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Analysis of HIRARC Implementation and Understanding of HIRARC on Work Accidents through Work Environment

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A B S T R A C T

The study was conducted with the aim of analyzing the effect of HIRARC implementation and understanding of HIRARC both directly and through the work environment on work accidents. The research was conducted at PT ABC located in Nabire Regency. The research was conducted with a quantitative approach and included causal associative research. The sample in this study were 250 production employees of PT ABC and data collection was carried out using a questionnaire. The data analysis technique was carried out using path analysis. The results showed that the implementation and understanding of HIRARC directly have a significant effect on work accidents. Other results show that the implementation and understanding of HIRARC through the work environment have a significant effect on work accidents in production employees of PT ABC. The study implies that management must strengthen its commitment to integrating HIRARC into operations, provide ongoing practical training, and regularly evaluate OHS performance based on HIRARC effectiveness and work environment quality to support continuous improvement and reduce work accidents.

KATA KUNCI

Implementasi, Pengertian HIRARC, Lingkungan Kerja, Kecelakaan Kerja, Kesehatan dan Keselamatan Kerja (K3)

A B S T R A K

Penelitian ini dilakukan dengan tujuan untuk menganalisis pengaruh penerapan HIRARC dan pemahaman HIRARC baik secara langsung maupun melalui lingkungan kerja terhadap kecelakaan kerja. Penelitian dilakukan di PT ABC yang berlokasi di Kabupaten Nabire. Penelitian dilakukan dengan pendekatan kuantitatif dan termasuk penelitian asosiatif kausal. Sampel dalam penelitian ini adalah 250 karyawan produksi PT ABC dan pengumpulan data dilakukan dengan menggunakan kuesioner. Teknik analisis data dilakukan dengan menggunakan analisis jalur (*path analysis*). Hasil penelitian menunjukkan bahwa penerapan dan pemahaman HIRARC secara langsung berpengaruh signifikan terhadap kecelakaan kerja. Hasil lain menunjukkan bahwa penerapan dan pemahaman HIRARC melalui lingkungan kerja berpengaruh signifikan terhadap kecelakaan kerja pada karyawan bagian produksi PT ABC. Hasil penelitian ini mengimplikasikan bahwa manajemen harus memperkuat komitmen untuk mengintegrasikan HIRARC ke dalam operasi, memberikan pelatihan praktis yang berkelanjutan, dan secara teratur mengevaluasi kinerja K3 berdasarkan efektivitas HIRARC dan kualitas lingkungan kerja untuk mendukung perbaikan berkelanjutan dan mengurangi kecelakaan kerja.

1. Introduction

According to data from the Social Security Administration (BPJS) of Employment, the number of work accidents increased sharply: from 297,725 cases in 2022 to 370,747 cases in 2023, and reached 162,327 cases in the first five months of 2024. This shows that despite rapid technological advances, worker safety in the manufacturing and heavy industry sectors remains a major challenge in Indonesia. Furthermore, total work accident claims reached IDR 2.39 trillion in 2022, emphasizing the significant economic burden. An increasing trend also occurred in the number of claims for Death Insurance (JKM). The number of JKM claims in 2019 reached 31,324 cases. The number of claims then rose to 32,094 claims in 2020 and 104,769 claims in 2021. In 2022, 103,349 claims were recorded. During January - November 2023, the number of claims jumped to 121,531 cases.

Occupational Health and Safety (OHS) is a highly crucial aspect in the industrial sector, particularly in manufacturing, which is characterized by a high potential for workplace hazards [1]. One of the systematic and structured approaches globally used to manage occupational risks is Hazard Identification, Risk Assessment, and Risk Control (HIRARC) [2], [3]. HIRARC is an internationally recognized method for risk management that aims to identify hazards, assess the level of associated risks, and establish appropriate control measures to prevent workplace accidents. Optimal implementation of HIRARC can assist

companies in creating a safe work environment, increasing workers' awareness of potential risks, and minimizing the likelihood of incidents.

HIRARC serves as the foundation for identifying hazards, assessing risks, and determining control measures aimed at preventing workplace accidents [4]. However, the high rate of work-related accidents in Indonesia remains an unresolved issue, indicating that the implementation of occupational safety programs including the application of HIRARC has not yet been fully effective across many organizations. Workplace accidents not only impact the health and safety of employees but also lead to financial losses, decreased productivity, and disruptions to operational stability. A study demonstrated that the implementation of HIRARC can effectively reduce the risk of workplace accidents [5]. In addition to implementation, a research found that understanding of HIRARC also contributes significantly to the prevention of workplace accidents [6].

The implementation of HIRARC involves the application of systematic steps to identify hazards, assess risks, and carry out risk control measures in the workplace to prevent accidents and create a safe working environment. Understanding HIRARC goes beyond theoretical knowledge; it encompasses the ability of workers to apply its principles in real work situations. A solid understanding of HIRARC enables employees to be more vigilant, more disciplined in following safety procedures, and more proactive in maintaining a secure work environment. Therefore, strengthening employees' understanding of HIRARC is a strategic step in enhancing the effectiveness of the occupational health and safety (OHS) system within an organization. On the other hand, the work environment also plays a significant role in the occurrence of accidents. Unsafe working conditions such as confined workspaces, poor ventilation, inadequate lighting, slippery floors, or non-ergonomic equipment arrangements can greatly increase the risk of workplace accidents. Hence, the work environment acts as a critical intermediary between the implementation of HIRARC and the actual rate of work-related accidents. The better the condition of the work environment, the greater the likelihood that HIRARC implementation and understanding will successfully reduce workplace accident rates.

This research was conducted at PT ABC which is engaged in the manufacturing production sector. Based on the researcher's initial observation, it is known that the application of HIRARC which is only administrative in nature without being supported by a good understanding of all workers often makes this system not run optimally. Understanding HIRARC is an important element because it involves workers' awareness, knowledge, and attitude towards work hazards and their preventive measures. Without sufficient understanding, the implementation of HIRARC is only a formality and unable to prevent accidents in real terms. In addition, the work environment is also a key factor that can strengthen or weaken the effectiveness of HIRARC. A work environment that is unsafe, unorganized, or not in accordance with ergonomic principles, will still create a high potential for work accidents even though HIRARC has been implemented. Therefore, it is necessary to see how the role of the work environment as a mediating variable that bridges the relationship between the implementation and understanding of HIRARC on work accidents. Therefore, it is important to analyze how the implementation and understanding of HIRARC affect work accidents, either directly or through the work environment.

2. Research Method

The research was conducted with a quantitative approach. The type of research is included in causal associative research. The population in this study were production employees of PT ABC, totaling 250 employees. The sampling technique uses saturated samples, where the entire population is used as a sample in the study. Data collection was carried out using a questionnaire with the help of google form. The data analysis was carried out using Partial Least Square-Structural Equation Modeling (PLS-SEM) with the help of the SmartPLs program. The operational definition of variables in this study is as follows on Table 1.

3. Result and Discussion

3.1. Evaluating Outer Model

Based on the results of the testing, the outer model algorithm is obtained as on Figure 1.

Table 1. Operational Definition of Variables

Variable	Operational Definition	Indicator
HIRARC Implementation (X1)	HIRARC Implementation refers to the systematic application of the three main stages in occupational safety management: Hazard Identification, Risk Assessment, and Risk Control [7].	Hazard Quantity Risk Distribution Extreme Activities Maximum Risk Control Hierarchy Risk Score Reduction Action Details
Understanding of HIRARC (X2)	Employee understanding of HIRARC refers to their comprehension of a systematic method in occupational safety management used to identify hazards, assess risks, and implement risk control measures [7], [8].	Classifying Inferring Exemplifying Interpreting
Work Environment (Z)	Work environment refers to the overall conditions surrounding the workplace that influence employees in performing their tasks, both physically, psychologically, and socially [9], [10].	Workplace Lighting Working Temperature Workplace Humidity Noise Level Use of Color Required Space Ability to Work Employee Relations Work Safety
Work Accident (Y)	Work accident is an unexpected and undesired incident that occurs in the course of work and can result in injury, illness, property damage, or even death [11].	Work Effectiveness Employee Negligence OHS Facilities (Occupational Health and Safety Facilities) OHS Socialization Workload

3.1.1. Outer Loading

Outer loading is part of the convergent validity test, which examines the strength of the correlation between each indicator and its corresponding latent variable. An indicator is considered valid if it achieves a loading value of no less than 0.7 [12]. Based on the Table 2, it is known that the Implementation of HIRARC variable (X1) obtained the lowest outer loading value of 0.708 and the highest of 0.919. The understanding of HIRARC variable (X2) recorded the lowest outer loading value of 0.829 and the highest of 0.884. The Work Environment variable (Z) obtained the lowest outer loading value of 0.793 and the highest of 0.813. Meanwhile, the Work Accident variable (Y) recorded the lowest outer loading value of 0.791 and the highest of 0.919. These results indicate that all indicators for each variable meet the criteria for good convergent validity.

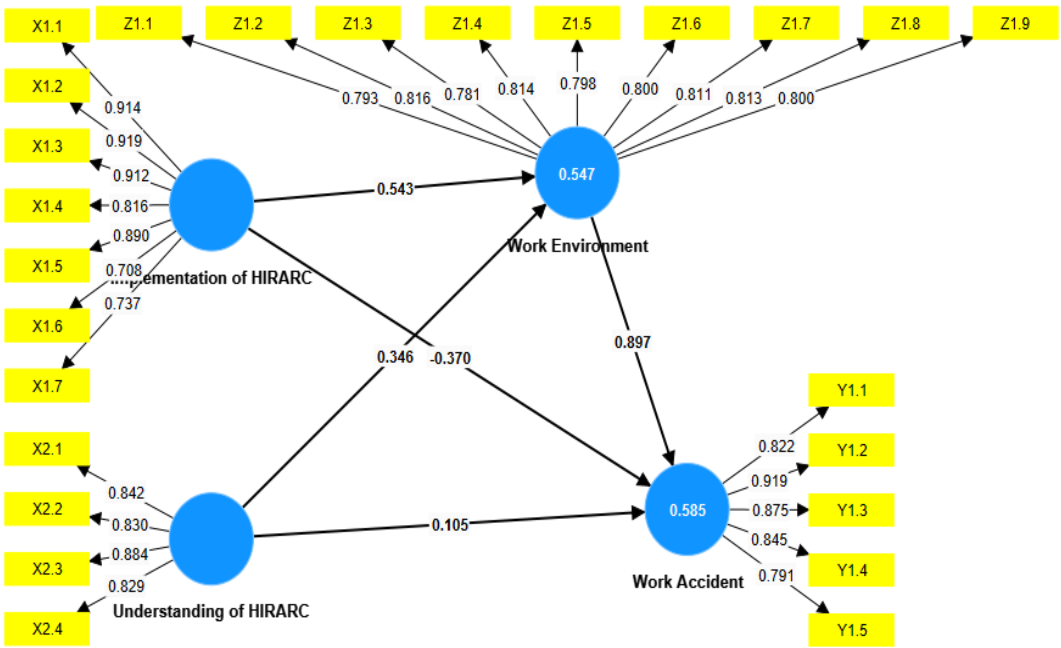

Figure 1. Outer Model Algorithm

Table 2. *Outer Loading*

	X1	X2	Y	Z
X1.1	0.914			
X1.2	0.919			
X1.3	0.912			
X1.4	0.816			
X1.5	0.890			
X1.6	0.708			
X1.7	0.737			
X2.1		0.842		
X2.2		0.830		
X2.3		0.884		
X2.4		0.829		
Y1.1			0.822	
Y1.2			0.919	
Y1.3			0.875	
Y1.4			0.845	
Y1.5			0.791	
Z1.1				0.793
Z1.2				0.816
Z1.3				0.781
Z1.4				0.814
Z1.5				0.798
Z1.6				0.800
Z1.7				0.811
Z1.8				0.813
Z1.9				0.800

Based on the Table 2, it is known that the Implementation of HIRARC variable (X1) obtained the lowest outer loading value of 0.708 and the highest of 0.919. The Understanding of HIRARC variable (X2) recorded the lowest outer loading value of 0.829 and the highest of 0.884. The Work Environment variable (Z) obtained the lowest outer loading value of 0.793 and the highest of 0.813. Meanwhile, the Work Accident variable (Y) recorded the lowest outer loading value of 0.791 and the highest of 0.919. These results indicate that all indicators for each variable meet the criteria for good convergent validity.

3.1.2. Average Variance Extracted (AVE)

Average variance extracted is a method used to evaluate discriminant validity for each construct and latent variable. The basis for decision-making in this test is that an AVE value greater than 0.50 indicates that the construct is valid, meaning it adequately explains more than half of the variance of its indicators [12].

Table 3. Discriminant Variable

	Average variance extracted
Implementation of HIRARC (X1)	0.716
Understanding of HIRARC (X2)	0.716
Work Accident (Y)	0.725
Work Environment (Z)	0.645

Based on the results of the Average Variance Extracted (AVE) test on Table 3, all constructs in the research model show AVE values above 0.50, which is the minimum threshold according to Fornell and Larcker's (1981) criteria for assessing discriminant validity. The AVE value for the HIRARC Implementation variable is 0.716, for HIRARC Understanding is 0.716, for Work Accidents is 0.725, and for Work Environment is 0.645. These values indicate that each construct is capable of explaining more than 50% of the variance of its respective indicators. Therefore, it can be concluded that all constructs demonstrate good discriminant validity.

3.1.3. Cross Loadings

Cross loadings is a method used to assess discriminant validity by examining the cross loading values. An indicator is considered valid when its loading on its assigned latent construct is higher than its loadings on other constructs [12]. The following Table 4 are the results of the cross loading test in this study.

Table 4. Cross Loadings

	X1	X2	Y	Z
X1.1	0.914	0.175	0.136	0.541
X1.2	0.919	0.187	0.131	0.547
X1.3	0.912	0.175	0.111	0.532
X1.4	0.816	0.135	0.045	0.441
X1.5	0.890	0.163	0.073	0.482
X1.6	0.708	0.526	0.422	0.608
X1.7	0.737	0.501	0.422	0.636
X2.1	0.355	0.842	0.349	0.479
X2.2	0.231	0.830	0.421	0.457
X2.3	0.352	0.884	0.452	0.485
X2.4	0.254	0.829	0.301	0.388
Y1.1	0.419	0.431	0.822	0.740
Y1.2	0.210	0.411	0.919	0.655
Y1.3	0.280	0.463	0.875	0.657
Y1.4	0.048	0.298	0.845	0.448
Y1.5	0.086	0.302	0.791	0.433
Z1.1	0.610	0.545	0.567	0.793
Z1.2	0.603	0.541	0.576	0.816
Z1.3	0.623	0.523	0.545	0.781
Z1.4	0.668	0.552	0.604	0.814
Z1.5	0.478	0.309	0.550	0.798
Z1.6	0.450	0.281	0.557	0.800
Z1.7	0.426	0.333	0.565	0.811
Z1.8	0.430	0.342	0.572	0.813
Z1.9	0.427	0.354	0.568	0.800

Based on the Table 4, it can be seen that the Implementation of HIRARC variable (X1) has cross loading values ranging from 0.708 to 0.919. The Understanding of HIRARC variable (X2) has cross loading values ranging from 0.829 to 0.884. The Work Environment variable (Z) shows cross loading values between 0.793 and 0.813. Meanwhile, the Work Accident variable (Y) has outer loading values ranging from 0.791 to 0.919. Accordingly, all indicators are considered valid, as each indicator loads more strongly on its respective construct than on others.

3.1.4. Fornell-Lacker Criterion

The Fornell-Larcker Criterion is a test used to assess the level of discriminant validity by comparing the square root of the AVE for each construct with the correlations between that construct and other constructs in the model. If the square root of the AVE for each construct is greater than the correlation values it has with other constructs, then the model is considered to

have good discriminant validity [13]. The following Table 5 are the results of the Fornell-Lacker criterion test.

Table 5. Fornell-Lacker Crition

	X1	X2	Y	Z
X1	0.846			
X2	0.355	0.846		
Y	0.264	0.457	0.852	
Z	0.665	0.538	0.707	0.803

Based on the Table 5, it is known that the square root of AVE of each variable is greater than that of other variables. In this regard, it can be concluded that all constructs in this model have met the criteria of discriminant validity.

3.1.5. Composite Reliability and Cronbach Alpha

Composite reliability is carried out with the aim of seeing how far the measuring instrument can be trusted. In a variable model, it is stated to be reliable if it obtains a composite reliability value of more than 0.60 [13]. Cronbach alpha is part of the reliability test, which can be declared reliable if it obtains a value of not less than 0.7. The following are the results of the composite reliability and Cronbach alpha tests in this study:

Table 6. Composite Reliability and Cronbach Alpha

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)
X1	0.934	0.940	0.946
X2	0.868	0.876	0.910
Y	0.906	0.918	0.929
Z	0.932	0.935	0.942

Based on Table 6, it is known that each variable obtains a composite reliability value of more than 0.60 and a cronbach alpha value of more than 0.70. In this regard, all variables in this study are declared reliable.

3.2. Evaluating Inner Model

3.2.1. Algorithm Inner Model

The algorithm inner model can be seen of Figure 2.

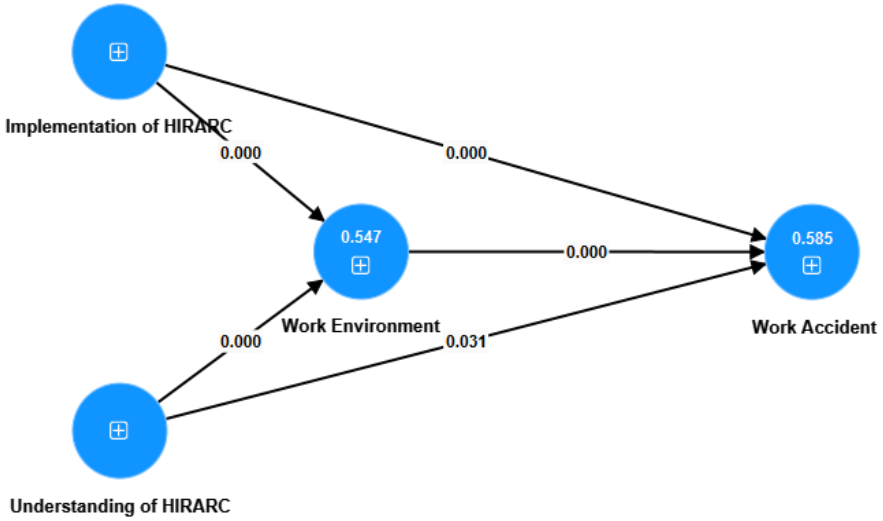

Figure 2. Inner Model Algorithm

3.2.2. R-Square

R-square is a test used to determine the extent of the impact on the dependent variable as a result of the influence of independent variables [13]. Based on the Table 7, the R-square value for the work environment variable is 0.547 or 54.7%. Meanwhile, the work accident variable has an R-square value of 0.585 or 58.5%. These values fall into the moderate category, indicating that the model has a sufficient level of explanatory power. Therefore, the data are deemed appropriate for further analysis.

Table 7. Value R Square

	R-square	R-square adjusted
Work Accident (Y)	0.585	0.580
Work Environment (Z)	0.547	0.543

3.2.3. Model Fit

Model Fit is a metric used to assess how well the model under study processes the data [13]. Model fit testing can be done by looking at the magnitude of the NFI value expressed as a percentage. The higher the percentage of NFI, the better the model is stated. Based on the Table 8, the NFI value is 0.491 or 49.1%. This means that the model is in the good category.

Table 8. Model Fit

	Saturated model	Estimated model
SRMR	0.146	0.146
d_ULS	6.966	6.966
d_G	5.798	5.798
Chi-square	5009.959	5009.959
NFI	0.491	0.491

3.3. Hypothesis Testing and Discussion

The result of hypothesis test can be seen on Table 9.

Table 9. Hypothesis Testing

	Original sample (O)	T statistics (|O/STDEV|)	P values	Decision
X1 → Y	-0.370	5.052	0.000	Accepted
X1 → Z	0.543	12.214	0.000	Accepted
X2 → Y	-0.105	2.161	0.031	Accepted
X2 → Z	0.346	7.447	0.000	Accepted
Z → Y	0.897	13.912	0.000	Accepted
X1 → Z → Y	-0.487	7.662	0.000	Accepted

3.3.1. Implementation of HIRARC on Work Accident

The results showed that the implementation of HIRARC has a significant influence on the level of work accidents. This indicates that the better the implementation of HIRARC in an organization, the lower the risk of occupational accidents. HIRARC is not just an administrative procedure, but a systematic approach that identifies potential hazards, assesses risks based on severity and likelihood of occurrence, and implements appropriate controls to reduce or eliminate these risks. Good implementation of HIRARC reflects a strong safety culture within a company. In many cases, workplace accidents occur due to lack of awareness of potential hazards or failure to implement appropriate control measures. When organizations routinely conduct hazard identification and risk assessment, potential accidents can be mapped early and prevented before they occur. The use of the risk control hierarchy, from elimination to the use of personal protective equipment (PPE), is key in reducing the incidence of accidents.

This finding is reinforced by various previous studies. For example, a study showed that the implementation of HIRARC in the aluminum industry directly contributed to reducing the number of work accidents [7]. Another study also proved that in the wood industry sector, the disciplined implementation of HIRARC was able to significantly reduce occupational risks through the application of engineering-based and administrative controls [14]. These studies support the argument that robust HIRARC practices result in tangible improvements in occupational safety. In addition, these results emphasize the importance of management involvement in ensuring that HIRARC implementation is not just documented, but actually implemented in the field. Commitment from the managerial level to field workers must be strengthened through training, periodic evaluation, and consistent supervision of the implementation of control measures. When every work unit understands and implements HIRARC correctly, the work system becomes safer and the risk of accidents can be optimally reduced.

3.3.2. Implementation of HIRARC on Work Environment

The results showed that the implementation of HIRARC has a significant influence on the work environment. This finding indicates that the consistent and comprehensive implementation of HIRARC is able to create a safer, more orderly, and conducive working environment for operational activities. In other words, the better the implementation of HIRARC in an organization, the more the quality of the work environment perceived by workers will improve. Effective implementation of HIRARC helps identify various sources of physical, chemical, biological, ergonomic, and psychosocial hazards in the workplace. Once these hazards are identified and assessed for risk, control measures are implemented to reduce or eliminate the risk. As a result, the work environment becomes more organized, free from potential accidents, and able to provide a sense of security and comfort for workers. This has a direct impact on the psychological well-being and work efficiency of employees [15], [16].

This finding is supported by research by reseracher who found that the implementation of HIRARC in manufacturing companies has a positive impact on improving work environment conditions, such as increased ventilation, lighting, and a more ergonomic workspace arrangement [17]. In addition, a study stated that HIRARC plays a role not only in reducing work accidents, but also in shaping a more disciplined and structured work environment through the administrative and technical controls applied [7]. In practice at PT ABC, when hazard identification and risk control become part of the work routine, the work process will run more smoothly and with less disruption. For example, a workspace that was previously cramped and full of dangerous tools can be rearranged based on the results of HIRARC so that it is more ergonomic and safer. Actions such as installing signs, improving ventilation, using PPE, and removing hazardous materials are concrete steps of implementing HIRARC that directly improve the quality of the work environment [18].

3.3.3. Understanding of HIRARC on Work Accident

The results showed that understanding of HIRARC has a significant influence on the level of work accidents. This means that the higher the level of workers' understanding of the concept and application of HIRARC, the less likely the occurrence of accidents in the workplace. Understanding HIRARC is the initial foundation of preventive action, where each individual in the organization realizes the importance of recognizing hazards, assessing risks, and carrying out appropriate controls. When workers have a good understanding of HIRARC, they can proactively identify potential hazards before they cause real harm. In addition, they will also be more aware of risky

actions and understand how to avoid them. Conversely, a poor understanding of HIRARC can lead to negligence, incorrect procedures, or disregard for safety protocols which ultimately increases the likelihood of workplace accidents.

This finding is supported by the research which shows that understanding of work risk management, including HIRARC, has a significant relationship with the level of work safety in the construction sector [7], [19], [20]. Another study in the chemical industry showed that employees with higher training and understanding of HIRARC had lower rates of work errors and were more disciplined in applying safety standards [21], [22]. This suggests that the cognitive aspect (understanding) has a real contribution to occupational risk reduction. Understanding HIRARC also contributes to the establishment of a safety culture in the workplace. When workers understand the value of each stage of HIRARC, they will collectively support the implementation of the safety management system and be actively involved in keeping themselves and others safe. This will create a more risk-aware and responsible work environment [23].

3.3.4. Understanding of HIRARC on Work Environment

The results revealed that understanding of HIRARC has a significant effect on the work environment. This means that the higher the level of employee understanding of the concepts and principles of HIRARC, the better the quality of the work environment created. This shows that understanding HIRARC not only has an impact on individual safety, but also on the formation of a safer, healthier and more orderly work environment as a whole. HIRARC understanding includes the ability of workers to recognize various potential hazards in the workplace, assess the level of risk based on its likelihood and impact, and select appropriate risk control measures. When workers have this knowledge and skill, they are better able to keep their work areas clean, tidy and free from sources of danger. Awareness of potential risks makes them more careful in arranging work equipment, storing hazardous materials, and consistently carrying out safety procedures.

This finding is in line with the research which states that an increased understanding of HIRARC positively influences the organization of the work environment, particularly in aspects such as improved lighting, optimal ventilation, and the reduction of potential mechanical hazards [17]. Their study emphasized that employees who possess a solid understanding of risk control principles are more likely to exhibit proactive behaviors in maintaining a safe and orderly workplace. This includes regular monitoring of hazardous conditions, compliance with safety procedures, and active participation in workplace safety initiatives [24]. Such proactive engagement not only minimizes the likelihood of workplace accidents but also fosters a culture of safety and accountability. Furthermore, a well-maintained and hazard-free environment contributes to higher levels of comfort and well-being among employees, which in turn enhances focus, motivation, and overall work performance. Therefore, improving workers' understanding of HIRARC is not only beneficial for accident prevention but also serves as a strategic investment in boosting organizational productivity and operational efficiency [25].

3.3.5. Work Environment on Work Accident

The results of the analysis show that the work environment has a significant influence on work accidents. This finding confirms that the condition of the work environment, whether physical, ergonomic, or psychosocial, determines the level of worker safety in carrying out their activities. Inappropriate work environments, such as poor lighting, extreme temperatures, inadequate ventilation, chaotic equipment layout, or even tense working relationships, have great potential to trigger accidents. A poor working environment can be a direct or indirect source of workplace accidents. For example, slippery and unmarked floors can cause workers to slip, or poor air circulation can cause workers to lose concentration due to fatigue. On the other hand, a comfortable and well-organized work environment can help workers stay focused, calm and alert during work, so the risk of accidents can be minimized.

Certain research reinforces this finding, where they state that the quality of the work environment is one of the mediating variables that strengthen the relationship between the implementation of HIRARC and the reduction of work accidents [7]. This means that even though a safety management system has been implemented, without the support of an adequate work environment, accidents are still likely to occur [26]. Therefore, attention to the work environment should not be ignored in the OHS management system. In addition to physical factors, ergonomic aspects also play an important role. Ergonomically unsuitable work environments, such as disproportionately high workbenches or excessive manual carrying loads, can lead to muscle fatigue and work injuries. In fact, in the long run, such conditions can lead to latent accidents due to damage to body tissues that are continuously left without improvement of working conditions [27].

3.3.6. Implementation of HIRARC through Work Environment on Work Accident

The results of this analysis show that the implementation of HIRARC through the work environment has a significant effect on work accidents. This means that a good implementation of HIRARC will create a safer and more orderly work environment, which in turn contributes to a decrease in the number of work accidents. The influence does not only occur

directly, but also indirectly through the improvement of work environment conditions as a mediating variable. In the implementation of HIRARC, hazard identification and risk assessment allow companies to detect work areas that have high accident potential. Furthermore, through the risk control stage, the company arranges a safer working environment, such as improving lighting, organizing ventilation, providing danger signs, and providing personal protective equipment. These processes will create a work environment that physically and operationally supports worker safety.

A work environment that is organized based on the results of HIRARC has a much better quality than a work environment that is not systematically analyzed for risks. A study showed that the work environment acts as a mediator between the implementation of HIRARC and occupational accidents, which means that the more effectively HIRARC is implemented, the safer the work environment will be, and the risk of accidents will decrease significantly [7]. This means that the success of accident reduction depends not only on the HIRARC document, but also on how the results are applied in real working conditions. The work environment serves as a tangible reflection of the successful implementation of HIRARC. If the results of hazard identification and risk assessment are not followed up with improvements to the work environment, the implementation of HIRARC will be ineffective [28]. Conversely, if the results of HIRARC are actually applied in improving the workplace, working conditions will become safer, more orderly, and avoid accident triggering factors. The implementation of HIRARC must be complemented by management commitment to make continuous improvements to the work environment. For example, by routinely conducting safety inspections, educating workers about workplace hazards, and updating risk controls if new potentially dangerous working conditions are found [29].

3.3.7. Understanding of HIRARC through Work Environment on Work Accident

The results of this analysis show that understanding of HIRARC has a significant influence on work accidents, with the work environment acting as a mediating variable. This means that workers' understanding of HIRARC principles not only has a direct impact on work safety, but also indirectly through the role of the work environment that is organized and maintained based on this understanding. When workers thoroughly understand the HIRARC concept, they are able to recognize potential hazards, assess the level of risk, and engage in appropriate control measures. This understanding does not stop at theoretical knowledge, but is also reflected in safe, proactive, and caring work behaviors. For example, workers who understand the importance of HIRARC will tend to keep their work area tidy, ensure personal protective equipment is used, and avoid risky work practices.

The work environment acts as a mediator between the understanding of HIRARC and the incidence of workplace accidents. A good understanding encourages workers to participate in creating and maintaining a safe and healthy work environment. A well-organized work environment free from hidden hazards, ergonomic, has sufficient air circulation, and adequate lighting and ventilation will reduce the risk of accidents caused by physical working conditions. An empirical study supports this finding, where the work environment is shown to be a mediating variable in the relationship between HIRARC understanding and work accidents [7]. The study shows that workers who have a high level of understanding of HIRARC are more likely to form a safe working environment, thus indirectly reducing the risk of work accidents [30]. This shows that knowledge must be internalized into concrete actions that affect daily working conditions [31]. The understanding of HIRARC applied in improving the work environment also contributes to the creation of a safety culture. In such a culture, workers not only understand the risks, but also remind each other and work together to keep the workplace safe. By creating a supportive work environment, the level of awareness of hazards increases, and the potential for accidents can be collectively minimized [32].

4. Conclusion

Based on the analysis and discussion, it can be concluded that the implementation and understanding of HIRARC directly have a significant effect on work accidents. Other results show that the implementation and understanding of HIRARC through the work environment have a significant effect on work accidents in production employees of PT ABC. From the results of the study, the implication in this study is that management needs to reaffirm its commitment in making HIRARC an integral part of the operational system, including updating hazard identification, risk assessment, and risk control periodically in accordance with dynamic working conditions. The company should organize continuous training that not only explains the HIRARC concept, but also encourages workers to apply it in real situations on the job. Management is also advised to evaluate OHS performance based on indicators of the effectiveness of HIRARC implementation and the quality of the work environment. Regular assessment of these two aspects can be used as a measuring tool for the success of work accident control and a basis for continuous improvement.

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