, making SOPs, standard OSH scaffolding, installation of manhole covers, installation of warning signs, using iron that comes out of the floor, using PPE, and providing first aid kits. After that, the next step is to communicate with all relevant parties with a focus on how to recognize these hazards, the risks, what they face and how to overcome them.

Based on the results of the research that has been done, the researchers would like to give some suggestions for the company, the first is that the company as the owner of the building must immediately hire HSE experts on each project so

that the company's QHSE Department only receives reports and proposals which will later be used as SOPs on next construction projects.

The second suggestion is that it is necessary to carry out Safety Induction, Fire and Earthquake Simulations at least once a month in order to always remind workers of the importance of Occupational Safety. Environmental Health is a shared task.

The third suggestion is that the company, in this case the QHSE team, must conduct regular socialization of safety rules so that workers also understand HSE and know what dangers or sanctions will be received by workers and the company.

The fourth suggestion is that the company must further equip adequate PPE and adapt it to their work as a form of responsibility as the organizer of this construction project.

And the fifth suggestion is that the company needs to give rewards or sanctions so that workers in carrying out their actions are better or more careful and get the results of their actions..

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HIRARC METHOD APPROACH AS ANALYSIS TOOLS IN FORMING OCCUPATIONAL SAFETY HEALTH MANAGEMENT AND CULTURE

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ABSTRACT

The purpose of this study is to observe and analyze the potential hazards that can cause accidents in the activity of lifting building materials using Tower Crane on a construction project. The method used in this research is Hazard Identification, Risk Assessment and Risk Control (HIRARC). By using this method, it is hoped that it can reduce the number of accidents that occur, find out the causes of accidents, and establish control measures. The results of the study indicate that there are 11 risks in activities that have the potential to cause accidents. Where 2 risks have an "Extreme" level of danger, namely an accident with more than one person and the status is "Urgent" so that it needs immediate treatment, 4 risks are classified as "High" which need serious attention and 2 risks are "Medium" which requires special attention. The conclusion of the research is that companies must establish and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using earplugs, making SOPs, using scaffolding, installing covers- holes, put up warning signs, cut metal out of the floor, used personnel protective equipment (PPE), and provided a first aid kit. It is recommended that the company immediately recruit HSE experts on each project so that the company's Quality Health Safety Environment (QHSE) Department only receives reports and proposals which will later be used as SOPs for the next construction project.

Key words: Accident, Hazard, HIRARC, HSE, Risk

PENDEKATAN METODE HIRARC SEBAGAI ALAT ANALISIS DALAM MEMBENTUK MANAJEMEN DAN BUDAYA KESELAMATAN -KESEHATAN KERJA

ABSTRAK

Tujuan dari penelitian ini adalah untuk mengamati dan menganalisis potensi bahaya yang dapat menyebabkan terjadinya kecelakaan pada aktivitas pengangkatan material bangunan menggunakan *Tower Crane* pada suatu proyek konstruksi. Metode yang digunakan dalam penelitian ini adalah *Hazard Identification, Risk Assessment and Risk Control (HIRARC)*. Dengan menggunakan metode ini diharapkan dapat menekan angka kecelakaan yang terjadi, mengetahui penyebab kecelakaan, dan menetapkan tindakan pengendalian. Hasil penelitian menunjukkan bahwa terdapat 11 risiko pada aktivitas yang berpotensi terjadinya kecelakaan. Dimana 2 risiko memiliki tingkat bahaya "Extreme" yaitu kecelakaan lebih dari satu orang dan berstatus "Urgent" sehingga perlu penanganan segera, 4 risiko tergolong "High" yang perlu mendapat perhatian serius dan 2 risiko berstatus "Medium" yang memerlukan perhatian khusus. Kesimpulan penelitian adalah perusahaan harus membuat dan memelihara prosedur untuk melakukan identifikasi bahaya, penilaian risiko, dan pengendalian risiko sesuai kebutuhan dengan cara membuang air di basement, menggiling pasangan pelindung, menggunakan penyumbat telinga, membuat SOP, menggunakan perancah, memasang penutup. lubang, memasang tanda peringatan, memotong logam yang keluar dari lantai, menggunakan Alat Pelindung Diri (APD), dan menyediakan kotak P3K. Disarankan agar perusahaan segera merekrut tenaga ahli K3 pada setiap proyek sehingga Departemen *Quality Health Safety Environment (QHSE)* perusahaan hanya menerima laporan dan proposal yang nantinya akan digunakan sebagai SOP pada proyek konstruksi selanjutnya.

Kata kunci: Bahaya, HIRARC, Kecelakaan, K3, Risiko Risiko

INTRODUCTION

In 2021, The Director of BP Jamsostek Services, Roswita Nilakurnia, explained that the first order of work accidents is in the work location. BPJS Employment or BPJamsostek recorded around 65.89 percent of work accident cases claimed by participants, occurred at work locations. The first sequence of work accidents is in the work location, and most occur in the morning. A total of 65.89 percent of work accidents occur in the work location, then 25.77 percent of accidents in traffic, and only 8.33 percent outside the work location (<https://finansial.bisnis.com/read/20210901/215/14>

[36724/bpis-ketenagakerjaan-catat-6589-persen-kecelakaan-terjadi-di-dalam-lokasi-kerja](https://finansial.bisnis.com/read/20210901/215/14)).

The main cause of work accidents is due to the skills and expertise of company leaders and supervisors, this can be overcome by holding special HSE training aimed at all workers and staff in the workplace and HSE training must be carried out by all workers and staff (Patel, Raichura & Pitroda,, 2021)

OSH is Occupational Safety and Health with the understanding of providing protection to everyone in the workplace, which is related to the transfer of raw materials, use of construction work equipment, production processes and the environment around

the workplace. Construction activities are an important element in development which in carrying out these construction activities cause various unwanted impacts, including those concerning aspects of occupational safety and health.

Occupational health and safety effects are important for organizations. Working in a safe environment leads to job satisfaction of employees. Leading to Job value, contentment, excitement, attachment to their job, reduced absenteeism, punctuality and low turnover rates (.Sembe & Amos, 2017).

Improving the organization's culture will increase organizational commitment and decrease employee turnover intentions (Husainah & Hanifah, 2021)

Safety management can estimate risks and accidents that can occur that may endanger all workers so that work safety is very important to be able to minimize hazards and risks in a definite and structured manner, especially in construction work (Saeed, 2017)

In construction project work, there are those who are less concerned about work safety issues when carrying out construction work, this may be due to a lack of information on project workers in using personal protective equipment which resulted in many workers having accidents ranging from ordinary injuries to death. (Widiastuti, Purba, Purba, 2020).

Purohit, et al (2018) states that construction is a high hazard industry that comprises a wide range of activities involving construction, alteration or repair. Examples include residential construction, bridge erection, excavations, demolitions and large scale painting jobs. Hazard identification and risk analysis is carried for identification of undesirable events that can leads to a hazard. The analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects.

Accidents are unavoidable occurrences on construction site all over the world with a lot of research done on mitigating it from source. The regular practice of safety known to building contractors is basically provision of personal protective equipment (Oreloluwa & Olasunkanmi, 2018).

Salim, et al (2017) states that common physical hazards at the building construction sites are slip, trip and fall, electrocution, noise and vibration. In some other cases, they are due to falling debris, nails, and sharp item.

Therefore, research on the identification of potential hazards is still a very interesting study, especially if it is extended to the full management of HSE.

The research was conducted at one of the largest state-owned companies in the construction sector where the construction sector is one area that has the potential to cause work accidents and the potential for accidents is high in the activity of

lifting building materials using Tower Cranes on construction projects. Because this process determines the speed of construction of a construction project and often time is running out to complete the apartment, it puts the operator under pressure, which results in miscommunication to the workers below to bind the building materials to be brought up. So that the fastening is not tight because in a hurry there is a potential hazard that has an impact on workers who are in the Tower Crane activity area.

So to protect workers in doing their jobs, companies need to implement an integrated Occupational Health and Safety (OHS) Management System program aimed at reducing and preventing the possibility of accidents and occupational diseases. The construction sector is one sector that has a high potential for danger and a lot of work accidents occur in this sector. Health, Safety and Environment (HSE) is very important for employees and companies in order to achieve a high and optimal level of work productivity. The research was conducted with a qualitative descriptive approach. The data used in the study were obtained from the results of worker interviews. the difference with previous research on workplaces that only identified occupational hazards, this study also wanted to know whether the HSE program had been carried out by the company or not. After the data was obtained, data analysis was carried out using the HIRARC method. Based on the background of the HSE problem above, the formulation of the problem in this study is as follows;

1. Has the company implemented the HSE program ?
2. How to identify and analyze occupational accident hazards using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method.
3. How to do good risk management to achieve Zero Accident in construction projects.

METHOD

HIRARC performed on all activities to determine activities which contain potential hazards and have a serious impact on occupational safety and health (Indragiri & Yuttya, 2020)

This study uses the Hazard Identification Risk Assessment and Risk Control (HIRARC) approach, which is a method to prevent or minimize work accidents. HIRARC is a method that starts from determining the type of work activity which then identifies the source of the hazard so that the risk is obtained.

HIRARC is a process of identifying hazards (Hazard Identification) that can occur in all company activities, then conducting a risk assessment (Risk Assessment) of the hazards that occur, then making hazard control (Risk Control) in order to minimize high risk levels to low (Sitepu & Simanungkalit, 2020).

This whole process is also called management risk (risk management). HIRARC is a key element in the system occupational safety and health management which is directly related to prevention and control of hazards. Besides, HIRARC too is part of the risk management system (risk management). according to OHSAS 18001, HIRARC should be carried out in all organizational activities to determine organizational activities that contain potential hazards and have a serious impact on occupational safety and health.

Furthermore, the results of HIRARC become input for the preparation of objectives and HSE targets to be achieved, which are outlined in the work program. From the groove in below it can be seen that HIRARC is the starting point for OHS management. If HIRARC is not carried out properly then the application of HSE will be in the wrong direction (misguided), random or virtual because they are not able to handle the main issue at hand within the organization.

The HIRARC method follows the following steps:

1. *Hazard Identification* :

Hazard identification is the process of identifying all hazards in the workplace. There is no set method for grouping agricultural injury and illness hazard (Chauhan & Siddiqui, 2018).

Hazard identification can be done through the following steps:

- a) Make a list of all objects of machines, work equipment, materials, work processes, work systems, working conditions that exist in the workplace.
- b) Check all objects in the workplace and its surroundings.
- c) Conduct interviews with workers who work in the workplace related to these objects.
- d) Accident review, first aid records and other information.
- e) Record all identified hazards.

The use of the likelihood of hazard method and severity of hazard can give good results good at work risk assessment (Desianna, & Yushannanta, 2020)

2. *Risk Assessment*:-

Risk assessment involves determining the impact level and recurrence of risk using available information. Moreover, in the risk analysis process, different factors, such as effects of recognized risks on project objectives, manageability, timing, the probability of occurrence, and relationship to other risks, must be considered. All these factors provide a better understanding of each risk type and increase the capacity for adoption of an adequate and appropriate approach to mitigating such risks (Jaber, 2019).

The organization must establish procedures regarding hazard identification identification) risk assessment (risk assessment work

environment, and determine control work or abbreviated HIRARC. This whole process is called as risk management (Kusumawardhani, Kasjono & Purwanto, 2019).

Putra, et al (2019) states accident risk must be analyzed in which the results of the risk analysis can assist company management in deciding whether the risk can be controlled or avoided.

Risk is the possibility of an accident or loss in a certain period of time or a certain operating cycle. The level of risk is the multiplication between the level of frequency (Likelihood) and the severity (consequence) of an event that can cause losses. At this risk assessment stage, the assessment follows:

A. Frequency Level (Likelihood)

That is how often workers are exposed to potential hazards. To be able to make the best estimate, we must consider the following:

1. Often the value is 5, the probability of exposure is between 90-100%.
2. Often the score is 4, the probability of exposure is between 60-89%.
3. While the score is 3, the probability of exposure is between 40-39%.
4. Rarely the value is 2, the probability of exposure is between 10-39%
5. Rarely the value is 1, the probability of exposure is between <10%.

B. Severity Level (Concequence)

The level of impact (consequence or severity) of an accident or illness can be categorized into 5 (five) categories as follows:

1. Extreme is an accident that causes the death of more than 1 person and is given a value of 5.
2. Fatal is an accident that causes a single death given a value of 4.
3. Serious Injury is an accident that causes serious injury or illness for a long time unable to work so that you are rushed to the hospital or cause permanent disability, which is given a score of 3.
4. Minor injuries are near-miss events that do not result in disability and only minor injuries are given a score of 2.
5. Near Injury is a near miss event that does not result in injury or does not require medical treatment given a value of 1.

C. Risk Matrix

Then perform calculations on the Risk Matrix table to find out the level of risk in these activities. Risk measurement to analyze and evaluate hazards. measurement is carried out by identifying how severe and when the hazard is likely to be. In other words,

risk assessment is an in-depth look to determine situations, processes and other hazardous activities or hazards in the workplace. Risks are presented in a variety of ways to communicate the distribution of risk across areas of the workplace. The results of the risk assessment presented in the risk matrix are very important for making decisions about risk control. Risk can be calculated using the following formula:

$$\text{Risk Level (R)} = \text{Likelihood (L)} \times \text{Impact (C)}$$

3. Risk Control

That is, implementing the control that has been selected and fulfilling all the provisions that have been set by means of a control hierarchy. The stages of preparing Risk Control are carried out after getting the level of risk (level of risk), then the control efforts are arranged based on risk. Risk control is a stage hierarchy used in prevention and risk control that may occur (Tarwaka, 2017)

RESULTS AND DISCUSSION

The results of the risk assessment using the HIRARC method can be seen in table 1 below:

Table 1. Risk Assessment

No	Hazards Identified	Risk Assessment		Risk Value L x C	Risk Level
		Possible	Consequences		
1 (Puddle of water on the basement stairs/ ground floor)	Fall	2	2	4	MEDIUM
	Slip	3	2	6	MEDIUM
	Bump	2	3	6	MEDIUM
2 (1st Floor: Cutting activity with Grinding machine)	Bounced	3	3	9	HIGH
	Scratched grinding machine	3	3	9	HIGH
	Noise	4	2	8	HIGH
3 (2nd Floor: Scattered building materials)	Hit by nails	3	3	9	HIGH
	Stumble	4	2	8	HIGH
4 (3rd Floor : Activities at height still use wooden scaffolding)	Fall	4	3	12	HIGH
	Hit by nails	3	3	9	HIGH
	Dropping work tools	4	2	8	HIGH
5 (4th Floor: There are holes from the construction)	Fell into the hole	3	2	6	MEDIUM
	Fall	3	2	6	MEDIUM
	Dropping things	3	2	6	MEDIUM
6 (5th Floor : Workers throw unused building materials)	Hit by a throw	2	2	4	MEDIUM
	Dusty	4	2	8	HIGH
7 (6th Floor : Floor Uncut iron from construction)	Stabbed	3	4	12	HIGH
8 (7th Floor :	Struck by raw	3	5	15	URGENT

Improper placement of building materials)	material				
9 (Evacuation Stairs on floors 1-7)	Fall	3	3	9	HIGH
	Bump	3	3	9	HIGH
10 (No first aid kit)	Unable to perform first aid	3	4	12	HIGH
11 (Not using personal protective equipment)	Object fall	4	5	20	URGENT
	Exposed to iron/ building materials	4	4	16	URGENT

Source: Data Processing

From the results of the risk assessment in table 1 above, then the hazard identification is carried out in each activity to determine the potential hazard and then analyzed and then determined how to control it. The result is as follows:

1. Activity 1 (Puddle of water on the basement stairs/ground floor):

The first potential hazard in puddles on the basement stairs can cause workers to "fall" due to the presence of moss in the puddles as a result of water deposition that is too long and not exposed to sunlight. The second potential hazard is "slipping", one of which is caused by some workers not wearing safety shoes, so they can slip when they go straight through puddles of water.

The third potential hazard can be "colliding" with objects around due to the absence of lighting so workers cannot clearly see what objects are around the basement stairs. To control these three potential hazards, immediately remove the water and then make a temporary water flow/channel so that when it rains it does not stagnate and does not pose a potential hazard.

2. Activity 2 (1st Floor: Cutting activity with Grinding machine):

The first potential hazard in activities that use a grinding machine is being "bounced" from the cutting iron due to the absence of a guard on the grinding machine so that when cutting the pieces can bounce off towards the workers. The second potential hazard is "scratch" the grinding machine if the worker is not focused or in an unhealthy condition can be hit by the grinding wheel (cutting iron) because the rotating power of the machine is quite large and requires high focus. The third potential danger is that workers can experience permanent "deafness" due to noise from activities using a grinding machine due to the closed condition of the room on the ground floor (basement) and workers do not wear ear plugs. In order to control the first and second potential hazards, it is necessary to install protective equipment on the grinding machine, and to

control the third potential hazard is to ensure that all workers use earplugs obediently.

3. *Activity 3 (2nd Floor: Scattered building materials) :*

The first potential hazard in work activities on the second floor is "taken nails" from building materials scattered on the access road. The first way to control this potential hazard is to make SOPs about the problem and install warning signs on the main floor.

The second potential hazard is that workers can "stumble" because the scattered building materials block the worker's access road to the 3rd floor. The second way to control this potential hazard is to tidy up the building materials before carrying out further activities so as not to disturb them.

4. *Activity 4 (3rd Floor : Activities at height still use wooden scaffolding):*

The first potential hazard in work activities on the 3rd floor is "falling" of workers at a height due to the use of wooden scaffolding that is not strong because the manufacture of this wooden scaffold uses used wood.

The second potential hazard is that the "nails" from the scaffold made of used wood can still be seen with nails coming out of the wooden scaffolding which could cause workers to hit the nails. The third potential hazard is that workers "drop work tools" so that nearby workers are hit by the falling object due to the absence of a barrier on the wooden scaffolding base that is useful as a barrier to objects placed on the scaffolding floor. To control these three potential hazards by replacing wooden scaffolding with iron scaffolding in accordance with safety standards and always using personnel protective equipment (PPE).

5. *Activity 5 (4th Floor: There are holes from the construction):*

The first potential danger in working activities on the first 4th floor is that workers "fall" due to the holes from the construction which are only covered by thin fiber material and are not given warning signs. The second potential hazard is workers "falling over" due to lack of attention to road access on the 4th floor. The third potential hazard is that workers can "drop the workpiece" because there are parts of the holes that are not tightly closed so that objects can fall through the cracks of the holes and have an impact on workers who are below. To control the three potential hazards, make sure the manhole cover is completely covered or use an iron plate

6. *Activity 6 (5th Floor : Workers throw unused building materials):*

The first potential hazard in work activities on the 5th floor is "throwing" due to workers not paying attention to safety so that workers throwing unused building materials can hit other workers. To control this first potential hazard, install warning signs about raw materials that are no longer used. The second potential hazard is "respiratory disorders" because the dust generated by workers often throws unused building materials so that dust can fly and be easily inhaled. To control the second potential hazard by placing used building materials carefully.

7. *Activity 7 (6th Floor : Floor Uncut iron from construction):*

The first potential hazard in work activities on the 6th floor workers can be punctured by the iron that is below because of the worker's lack of attention to safety so that the iron from the construction has not been cut. The potential danger of further tripping is due to the uncut iron from the construction and the absence of warning signs in the area, so the possibility is quite high. In order to control these potential hazards, the uncut iron must be cut/removed immediately so that the potential hazards are also lost.

8. *Activity 8 (7th Floor : Improper placement of building materials):*

The potential hazard in work activities on the 7th floor is "stripped by raw materials" due to the inappropriate placement of materials and the condition is right in front of the elevator aisle which is only limited to polynet while the building material is higher than polynet so that it has an impact on the workers below. To control these potential hazards, signs must be installed regarding the placement of raw materials and the raw materials are immediately transferred to the safest place.

9. *Activity 9 (Evacuation Stairs on floors 1–7):*

The potential danger from work activities from floors 1 to 7 is on the evacuation route (emergency stairs), the first is the potential for workers to "fall" on the emergency stairs due to the absence of railings as a handrail when climbing stairs while the emergency stairs are the main access to go up or down. to the next floor. To control it, immediately install railings on each staircase. The second is that workers can "hit" when they fall due to not being able to support their body weight when using the railing as a holding tool on the ladder. The way to control it is to make sure workers always use PPE when working.

10. *Activity 10 (No first aid kit):*

The next potential hazard in the workplace is the absence of a first aid kit in the workplace so that the impact is that workers cannot perform first aid on other workers who are experiencing minor accidents. The way to control this potential hazard is to immediately provide a first aid kit that is placed in an area that is easy to see and reach and put up signs regarding the presence of a first aid kit.

11. *Activity 11 (Not using personal protective equipment):*

The potential hazard in the work environment is the lack of self-awareness about the importance of using PPE in this activity, workers are seen not using safety shoes and helmets, while their activities have high potential hazards, for example falling building materials. To control it, it is necessary to install warning signs about the importance of using PPE and the company is obliged to provide complete PPE which is maintained at all times.

Tiwari, et al (2021) conclude that HIRAC provides a little advantage over the conventional HIRA approach by including the criteria specific control measures providing a holistic and comprehensive approach to safer and healthier working.

In this study using the HIRAC approach, it was found that the results of the risk assessment as listed in table 1 above, it can be seen that there are 24 types of potential hazards in 11 identified work activities and of the 24 potential hazards there are 3 potential hazards with a risk level of "Urgent" (12.5%), 14 potential hazards with a risk level of "High" (58.3%) and 7 potential hazards with a risk level of "Medium" (29.2%), meaning that the level of risk that can become a potential hazard on the project is very high and most of them require urgent attention (category "Urgent" and "High" = 70.8%). In general the hazard risk category "Low" must be carried out with Routine actions, "Medium" with Special Attention measures, "High" with Serious Caution measures and "Urgent" with Immediate actions. By categorizing the potential hazards based on the existing hazard risk categories, it is necessary to take action to be used as control by using a Control Hierarchy based on the hazard risk category.

From the results of the identification of HIRARC on 11 work activities which show there are 24 potential hazards that may occur in each activity, namely on activities from floors 1 to 7 where the potential hazards that may occur are caused by human factors (workers do not carry out activities properly such as throwing unused materials, not using PPE, etc.), safety facilities (railing, PPE, first aid kit) and the work environment (puddles, building materials, etc.). Of the 24 potential hazards, the factors causing the potential hazards have been analyzed and how to

control them to eliminate or at least reduce potential hazards that may occur. However, a more in-depth study of the 24 potential hazards is needed in order to identify the root of the problem.

Hazards must be controlled at the source (where the problem occurs). The closer the control to the source of the hazard is, the better. This method is often referred to as applying engineering control. If this does not work, the hazard can often be controlled all the way to the worker, between source and worker. This method can be referred to as applying administrative controls. If this is not possible, the hazard should be controlled at the worker level through the use of personal protective equipment (PPE), although this is the least desirable control.

Hazard control is an effort in risk management to produce a safe, healthy and safe condition in the work environment. The benefits of risk management are ensuring business continuity by reducing the risk of any hazardous activity, reducing costs for handling unwanted events, creating a sense of security among shareholders regarding the sustainability and safety of their investments, increasing understanding and awareness of operational risks for each element in the organization/company, and meet the requirements of the applicable laws environment (Darwis, et al, 2021).

Choosing a potential hazard control method can be done by:

1. Evaluate and select short-term and long-term controls
2. Implement short-term measures to protect workers until permanent controls can be placed
3. Implement long-term controls where reasonably practicable. For example, suppose a noise hazard is identified. Short-term control may require workers to wear hearing protection.

Long term, permanent control may remove or isolate the noise source.

Proper management of continuously identified hazards in the workplace can be carried out through an effective process. Ultimately, the individual or team identifying the hazard must ensure proper communication of the hazard to the appropriate workplace authority (project manager, department head, or designated person). Every HIRARC must be fully documented.

A special department/section responsible for hazards and controls is required to maintain all assessment records for a minimum of 3 years. This special section is more appropriate for every project/work carried out by the company because construction projects have their own unique characteristics depending on the type of work, location and other matters related to the project/work. In some cases, requirements under company management policy will specify a minimum time to keep records) which ensures there is an appropriate authority responsible for ensuring

that effective and timely controls are in place for the hazard and communicating the results back to the originator. The manager or employer must support and approve the HIRARC results. Company management must communicate all HIRARC to employees, monitor follow-up and keep records.

Accuracy in risk management can affect overall HSE management which must later be described in the company's HSE program plan. Good management of the HSE program starting from planning, structuring and implementing it will give positive results in the form of increasing productivity and have an impact on the realization of a safety culture in the company. Effective HSE management resulting from good planning and arrangement as well as implementation and providing positive results will increase productivity in the end will result in a safety culture in the company.

From the results of this study, it can be seen that the company must have an occupational safety and health management system, especially in jobs that have a high risk of accidents such as construction work. This occupational safety and health management system consists of an organizational structure, a planning system, responsibilities, work performance, process and operating procedures as well as the availability of resources in accordance with the needs of developing an occupational safety and health system to create safe, healthy, efficient and effective working conditions.

The success of the Occupational Health and Safety Management System program in construction projects cannot be separated from the role of various parties who are involved, interact and work together. This should be a major consideration in the implementation of construction project development carried out by the project team and all management from various parties involved in it. Each party has a shared responsibility that supports each other for the successful implementation of a construction project which is marked by a positive evaluation of the implementation of the occupational safety and health program.

Good HSE management starts with good planning and arrangement so that its implementation can produce a positive impact, namely increasing work productivity which affects the realization of a safety culture in the company (Kabul, 2020).

HSE is one of the functions of Human Resource Management. HSE requires commitment from top management and in its implementation requires a special program that includes hazard identification, risk control and assessment, information and data storage and training. Specifically for this aspect of the training, Priatna (2020) stated are very important for companies to pay attention to the implementation of the education and training program has an effect on the work productivity and the effect of the implementation of the education

and training program is more dominant, this is because the implementation of the education and training program is more frequent and more applicable even though it still seems theoretical.

In addition, HSE also requires active participation from all elements of the organization in order to build a safety culture as the main pillar of HSE. At the heart of HSE management is an organizational commitment to a comprehensive HSE effort. This effort must be coordinated from top management to include all members of the organization and must also be reflected in managerial actions. Kabul, (2020) explicitly states that the HSE management system is part of the overall management which includes organizational structure, planning, responsibilities, implementation, procedures, processes, and other resources needed for development, implementation, achievement, assessment and maintenance. K3 policy in the context of controlling risks related to work activities in order to create a safe, efficient, and productive workplace.

In relation to HSE in construction projects, of course, the management of human resources in the construction sector also has a very important role like other fields. work. Moreover, earlier in the introduction it was stated that the construction sector is a field of work that is very risky to potential hazards in the workplace.

The presence of HSE experts, work procedures related to HSE, strict enforcement of rules and workers trained in HSE will ultimately shape a culture of safety and health in the workplace. With the development of a culture of safety and health in a company, it will have an impact on the company's overall performance.

CONCLUSION

The conclusions of this study are as follows:

1. The OSH program implemented by the company is carried out through the QHSE Department, which twice a week, a representative from the QHSE Department comes to the project site to carry out routine inspections in the first week related to OHS from the work by conducting routine inspections. And the results of this inspection will be brought into discussion at the Implementation meeting which is held every Friday. The QHSE department will discuss the activities or objects that have the potential to have risks in order to obtain repair or control solutions so that these risks can be reduced or eliminated.
2. Identifying the dangers of using the HIRARC method in construction projects is by looking at the potentials that will cause hazards that lead to accidents, such as iron cutting activities using unprotected grinding machines, activities at heights using non-standard K3 scaffolding, workers throwing building materials, placement of building materials that are not appropriate and activities

of lifting raw materials using Tower Crane with workers who do not use PPE. Of these potential hazards, there are some that have the highest impact, namely Extreme which leads to the accident of more than one person. So from the results of this identification, researchers can do calculations with the Risk Matrix which will later show the level of risk in the potential hazard.

3. In carrying out a risk management must include planning, hazard identification, risk assessment, and risk control. From the results of observations about the possible risk of accidents using the HIRARC method above, the company must create and maintain procedures to carry out hazard identification, risk assessment, and risk control as needed by removing water in the basement, grinding protective pairs, using ear plugs, making SOPs, use standard K3 scaffolding, install manhole covers, install warning signs, cut metal that comes out of the floor, use PPE, and provide a first aid kit. After that, the next step is to communicate and consult with all relevant parties with a focus on how workers recognize this hazard, the risks, what they are facing and how to overcome them..

Based on the results of the research that has been done, the researchers would like to provide some suggestions for the company as follows:

1. The company as the owner of the building must immediately employ HSE experts on each project so that the company's QHSE Department only accepts reports and proposals which will later be used as SOPs in the next construction project.
2. It is necessary to carry out Safety Induction, Fire and Earthquake Simulations at least once a month in order to always remind workers of the importance of Occupational Safety Health Environment is a shared task.
3. The company, in this case the QHSE team, must conduct socialization on routine work safety rules so that workers also understand HSE and know what dangers or sanctions will be received by workers and the company.
4. The company must further equip sufficient PPE and adapt it to its work as a form of responsibility as the organizer of this construction project
5. Companies need to give rewards or sanctions so that workers in carrying out their actions are better or more careful and get the results of their actions.

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