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Risk Assessment of Supervision Consultants for Multi Storey Construction Projects in Palu City

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Abstract
Construction projects frequently involve significant risks, especially due to the dependence on forecasts for future occurrences. The prolonged duration of construction procedures increases ambiguity, resulting in various dangers. Consultants are essential in providing specialised services. This study utilises a quantitative method and applies the saturation sampling (census) technique, which is a form of nonprobability sampling. The data is then analysed using factor analysis with the aid of the SPSS version 25 software.
The research findings identify four prominent risk variables that impact the supervision consultants involved in multi-storey building construction projects in Palu City. The criteria include aspects related to human resources, field conditions, considerations of oversight consultants, and force majeure factors.
***Keywords**: Construction Project, Risk, Supervision Consultant, Factor Analysis.*

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I. INTRODUCTION

Construction projects are overseen by a set of specific objectives known as the Triple Constraint. These objectives encompass limitations on the level of work quality, financial resources, project timeline, and potential risks. The user's text is [1]. Risk, which refers to the presence of uncertainty and its potential outcomes, infuses a level of unpredictability into situations involving planning and decision-making [2]. Multiple variables might hinder the accomplishment of objectives, resulting in unfavourable consequences [3]. Risk and uncertainty are inherent in all project operations and vary proportionally throughout the process.

Risk variables that affect the timeliness and quality of construction projects encompass various elements such as materials, equipment, finances, environment, community, workforce, planning, and management. Efficientmanagement requires the participation of supervisory consultants, who have a vital role in reducing risks by overseeing the execution of tasks.

Building construction project risks are the primary subject of this research, which zeroes in on the role of construction management consultants in development projects' execution stages. Research in this area often makesuse of the "Model for International Construction Risk Assessment" to identify and evaluate major threats to building projects.

Finding out what risks supervision consultants working on Palu City multi-story construction projects face is the primary goal of this research. In the context of Palu City's multi-story construction projects, this study aims to determine the main variables that have the greatest impact on the risk encountered by supervision consultants.

II. LITERATUR REVIEW

Here are several relevant concepts and literature studies that support the research objects :

2.1 Construction Projects

Construction projects have heightened degrees of risk as they depend on forecasts of forthcoming events associated with building construction. The forecasts are used to assess the level of risk linked to any hazardous occurrences observed throughout the construction phase [4]. It is essential to have a comprehensive risk management plan that addresses several aspects of a construction project in order to complete it successfully, suchas budget, schedule, safety, quality, and environmental sustainability [5]. Field surveys using well-designed questionnaires are used to gather data in the construction industry.

2.2. Projects Risk
To effectively execute a construction project, it is vital to have a thorough risk management plan that includes multiple areas, including money, time, safety, quality, and environmental sustainability [5]. In order to collect data, the construction sector uses field surveys using well crafted questions.

1. Pure risk and speculative risk refer to two distinct types of risks. Pure risk involves uncertainty regarding the occurrence of a result, specifically loss [8].
2. There are two types of risks: risks to objects and risks to humans. Risks to objects refer to potential harm or damage that can happen to physical things, like a home catching fire. Risks to humans, on the other hand, pertain to potential harm or negative outcomes that can affect people, such as ageing or death [9].
3. There are two separate types of hazards: fundamental risks and specific risks. All members of society are vulnerable to fundamental hazards, which are intrinsic dangers that cannot be explained by any one factor. [10].

2.3 Supervision
Professional consultants are individuals or organisations with extensive knowledge, specialised abilities, and a consistent willingness to learn. Their objective is to offer advise to clients, with the intention of not just providing advice but also aiding in its implementation [11]. To finish the project on schedule, consultants must focus their efforts throughout the whole design process, including obstacles like unrealistically ambitious deadlines and the practicality of implementing the project in the field [12].

2.4 Factor Analysis
Factor analysis is a statistical technique used to uncover the relationships between different variables that are not reliant on each other. The goal is to generate one or more groups of variables that are less in quantity than the original set, thus reducing the intricacy [13].
Finding the variables that will be studied is the first step in factor analysis. To do this, we will use the Measure of Sampling, or MSA for short, and the Bartlett test to determine specificity in order to calculate the correlation matrix. After that, factoring or extraction takes place [14].

III. RESEARCH METHODS
To kick things off, we'll have a look at the background of the topic at hand, which is the implementation of risks faced by supervisory consultants in Palu City's multi-story construction projects. Gathering primary and secondary sources of information is part of the process. Validity testing is done to find out how accurate the measuring tools are, while reliability testing is done to make sure the results are consistent. Then, the most important and prominent parts of the research domain are located using factor analysis. [15]

3.1 Data collection and retrieval methods
Consultant and PPK participant recruitment for Palu City construction projects. Using a purposive sampling approach, the researcher deliberately chose participants based on predetermined characteristics of the sample [16]. Observation, interviews, questionnaires, and documentation were some of the data retrieval and collection strategies used in the research.

Figure 1. Project risk factors

3.2 Data Retrieval and Collection Techniques
The data collected during the data collecting stage remains in its original form, known as raw data. To proceed with this research, the next step is to do data analysis [17]. Analysing data is a crucial phase in research since it allows for the extraction of meaningful insights that can be applied to problem-solving in research [18]. The factor analysis method was utilised to conduct data analysis in this research.

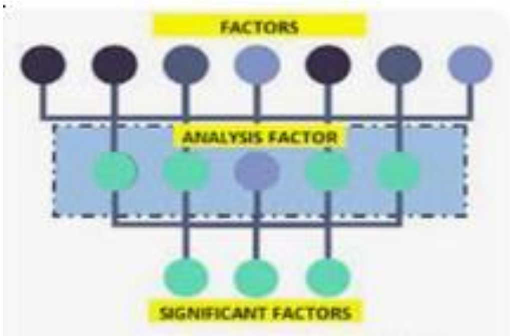

Figure 2. Factor Analysis

Factor Analysis is an exploratory method that offers a comprehensive understanding of statistical techniques and their applications in different study settings. An overview of the methodology's functioning and its criteria, encompassing the primary assumptions addressed and their appropriate application. First, we show you how to use SPSS to do exploratory factor analysis, and then we go over how to publish your results. With this enhanced understanding, readers will be better equipped to use factor analysis correctly and understand the results in a graphical and tabular format [19].

3.3 Factor Analysis Requirements

In order to do factor analysis, it is necessary for the data to exhibit both univariate and multivariate normality [20]. The absence of univariate and multivariate outliers is also crucial [21]. Furthermore, the determination of factors relies on the assumption of a linear correlation between factors and variables during the calculation [22]. For factor analysis to be applicable, a minimum of three variables is required, although this requirement may vary depending on the specific research design [23]. The minimum required sample size is 300 participants, and each variable used for factor analysis should have at least 5 to 10 citation observations [24]. Typically, it is recommended to have a ratio of at least 10 respondents per variable in order to ensure stability. This ratio can be further validated by using a ratio of 30 respondents per variable. Guadagnoli and Velicer (1988) suggested that if adataset has multiple factor loading scores that are over 0.80, then a sample size of more than 150 is adequate [26]. The factor loading of a variable quantifies its contribution to a certain factor. The factor loading score suggests that the variable [27] provides a more accurate representation of the factor dimensions. Moreover, it is recommended that the correlation coefficient r should be equal to or greater than 0.30, as lower values suggest a significantly weak association between the variables [28].

IV. RESULTS AND DISCUSSION

The data collected during the data gathering stage remains unprocessed and requires further analysis as an essential step in the research process. Analysing data is a crucial phase in research since it allows for the extraction of meaningful insights that can be applied to problem-solving. The factor analysis method was employed to conduct data analysis in this research.

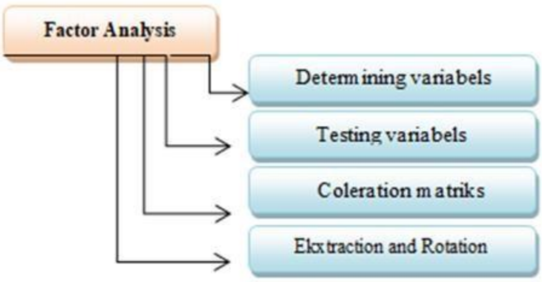

Figure 3. Factor analysis process

People from PPK and Consultants who were involved in six different projects in Palu in 2023 were the subjects of this study. These projects included the high court, Telkom, administrative court, national and political unity, and Sis-Aljufri airport buildings. Fifty individuals were enrolled in the study, and these projects were chosen as the subjects of investigation.

4.1 Respondent Characteristics

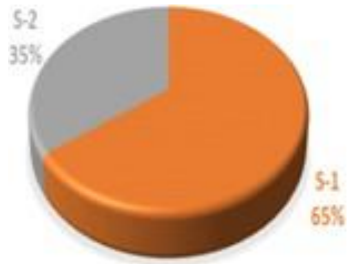

Figure 4. Education Levels Percentage Diagram

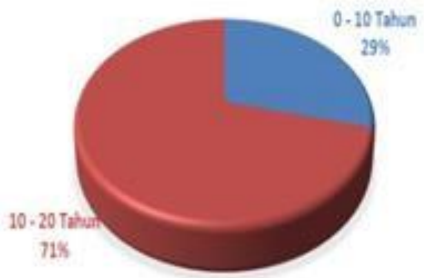

Figure 5. Depiction of Work Experience as a Percentage

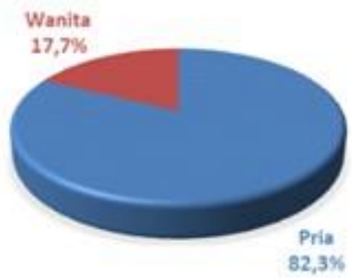

Figure 6: Representation of the Years of Work Experience as a Ratio

4.2 Validit Test

An r-table of 0.273 was produced after researchers used a 95% confidence level or a level of significance (ÿ) = 0.05 to examine the outcomes of 50 respondents' answers.

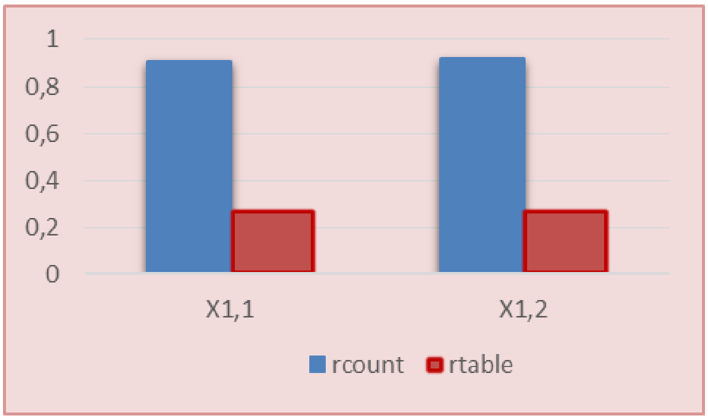

Figure 7. Curve of Source Variable Validity Test Results Human Powe (X1)

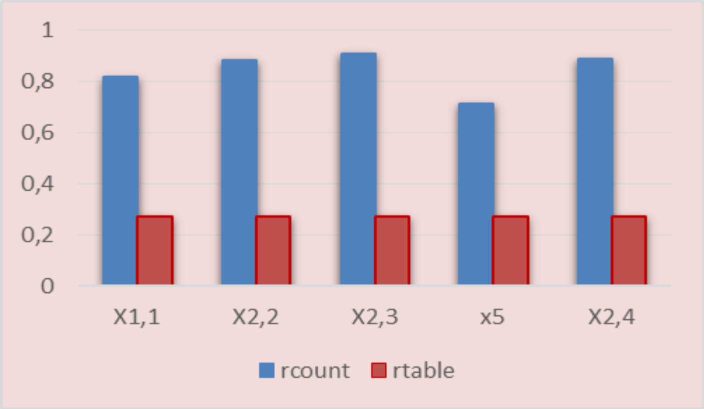

Figure 8. Validity Test Results for Field Condition variable (X2)

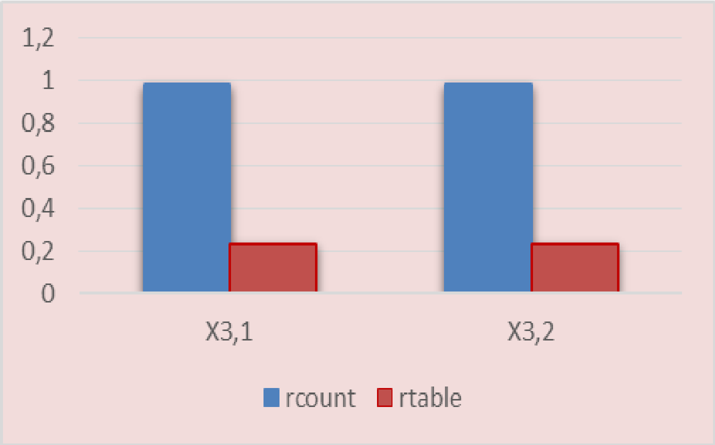

Figure 9. Curve of Consultant Variable Validity Test Results Supervision (X3)

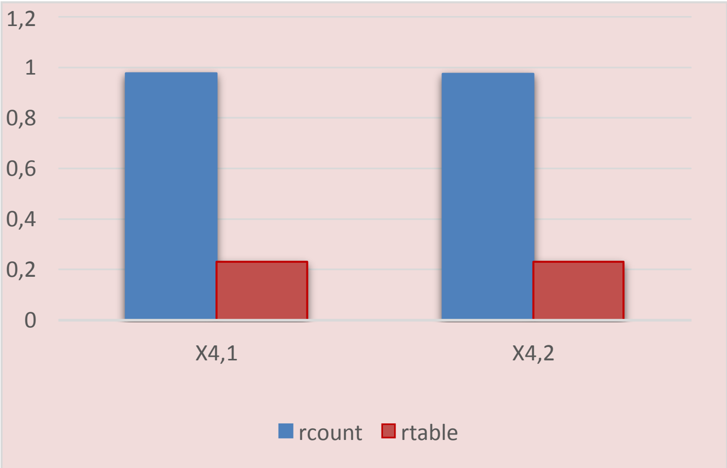

Figure 10 .Variable Validity Test Results Curve *Force majeure.* (X4)

Since the computed r values are greater than the r table values, all assertions are deemed authentic, asshown in the shown graph. Hence, research questionnaires can make use of any assertion.

4.3 Reliability Test

In order to determine how consistent a questionnaire is, researchers use reliability testing. When Cronbach's Alpha is greater than 0.60, we say that the variable is reliable.However, the variable in question isconsidered unreliable if its Cronbach's Alpha value is shorter than 0.60.

Table 1 Reliability Test Results

Variabel	*Cronbach's Alpha*	Information
Human Resources (X_1)	0,796	Reliabel
Field Conditions (X_2)	0,837	Reliabel
Supervision Consultant (X_3)	0,964	Reliabel
Force majeure (X_4)	0,949	Reliabel

Table 1 shows that all of the Cronbach's Alpha values that were obtained are higher than 0.60. It follows that all thevariables must be trustworthy.

4.4 KMO test (Keiser Meyer Olkin) and Bartlett's test

All of the acquired Cronbach's Alpha values are greater than 0.60, as shown in Table 1. So, it's imperativethat you rely on all the factors.
Table 2 Results of the KMO Test and Bartlett's Test

Table 2 Results of the *KMO* Test and *Bartlett's* Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of SamplingAdequacy,		0,658
Bartlett's Test of Sphericity	*Approx, Chi-Square*	789,820
	Df	153
	Sig,	0,000

To determine whether a variable is suitable for additional factor analysis research, the Keiser Meyer Olkin test(KMO) and Bartlett's test are utilised.

4.5 MSA Test *(Measure of Sampling Adequacy)*

When deciding whether or not to utilise factor analysis, statisticians use the Measure of Sampling Adequacy (MSA) to look at the degree of correlation between different variables.

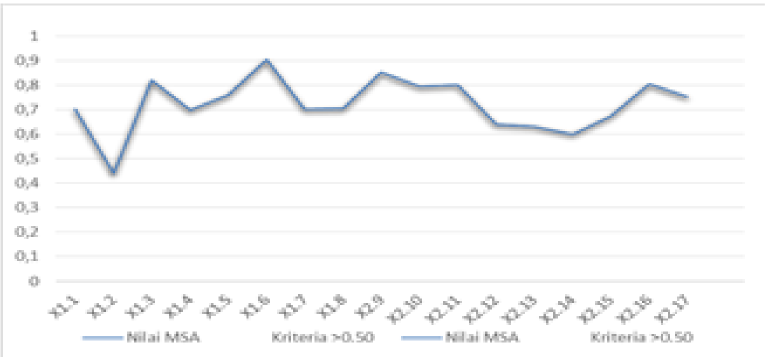

Figure 11 *MSA* Test Results Curve Before Issue

Statisticians examine the level of correlation between various variables using the Measure of Sampling Adequacy (MSA) when determining if factor analysis should be employed.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy,		0,763
Bartlett's Test of Sphericity	Approx, Chi-Square	659,765
	Df	120
	Sig,	0,000

Table 3 Results of the KMO Test and Bartlett's Test after discharge

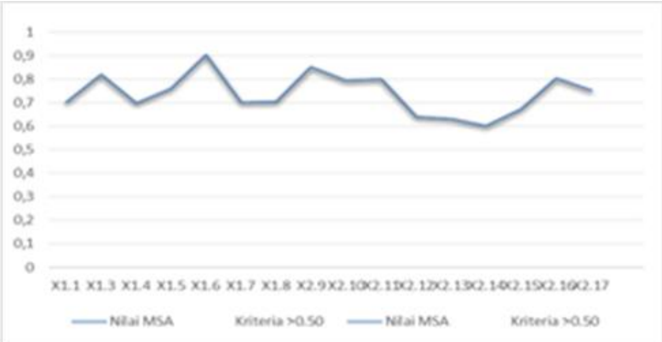

Figure 12 After MSA Test Results Curve Issued

Because every single indicator we looked at had a value higher than 0.5, we can move on to the next stage of factoranalysis with confidence in our findings.

4.6 Communality Estimation

To what degree does the principal component explain the variation of a given variable? This is what we mean when we talk about communalities. A Communalities value greater than 0.5 is considered to be the minimal criteria. Results from the Communalities study With extraction values higher than 0.50, every variable is considered.

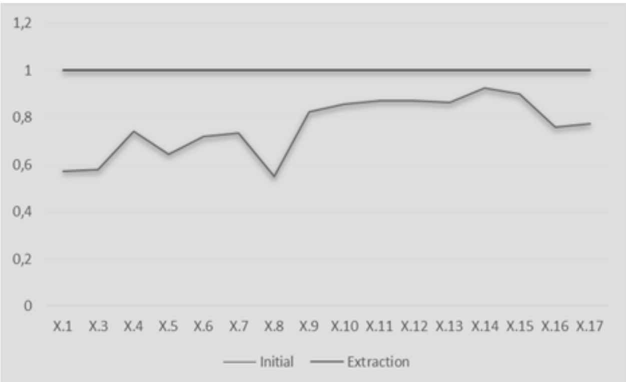

Figure 13. *Communality Estimation* Analysis Results Curve

4.7 Factor Extraction

Finding out how many factors are used to convey the data and how much each element contributes to the research phenomenon is the goal of factor extraction. In order to derive factors, components with an eigenvalue greater than 1 will be considered. When determining the number of components acquired from the extraction results, the eigenvalues are always ordered in descending order.

Table 4 Factor Extraction Results

Total *Variance Explained*						
Component	*Initial Eigenvalues*			*Extraction Sums of Squared Loadings*		
	Total	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	7.129	37,176	37,176	10,038	37,176	37,176
2	2.565	17,096	54,273	4,616	17,096	54,273
3	1.332	5,389	59,662	1,455	5,389	59,662
4	1.151	4,821	64,483	1,302	4,821	64,483
5	0.824	4,110	68,592	1,110	4,110	68,592
6	0.612	3,961	72,554	1,070	3,961	72,554
7	0.560	3,354	75,908			
8	0.521	3,110	79,018			
9	0.348	2,830	81,848			
10	0.320	2,162	84,009			
11	0.191	1,999	86,008			
12	0.157	1,842	87,851			
13	0.138	1,764	89,614			
14	0.064	1,634	91,249			
15	0.057	1,383	92,632			
16	0,030	1,218	93,850			

The values of each variable that was examined are displayed in the provided table. The examination of the sixteen components yielded four subfactors in particular. The eigenvalues of all four of these components are more than 1. Component 1 explains 44.558 percent of the total variation with an eigenvalue of 7.129. With an eigenvalue of 2.565, component 2 explains 16.032% of the total variance. The third component accounts for 8.325% of the total variance with an eigenvalue of 1.322. Finally, 7.195% of the variation is attributable to Component 4, which has an eigenvalue of 1.151. The eigenvalue measures how important each component is in explaining the variance of the 16 components that are being considered. Add up the variance numbers in this way to find out how the four sub-factors fared.:

44.558% + 16.032% + 8.325% + 7.195% = 76, 110%

With a combined explanatory power of 76.110%, the four components clearly have an impact on the consultant's risk profile in terms of supervision. Other variables, not addressed here, account for the remaining 23.89%. The study can move further since the total variance of 76.110% is greater than the implied total variance of60%.

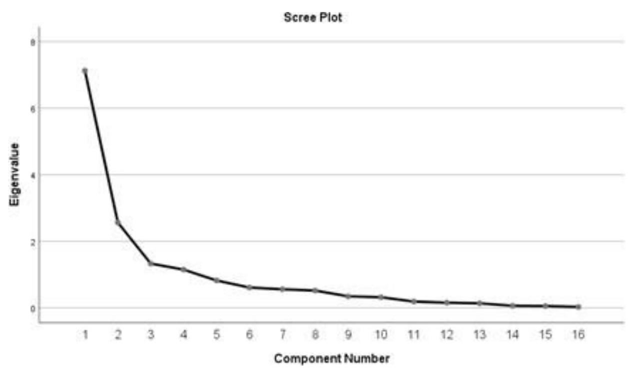

Figure 14. Scree Plot Curve

Figure 4 shows that the Scree Plot will graphically show the number of factors that will be formed when the Initial Eigenvalues are greater than 1.00. Four of the component points clearly have values greater than 1, suggesting the existence of four additional components.

4.8 Matrix Components and Rotation

A visual representation of the number of factors that will be generated, specifically those with Initial Eigenvalues greater than 1.00, is shown in Figure 4 by use of the Scree Plot. It is evident that four of the componentpoints have values higher than 1, suggesting the presence of four more parts.

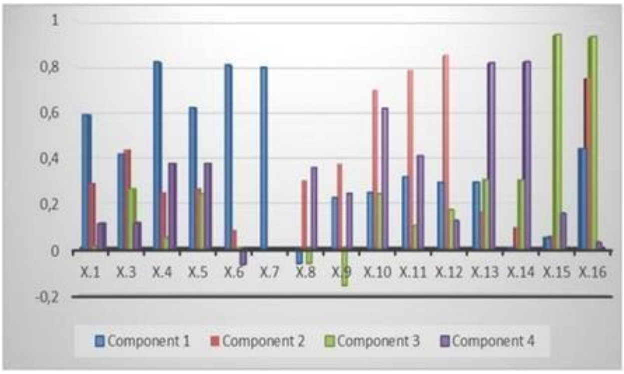

Figure 15 Matrix Component Rotation Curve

This means that the loading factor for each variable is greater than 0.3, which means that the factors that were considered had an impact on the risk analysis that the supervision consultant performed. A study conducted in Palu City using factor analysis on 50 participants identified four characteristics that impact the involvement of risk supervision consultants in multi-story construction projects. A total of eighteen sub-factors make up these factors. Therefore, it is clear that two initial sub-elements were not taken into account as factors that impact the implementation of work risks in Palu City's high-rise buildings.

4.9 Dominant Risk Factors

a. Human Resources Factors

The factor can be divided into two sub-factors: the absence of knowledge and expertise among staff, and the failure to supervise comparable tasks in the past. Effective oversight of human resource elements in the construction of tall structures is crucial to guarantee efficient, secure, and compliant execution of activities.In order to enhance the effectiveness and efficiency of multi-storey building construction projects, it is crucial to employ suitable monitoring techniques. This will ensure that human resources play a significant role in the project's success.

b. Field Condition Factors

This factor consists of four subfactors: limited availability of project supplies at the location, security disruptions, resistance, inadequate implementation of personal protective equipment (PPE), and ineffective personnel allocation. There is a lack of conformity. There are several potential dangers to the health and safety of construction workers when PPE is not properly used when erecting tall buildings. Falling from great heights is a real possibility when workers aren't properly protected by PPE during the construction of towering buildings. Establishing a strong safety culture, providing adequate training, and ensuring the accessibility and use of appropriate personal protection equipment (PPE) are so fundamental.

C. Supervision consultant factors

This factor comprises three subfactors: limited accessibility to resources, absence of field coordination, and incapacity to analyse data. These issues encompass limitations or obstacles that can impact the capacity to gather, analyse, or interpret data. To surmount this obstacle, it is crucial to strategically organise and oversee the process of gathering and analysing data right from the inception of the project. Engage data specialists or consultants, allocate sufficient resources, and sustain transparent communication with all pertinent stakeholders.

d. Force Majeure Factor

This factor consists of two subfactors, specifically natural catastrophes and societal disasters. societal disasters in the context of high-rise building development encompass a range of societal issues and difficulties that emerge during or following the construction phase. In order to mitigate the consequences of this societal catastrophe, conflict arises when there is a discrepancy between the ideals or objectives to be attained, both internally within an individual and in their interactions with others. The aforementioned variables can impede or obstruct the attainment of emotions or stress levels that impact work efficiency and production. Community engagement is crucial in project planning and development, as it allows for the incorporation of many perspectives, addresses community issues, and promotes inclusive and sustainable solutions. Full engagement from all parties involved can contribute to the establishment of a more equitable and impartial atmosphere throughout the process of constructing tall buildings.

V. CONSLUCION

A total of seven6.180% of the total impact is attributable to all causes, according to a factor analysis of Palu City's risk implementation of supervisory consultants on multi-story building work. According to the results of the factor analysis, other factors account for the remaining 23.89% but have no discernible impact. Human resources have the highest Variance value of 42.408% and are the main factor in the execution of risk supervision consultants on multi-storey construction projects in Palu City.

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