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Analysis of Implementation Factors and Constraints of Occupational Health and Safety in Multi-Story Building Construction Projects

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ABSTRACT

The implementation of occupational safety and health is one of the key factors in construction project execution, and fundamentally, construction projects involve many hazardous elements. This research aims to analyze the implementation factors and challenges that occur in the application of occupational safety and health (OSH) in high-rise building construction projects by distributing questionnaires to contractors and consultants to obtain data for subsequent analysis. Based on data analysis, nine implementation factors and obstacles in OSH application in building projects were identified, namely workplace safety in the project (X1), equipment and work attire (X2), fire safety (X3), protection of the public (X4), worker health (X5), worker communication (X6), general factors (X7), obstacles from the company's perspective (X8), and obstacles from the worker's perspective (X9). These results were then tested for validity and reliability to determine their validity and reliability, and they were analyzed using descriptive analysis and Pearson correlation analysis. The results of the descriptive analysis indicate that the highest or most frequently implemented OSH factor is the protection of the public (X4) with a mean value of 3.725 and a standard deviation of 0.459. Among the obstacles to OSH implementation, the highest or most frequently occurring factor is the obstacles from the company's perspective (X8) with a mean value of 3.620 and a standard deviation of 0.500. The results of the Pearson correlation analysis show that equipment and work attire (X2) and protection of the public (X4) have the highest correlation value, which is 0.825, indicating a very strong relationship.

Keywords: *Multi-storey building; implementation K3; Obstacles to implementing K3.*

INTRODUCTION

Development in the field of infrastructure can contribute significantly to the growth of the surrounding sectors [2]. Growth in infrastructure is believed to have a substantial impact on the growth of other business activities [3]. However, the implementation of construction projects is highly susceptible to the possibility of work accidents and illnesses caused by such work [4], and construction of multi-story buildings is considered a high-risk job [5].

Construction projects are temporary actions that involve the use of various resources within a specific timeframe, with the goal of producing products or services to meet the demands of the task giver [6]. The implementation of workplace safety, health, and environmental concerns in companies plays a crucial role. Attention to the aspects of safety, health, and the work environment for employees is crucial as it directly affects achieving maximum productivity. Efforts to apply the principles of occupational safety, health (OSH), and maintaining the quality of the work environment are key to minimizing the risk of work accidents during the working process [7].

This situation often poses a challenge in construction projects, as there is still a perception that investing in safety attributes merely consumes funds, given that these attributes are considered expensive. There is also a perception that does not prioritize occupational safety, and some opinions about the discomfort when using safety attributes that may contribute to the risk of accidents in construction projects [8].

Therefore, an in-depth study is needed regarding the factors influencing the implementation of safety and health in multi-story building construction projects. This study aims to identify the obstacles that may arise during the implementation of OSH in the context of these construction projects. The results of this research are expected to provide valuable insights for contractors and government authorities in supervising OSH practices in the field. The main goal is to encourage worker compliance with good and effective OSH practices, as well as to enhance their awareness and knowledge of the importance of these aspects. Thus, it is hoped that it can reduce the number of work accidents within the multi-story building construction project environment.

METHODS

Location, subject and object of research

This research was conducted on several ongoing multi-story building construction projects in several cities, namely Surabaya, Sidoarjo, and Gresik, with a minimum contract value of Rp5,000,000,000. The research subjects were the analysis of implementation factors and constraints in the application of occupational safety and health (OSH).

Identification of factors affecting quality reduction in building construction projects

In the stage of questionnaire development to obtain factors related to the implementation of OSH and constraints in the application of OSH, identification was carried out from various sources through a literature review based on relevant previous journals. The following are the factors obtained from the literature study: And obtained 52 variables, as shown in table 1:

Table 1. Variable list

Factor	Variable no	indicator
Workplace Safety in Project (X1)	X1.1	There is no risk in accessing and exiting the project.
	X1.2	Potentially hazardous areas are equipped with covers or safety fences, such as over holes or excavations.
	X1.3	The lighting at the project site is sufficiently bright and adequate.
	X1.4	Workplace safety signs are installed in specific areas within the project.
Work Equipment and Attire (X2)	X2.1	The company provides equipment in adequate quantities.

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Factor	Variable no	indicator
	X2.2	Safety equipment such as ladders, nets, and safety fences are available from the company.
	X2.3	Workers in the project area are required to wear work equipment and clothing while carrying out tasks.
	X2.4	All of this equipment is in good condition and complies with workplace safety and health standards.
	X2.5	Cleanliness and orderliness of materials and work equipment at the workplace are maintained.
	X2.6	Inspection and maintenance of frequently used tools are routinely carried out.
Fire Safety (X3)	X3.1	Smoking prohibition has been implemented in the project environment to prevent the potential for fire.
	X3.2	Adequate fire extinguishing equipment is available on-site.
	X3.3	Restrictions on flammable materials have been applied.
	X3.4	A designated area has been prepared for the storage and disposal of flammable materials/items.
Protection towards the Public (X4)	X4.1	Fences and entrance-exit gates around the project site have been properly installed.
	X4.2	Project-related signs and information have been placed around the project area.
	X4.3	OSH (Occupational Safety and Health) signboards have been installed, including slogans reminding of the importance of workplace safety.
	X4.4	Adequate alternative evacuation routes are available in emergency situations.
Occupational Health (X5)	X5.1	The company responds quickly to field accident cases.
	X5.2	Rest facilities and a kitchen with a supply of drinking water are provided for workers.
	X5.3	A first aid kit (P3K) box has been prepared to provide initial assistance to workers.
	X5.4	All workers in the construction project undergo periodic health check-ups.
	X5.5	Insurance is provided, and cooperation with an insurance company has been established for worker benefits.
Worker Communication (X6)	X6.1	The communication of OSH-related information can be understood by workers.
	X6.2	Effective communication between workers and management has been established.

Factor	Variable no	indicator
	X6.3	Good interactions occur among fellow colleagues.
	X6.4	Workers remind each other of hazards and the importance of OSH.
Ganeral (X7)	X7.1	OSH (Occupational Safety and Health) training is provided to workers to understand safety procedures.
	X7.2	Clear OSH regulations exist, and sanctions are applied for violations.
	X7.3	Instructions regarding safety procedures are provided on designated days throughout the project.
	X7.4	Regular safety meetings are held periodically.
	X7.5	In-depth analysis is conducted on previous work accidents.
	X7.6	Adequate evacuation routes have been designated for emergency conditions.
Company Side Obstacles (X8)	X8.1	Budget allocation for the K3 aspect is not provided in the construction project.
	X8.2	Lack of attention to the proper and correct use of personal protective equipment provided by the company.
	X8.3	Rest facilities or a P3K station and maintaining cleanliness in the construction project are not available.
	X8.4	Shortage of personal protective equipment that should have been provided by the company.
	X8.5	The absence of strict sanctions for workers who do not comply with K3 practices.
	X8.6	Government oversight of K3 implementation in the field seems lax.
	X8.8	Low commitment to maintaining workplace safety from contractors and management.
	X8.9	Supervision of K3 implementation has not been effective.
	X8.10	Lack of training for workers on protection and the application of K3 principles.
Worker Side Obstacles (X9)	X9.1	Discomfort with provided personal protective equipment.
	X9.2	Workers have become accustomed to working without using protective equipment.
	X9.3	Existing tools are not suitable for workers' needs.
	X9.4	Limited understanding of workplace safety makes workers reluctant to use protection.
	X9.5	Many workers lack knowledge of K3 protection in the ongoing construction project.

Factor	Variable no	indicator
	X9.6	The primary focus of workers remains on fulfilling basic needs.
	X9.7	There is no communication involving workers in the K3 program.
	X9.8	Low commitment from workers in applying K3 principles.
	X9.9	Shortage in the quality of Human Resources (HR).

Data collection methods

The collected data was obtained through the distribution of questionnaires at several ongoing multi-story building construction projects, targeting 30 respondents, including contractor companies and supervising consultants. Data management will be carried out using Microsoft Excel software and version 23 of SPSS.

Validity test

Validity testing is a process used to assess the extent to which data obtained from a questionnaire can be considered accurate or appropriate in measuring the researched variables. The general purpose of validity testing is to determine how accurately the questionnaire can measure the variables being studied [9]. Testing is considered valid if the calculated correlation coefficient value (r observed) is greater than the correlation value listed in the distribution table (r table); if the r observed value is not greater, it is considered invalid.

Reliability test

Reliability testing is a method used to measure the extent to which a questionnaire or measurement instrument can be relied upon and is consistent in measuring the relevant variables. This indicates whether the measured variables can be trusted and remain consistent if the measurement is repeated [10]. In this testing, researchers use a reference of Cronbach's Alpha of 0.75. If the Cronbach's Alpha value is > 0.75, it is considered reliable with a high degree of reliability.

Descriptive and ranking analysis

In the descriptive analysis of this study, the objective is to obtain the mean (average) and standard deviation values for each factor related to the implementation and challenges of K3. This aim is to provide an overview of how the implementation and challenges of K3 in multi-story building construction projects are perceived by the respondents. By utilizing mean values, rankings can be generated for each factor, offering an indication of the level of importance or issues that might be encountered.

Pearson correlation analysis

The Pearson correlation analysis method used in this study aims to assess the relationship between two variables. The results of this correlation analysis yield values that can be positive (+) or negative (-). In the case of a positive value, when one variable increases, the other variable tends to increase as well. Conversely, if the value is negative, an increase in one variable is accompanied by a decrease in the other variable. If there is no change in one variable even though the other variable changes, it can be concluded that the two variables do not have a significant relationship [1].

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RESULTS AND DISCUSSION

Validity Test

The validity testing in this research aims to assess the validity of a variable in the questionnaire. In the context of this study, 30 respondents from various construction projects were involved. The table correlation value (r table) taken is 0.361. The results of the validity test can be seen in Figure 1 below:

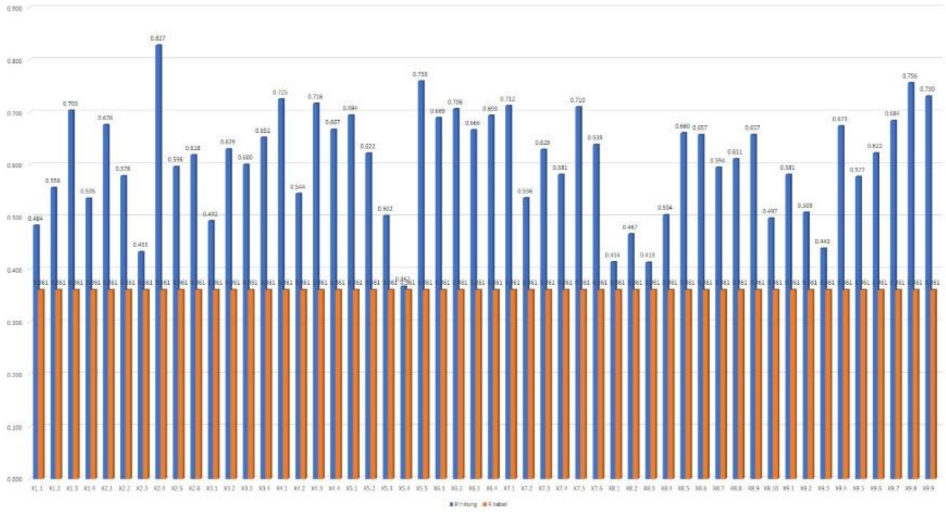

Figure 1.Validity test results

Based on Figure 1 above, it can be concluded that there are 52 indicators from 9 factors that constitute the research variables, where the observed correlation coefficient (r observed) for each indicator has a value greater than the r table (0.361). Therefore, it can be concluded that the above variables are considered valid.

Reliability Test

Reliability testing aims to measure the consistency of questionnaire variables in the research. In this study, a reference of Cronbach's Alpha of 0.75 was used. This testing was conducted to examine the overall factors and indicators by comparing the reliability coefficient values with the reference value of Cronbach's Alpha. The testing results from SPSS 23 are as follows:

Table 2. Reliability test results

RELIABILITY TEST		
Reference Value	**Cronbach's Alpha Value**	**Conclusion**
0.75	0.9649	Reliabel

From the data presented in Table 2 above, it can be suggested that the coefficient resulting from the reliability test for all factors reaches a value of 0.9649. This value surpasses the reference value for Cronbach's Alpha, which is 0.75, indicating that the instrument used in this study possesses a high level of reliability and can be trusted.

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Descriptive and Ranking Analysis

The descriptive analysis in this study aims to determine the mean and standard deviation values for each implementation and challenge factor of K3. The mean values can indicate the highest ranking for each implementation and challenge factor of K3. The results of the descriptive analysis for each implementation and challenge factor of K3 are presented as follows:

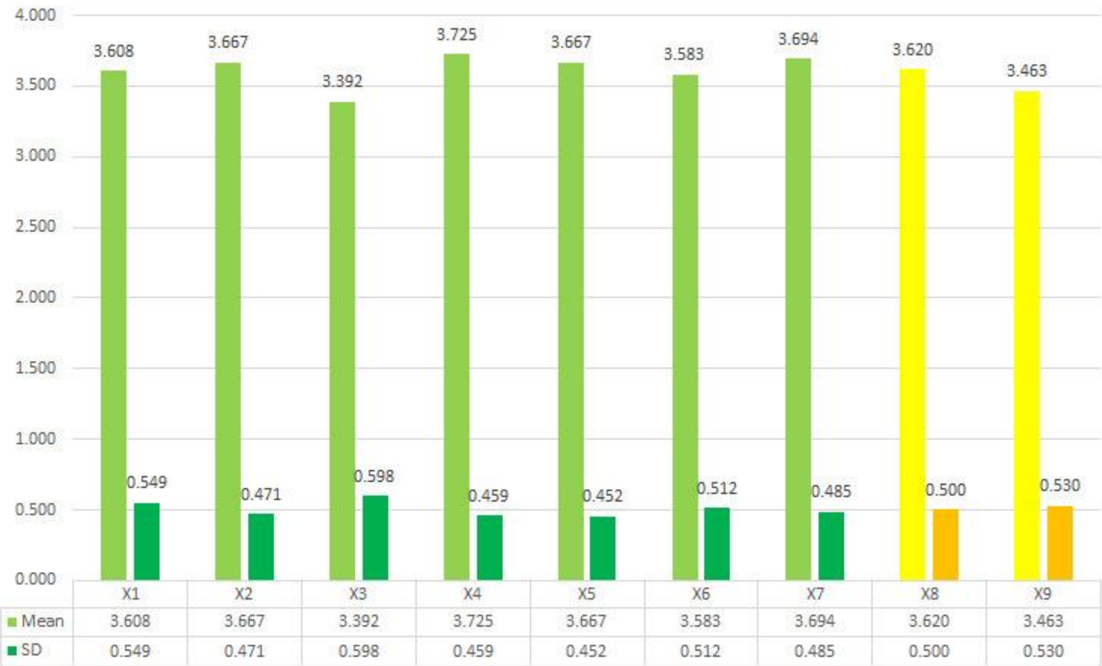

Figure 2. Results of Descriptive Analysis

Based on Figure 2 above, it can be shown that the mean and standard deviation values for each factor can be explained. Among the implementation factors of K3, the highest mean value is found in the factor of public protection (X4) with a mean value of 3.725 and a standard deviation of 0.459. Public protection includes actions such as installing well-maintained fences with proper entry and exit points around the project area. Additionally, it's crucial to have clear signage or information signs regarding the project and to place K3 safety signs as reminders of the importance of workplace safety. All these measures aim to ensure the safety and comfort of the public around the construction project site.

Pearson Correlation Analysis Between Factors

In the correlation analysis of relationships between the 9 factors, it is shown that these factors exhibit significant correlations, and the highest correlation coefficient is observed between factor X2 and X4. This indicates a very strong relationship between these two factors, with a correlation coefficient value of 0.825.the next correlation value can be seen in Figure 3.

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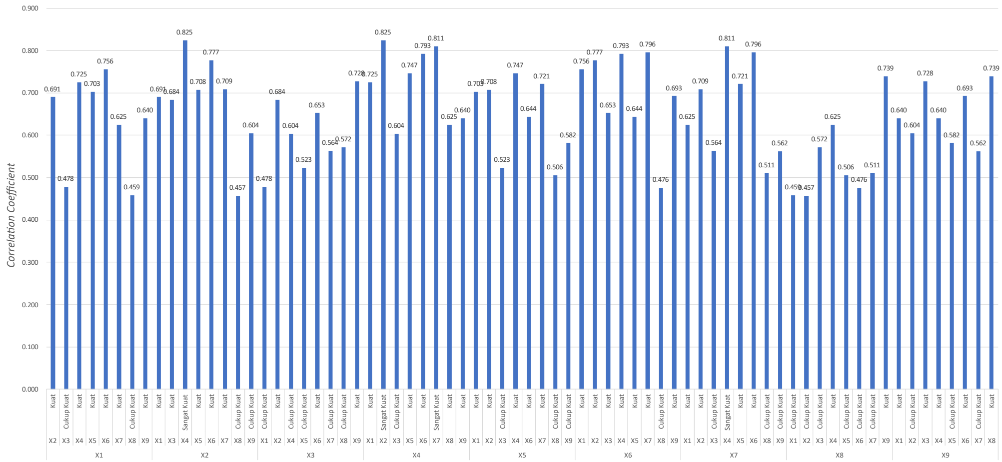


Figure 3. Pearson correlation test analysis results between factors

Pearson Correlation Analysis Between Factors and Indicators

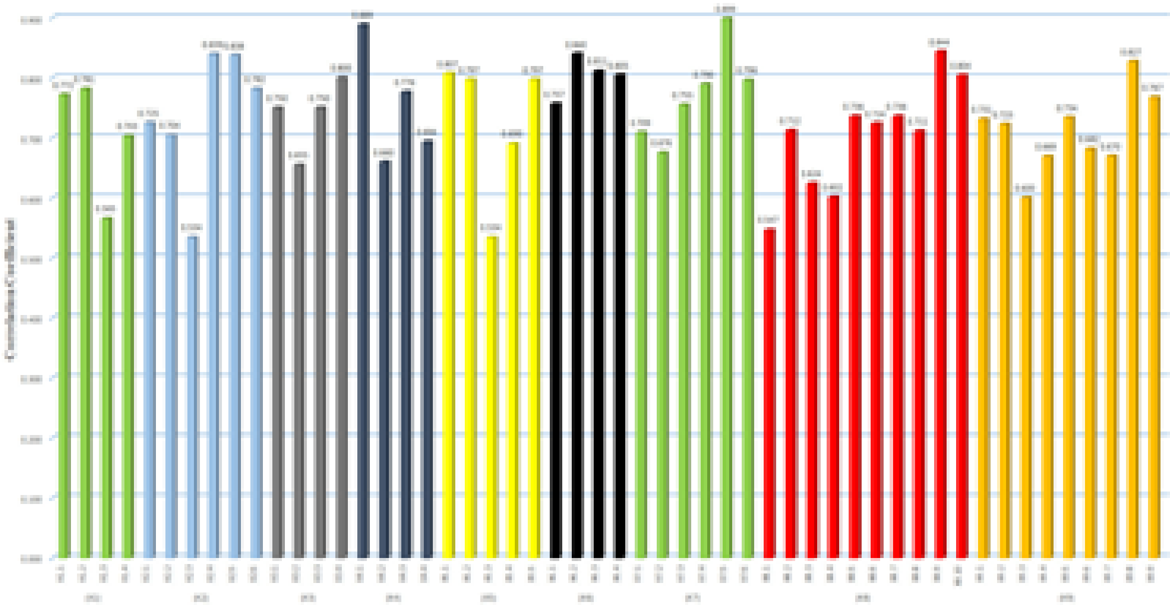


Figure 4. Pearson Correlation Test Analysis Results Between Factors and Indicators

Based on Figure 4 above, the highest correlation values obtained from the Pearson correlation analysis between factors and indicators are as follows The highest correlation is observed between factor X7 and indicator X7.5, indicating a very strong relationship between the factor and indicator with a correlation coefficient of 0.899. The second-highest correlation is found between factor X4 and indicator X4.1, also showing a very strong relationship between the factor and indicator with a correlation coefficient of 0.899. The third-highest correlation is between factor X8 and indicator X8.9, indicating a very strong relationship between the factor and indicator with a correlation coefficient of 0.844.

Pearson Correlation Analysis Between Indicators

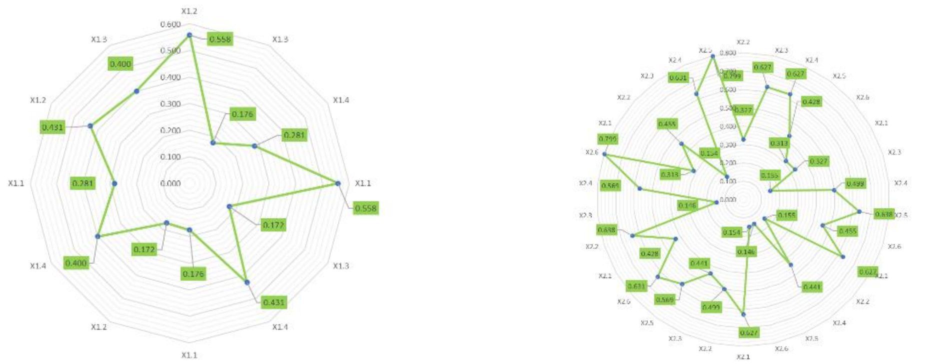
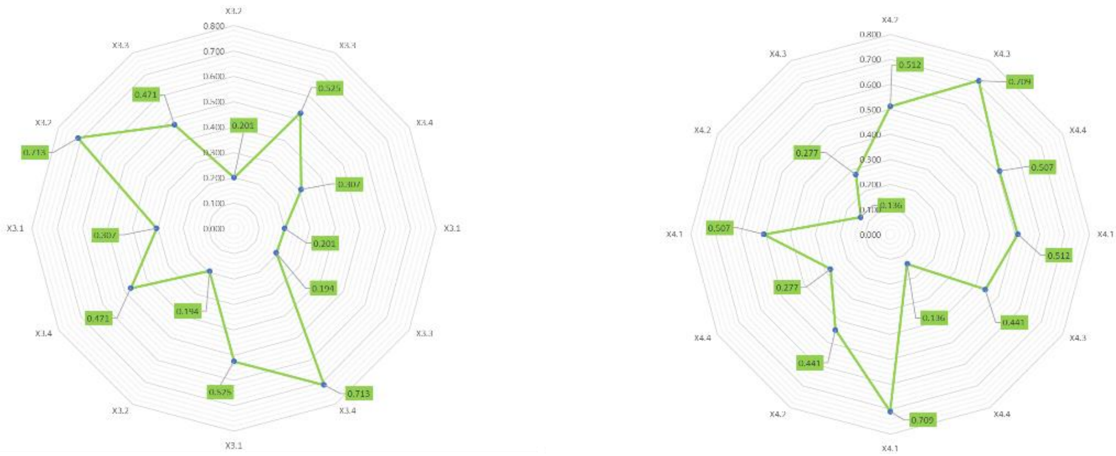


Figure 5. (a) Results of Pearson Correlation Analysis Between Indicators of Workplace Safety Factor in the Project (X1) and (b) Results of Pearson Correlation Analysis Between Indicators of Equipment and Work Attire Factor (X2)

Based on Figure 5 (a), the highest correlation coefficient between indicators in the factor of workplace safety in the project is observed between indicators X1.1 and X1.2, with a strong correlation of 0.558. Based on Figure 5 (b), the highest correlation coefficient between indicators in the factor of equipment and work attire is found between indicators X2.5 and X2.6, with a very strong correlation of 0.799.



- **Figure 6. (a) Results of Pearson Correlation Analysis Between Indicators of Fire Factor (X3) and (b) Results of Pearson Correlation Analysis Between Indicators of Public Protection Factor (X4)**

Based on Figure 6 (a), the highest correlation coefficient between indicators in the fire safety factor is observed between indicators X3.2 and X3.4, with a very strong correlation of 0.712. Based on Figure 6 (b), the highest correlation coefficient between indicators in the factor of public protection is found between indicators X4.1 and X4.3, with a very strong correlation of 0.709

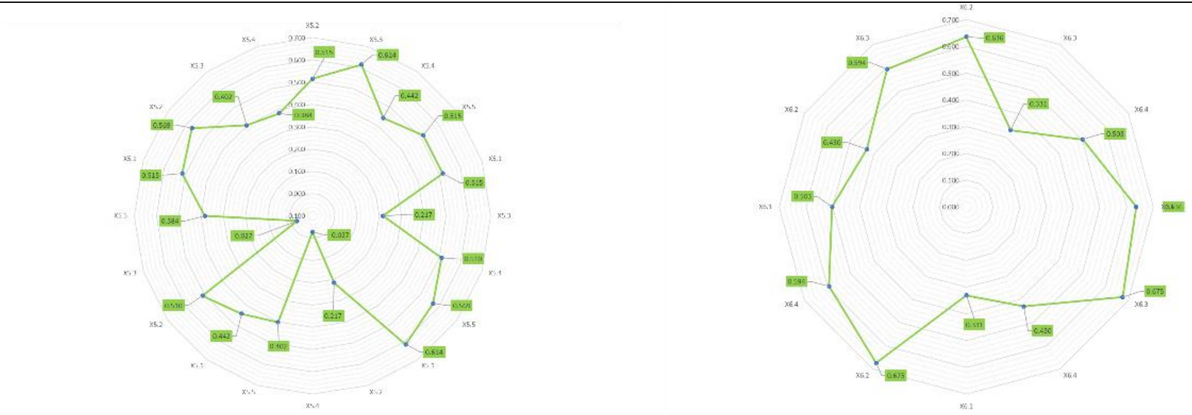


Figure 7. (a) Results of Pearson Correlation Analysis Between Indicators of Occupational Health Factor (X5) and (b) Results of Pearson Correlation Analysis Between Indicators of Worker Communication Factor (X6)

Based on Figure 7 (a), the highest correlation coefficient between indicators in the occupational health factor is observed between indicators X5.1 and X5.3, with a strong correlation of 0.614. Based on Figure 7 (b), the highest correlation coefficient between indicators in the worker communication factor is found between indicators X6.2 and X6.3, with a strong correlation of 0.675.

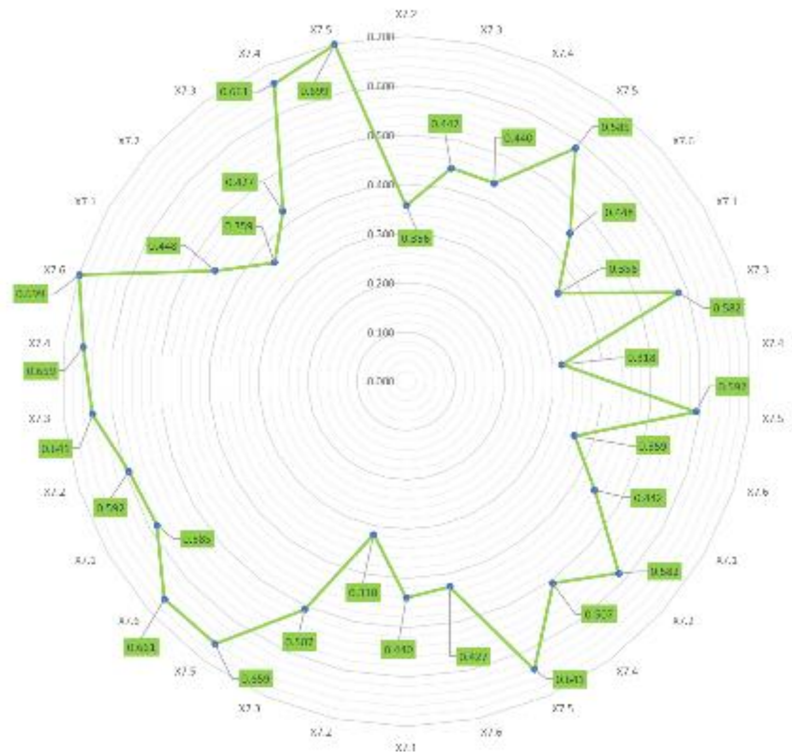


Figure 8. Results of Pearson Correlation Analysis Between Indicators of General Factor (X7)

Based to Figure 8, the highest correlation coefficient between indicators in the general factor is observed between indicators X7.5 and X7.6, with a strong correlation of 0.699.

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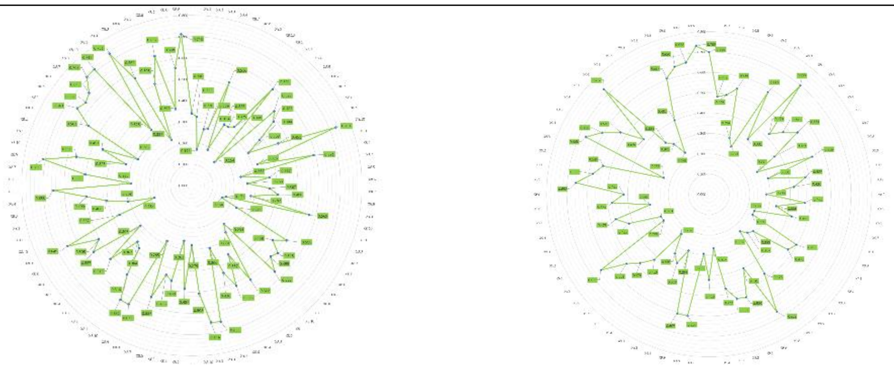

Figure 9. Results of Pearson Correlation Analysis Between Indicators of Company-Side Barrier Factor (X8) and (b) Results of Pearson Correlation Analysis Between Indicators of Worker-Side Barrier Factor (X9)

Based on Figure 9 (a), the highest correlation coefficient between indicators in the "Barriers from the Company's Side" factor is observed between indicators X8.2 and X8.10, with a very strong correlation of 0.713. According to Figure 9 (b), the highest correlation coefficient between indicators in the "Barriers from the Worker's Side" factor is observed between indicators X9.8 and X9.9, with a very strong correlation of 0.731.

Discussion

The construction process of construction projects in general involves many hazardous elements. The implementation of workplace safety and health is crucial within a company. Workplace accidents can be minimized by applying occupational health and safety measures. The following are several factors and indicators that demonstrate the implementation and constraints of K3 application that are frequently carried out or commonly encountered, which have been subjected to descriptive analysis, ranking, and Pearson correlation analysis:

- The factor ranked first in K3 implementation is the factor of public protection, with a mean value of 3.725 and a standard deviation of 0.459.
- The factor ranked first in K3 application constraints is the company-side barrier factor, with a mean value of 3.620 and a standard deviation of 0.500.
- In the Pearson correlation analysis of relationships among the 9 factors, it is evident that these factors exhibit significant correlations. The highest correlation coefficient is observed between factors X2 and X4, showing a very strong correlation with a value of 0.825.

CONCLUSION

Based on the above discussion, the conclusion drawn from the descriptive analysis is that the highest factor in K3 implementation or widely practiced in several construction projects is the factor of "Protection of the Public" (X4) with a mean value of 3.725 and a standard deviation of 0.459. The highest factor in K3 implementation challenges or obstacles encountered is the factor of "Barriers from the Company's Side" (X8) with a mean value of 3.620 and a standard deviation of 0.500. The results of the Pearson correlation analysis indicate that the "Protection of the Public" factor (X4) has a significant correlation with K3 implementation, with a correlation coefficient of 0.912. Similarly, the "Barriers from the Company's Side" factor (X8) has a significant correlation with K3 implementation challenges, with a correlation coefficient of 0.935.

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