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Analysis of the Implementation of the Use of Personal Protective Equipment on Road Works in Sigi Regency

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ABSTRACT

The use of Personal Protective Equipment (PPE) is crucial for workers, especially to prevent work accidents or occupational diseases. The road infrastructure project in Sigi Regency, which is currently being carried out by ten construction service companies as tender winners, is among the building initiatives, in Sigi Regency that is prone to workplace accidents. One of the causes is the employment of large machinery that needs to be operated with skill. In this study, using quantitative and descriptive qualitative methods with data processing using factor analysis. There are six factors that influence the implementation of using personal defense equipment, namely: knowledge and attitude factors, PPE facilities, PPE supervision, motivation and sanctions, the company's role in OHS and the active role of workers in OHS.

Key words: PPE, Factor Analysis, Road, Company and Worker.

1. INTRODUCTION

Wearing personal protective equipment, or PPE, is necessary, particularly in workplaces where there may be risks to occupational health and safety. [1].

Among the initiatives aimed at enhancing occupational safety and health is the provision of personal protective equipment to workers in settings where accidents may occur [2]. As a result, it is essential that business executives and employees both use personal protective equipment when working because it can affect accidents where there are factors that may affect such as workers' knowledge about PPE, workers' attitudes, PPE availability and PPE supervision. Currently in Sigi Regency there are 14 packages of the Road Implementation Program that are being handled by the Public Works and Spatial Planning Office of Sigi Regency in the Bina Marga Division for Fiscal Year 2023 with funding sources coming from Balancing Funds, especially Funds. Physical Special Allocation Ministry of Public Works a n d Housing and Ministry of Villages. Figure 1 below shows a map of the Sigi Regency area.

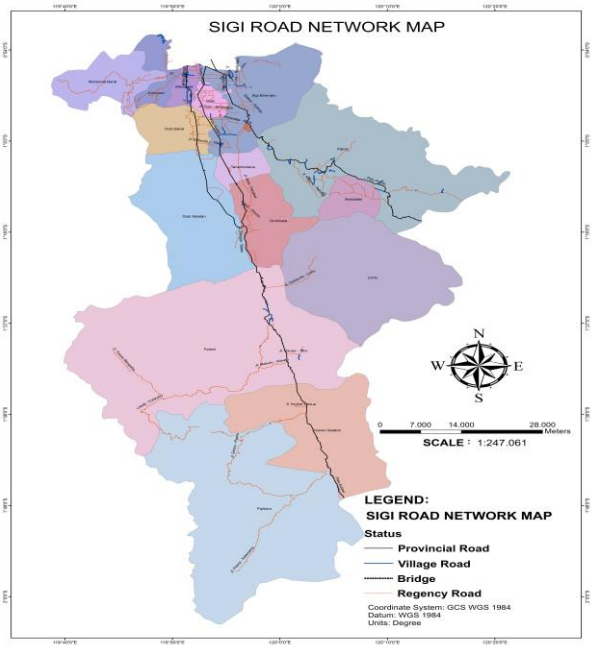

Figure 1: Road Map of Sigi District

Related to the road infrastructure project from the Road Implementation Program of the Bina Marga Sector for Fiscal Year 2023, which is currently being carried out by 10 construction service companies as tender winners, is one of the Sigi Regency's construction projects with the highest risk of workplace accidents. Using heavy machinery and complex equipment that needs to be operated by someone with experience is one of the causes.

Based on an initial survey and interviews with supervisors at one of the tender-winning companies of the Road Implementation Program for Bina Marga Sector for Fiscal Year 2023 in Sigi Regency about the behavior of workers using PPE in the field when working on road infrastructure projects, there are workers who do not wear PPE while working, the reason is the inconvenience when wearing PPE, for example the use of helmets and gloves which are considered difficult when operating the Company's heavy equipment. It is regrettable if employees don't.

Employees wear personal protective equipment (PPE) when working, as provided by the company. Then based on an initial survey conducted on a worker from one of the companies that won the tender for the Road Implementation Program for the Bina Marga Sector for Fiscal Year 2023 in Sigi Regency, there are similarities in the responses of project supervisors and project workers. Based on the results of interviews with workers who did not use PPE in full, several reasons were found for workers who were reluctant to use PPE, namely a sense of discomfort when used, workers felt that they had been working for a long time so they did not need PPE, and workers felt that PPE could hamper their work so that there was not enough time to meet their daily targets, Another reason is that workers do not know the importance of using PPE when they work.

The aim of this research is to identify and evaluate the variables that impact the application of PPE on road construction in Sigi Regency, as well as the variables and indicators that are crucial in influencing PPE implementation on road construction.

2. LITERATURE REVIEW

Some concepts and literature reviews related to and supporting the object of research are as follows:

2.1 Project Definition

A project activity is a transient activity that occurs for a set amount of time, involving the deployment of specific resources, and is meant to accomplish tasks with well-defined goals [3].

A project is the result of combining different resources—people, materials, and tools to perform a number of tasks in a makeshift organizational container with the goal of realizing ideas that emerge from human nature and developing them within predefined boundaries of cost, time, and quality [4]. A project always considers several stages of activities and tasks, namely having a specific goal, having a start and end time, using limited energy and using resources such as money, people and tools [5].

2.2 Construction Services Company

Construction planners, which provide planning services in construction which includes a series of activities or parts of activities ranging from development studies to the preparation of construction work contract documents, this is generally called a Planning Consultant; Construction executors, namely

Construction supervision, which is an activity that provides Some or all of the construction implementation work, from field preparation to the final delivery of construction work, may be supervised, which is commonly called a Construction Contractor; Construction supervision, which is an activity that provides A supervisory consultant is a person who provides supervision services for all or part of the construction implementation work, from field preparation to the final delivery of construction [6].

2.3 Definition of Personal Protective Equipment

A set of safety gear known as personal protective equipment (PPE) is worn by employees to shield all or a portion of the body from potential workplace hazards, accidents, and occupational illnesses [7]. All apparel and other work accessories intended to provide a barrier against workplace hazards are considered personal protective equipment (PPE). The use of PPE must be regulated by the individual, particularly in a workplace [8].

When employees are performing tasks that carry potential risks to their safety or occupational health, they need to wear personal protective equipment (PPE), PPE that is used must be in accordance with the potential hazards and risks of the job so that it effectively protects workers as its use [9].

2.4 Types and Functions of PPE

A. Head Protection Equipment

Head protective equipmentis a piece of equipment designed to shield the head from heat radiation, fire, chemical sparks, microbes, and extremely high or low temperatures. It can also be used to protect the head from impact, slamming, falling, or being struck by hard or sharp objects that float or slide in the air. Types of head protective equipment consist of safety helmets, hats or head hoods, hair cover or safety [10].

B. Face and Eye Protection

Eye and face protection equipment is a type of protective gear that shields the eyes and face from potentially harmful substances, airborne and waterborne particles, small object splashes, heat, and steam.

C. Ear Protection Equipment

Ear protective equipment is an apparatus designed to shield the hearing aid from pressure or noise, types of ear protective equipment consist of ear plugs andearmuffs.

D. Wearing Respiration Protective Gear

The purpose of respiratory protective equipment and its accessories is to safeguard respiratory organs by providing clean, healthy air. Figure 2 below shows workers who wear masks while working.

Figure 2: Workers wearing masks

E. Hand Protection Equipment

Gloves, also known as hand protection, are protective gear that shields the hands and fingers from things like fire, extreme heat or cold, electromagnetic radiation, ionizing radiation, electric current, chemicals, collisions, blows, and scratches.

F. Foot Protection Equipment

The purpose of foot protection equipment is to shield the feet from sharp objects and impacts from heavy objects. Safety shoes are one type of foot protection used in smelting, metal casting, industry, building construction, and jobs where there may be electrical or blasting hazards as well as wet or slick conditions.

G. Safety Apparel

Wearing protective clothing can shield a portion of the body from the risks of extremely hot or cold temperatures, fire and hot object exposure, and chemical splashes. Figure 3 below shows workers while working wearing protective clothing.

Figure 3: Workers wearing protective clothing

2.5 Compliance with Personal Protective Equipment Use

Compliance is an action taken by someone or more precisely the workforce due to a stimulus or encouragement, this stimulus triggers compliance in the form of rules, directions, requests and coercion that can cause action to follow the stimulus [11].

Factors that influence compliance are [12]:

A. Worker knowledge factor

An individual's knowledge will be shaped by a variety of factors, including personal experience and that of others, as well as access to resources regarding local customs and culture within the family.

B. Worker attitude factor

The factors that determine this behavior can be broken down into two categories: internal factors, which are the person's innate characteristics like intelligence, emotional quotient, gender, and so on, and external factors, which are the physical, social, cultural, political, economic, and so on environment; the latter is frequently the primary factor influencing an individual's behavior).

C. PPE availability factor

Gloves, to protect workers' fingers and hands from scratches, shoes to protect feet when working in construction work, helmets to protect the head against the possibility of being hit by falling objects or head injuries due to collisions with hard objects, masks to protect the face from the influence of light and protect breathing from dust particles flying during work.

D. PPE Supervision Factors

The activity of checking, measuring, evaluating and determining follow-up on the results of the implementation of a predetermined function and task, PPE supervision can be carried out by the company's internal parties, internal supervision is intended to ensure the extent to which personal protective equipment is actually used by workers when working or when not working but still within the project site

2.6 Definition of Occupational Health and Safety

The overall management system, which comprises the organizational structure, planning, responsibilities, implementation, procedures, processes, and resources required for the creation, execution, accomplishment, assessment, and upkeep of policies, comprises the Occupational Safety and Health Management System, or OHSM [13]. The acronym OHS stands for Occupational Health and Safety, which is the management of work-related risks to establish a secure, effective, and productive work environment. The goal of occupational accident prevention

and control must be to identify and manage the risks related to the workplace.find the cause[14].

2.7 Factor Analysis

One multivariate statistical technique called factor analysis seeks to explain the relationship between a number of independent variables in order to generate one or more sets of variables that are smaller than the original set of variables [15].

In principle, factor analysis aims to find whether there is a correlation or relationship (interrelationship) between a number of variables that initially have no relationship or are independent of each other.

Factor analysis's primary goal is to provide an explanation for the covariance relationship between numerous variables in the form of several factors—unobserved random population quantities. Factor analysis can also be used to test hypotheses about a construct.

The first step in the factor analysis process is deciding which variables will be examined; measuring the Measure of Sampling, or MSA, and computing the correlation matrix using the Bartlett test of spericity method; Procedure for Factoring or Extraction [16].

3. RESEARCH METHODS

This section starts from the background of identifying factors that influence the implementation of PPE use. Collecting primary data and secondary data. Data processing validity test to ascertain the measuring device's degree of accuracy and reliability test to yield measurement results that are consistent. Factor analysis is carried out to extract influential and dominant factors in the study [17].

3.1 Data Collection and Retrieval Techniques

The selection of respondents in the ten construction service companies as tender winners of the Road Implementation Program for Bina Marga Sector for Fiscal Year 2023 in Sigi Regency Purposive sample was the method used in this investigation, namely selecting people selected by researchers based on the special characteristics of the sample that have a close relationship with the characteristics or properties of the population [18].

Description:

n = Sample magnitude
N = Number of people
E = Critical value that is desired despite a 10% sampling error

In this study, questionnaires, documentation, interviews, and observation were the methods used to collect data

3.2 Data Analysis Technique

The data obtained from the data collection stage is still raw data, to continue the process in this study, data analysis is the next step that must be done [19]. Analysis is a very important step in research, this is because the data can be given a meaning that is useful in solving problems in research [20]. In this study, data analysis was carried out using the factor analysis method. Figure 4 below shows the factor analysis process.

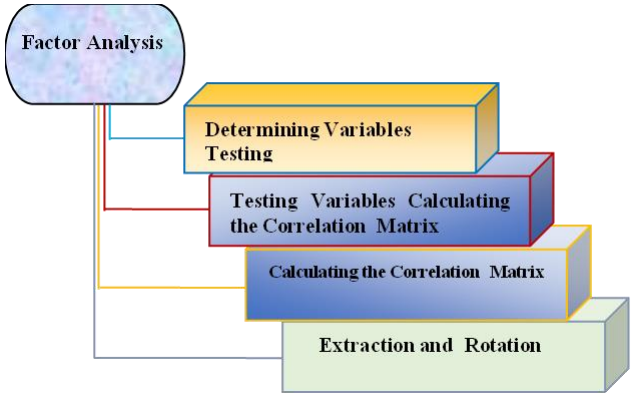

Figure 4: Factor analysis process

4. RESULTS AND DISCUSSION

Respondents taken in t h i s study were foremen, head builders, workers, dump truck drivers and heavy equipment operators, working for 10 companies that won the tender for the Sigi Regency Special Allocation Fund package in 2023 which was used as the object of research with a total of 70 respondents.

4.1 Respondent Characteristics

Figure 5 below shows the ages of the respondents used in the research.

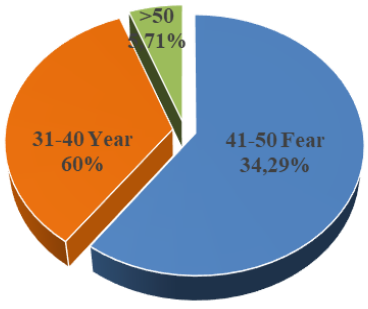

Figure 5: Percentage Chart of Respondents' Age

Figure 6 below shows the number of years respondents have worked.

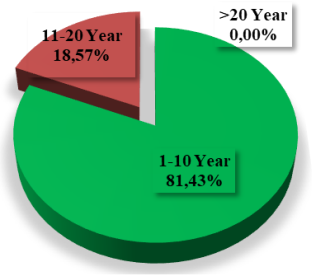

Figure 6: Percentage Chart of Respondents' Length of Service

Figure 7 below shows the percentage of respondents' education used in the research.

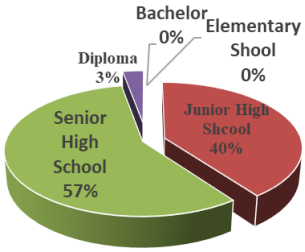

Figure 7: Percentage Chart of Respondents' Last Education

4.2 Validity Examination

A validity test is used to determine the validity of a questionnaire. By employing a 95% confidence interval or a significance level of (α) = 0.05,

Rcount > rtable is deemed valid, while rcount < rtable is deemed invalid.

$$r = \frac{N(\sum XY) - (\sum X \sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

r = Coefficient of orrelation
N = Sample size (number of respondents)
X = Statement grade
Y = Total rating

Researchers tested the results of the respondents' answers as much as Seventy respondents with a 95% confidence level or a significance level of (α) = 0.05, then obtained an rtable of 0.232.

Figure 8 below shows the Knowledge Variable Validity Test Results Curve

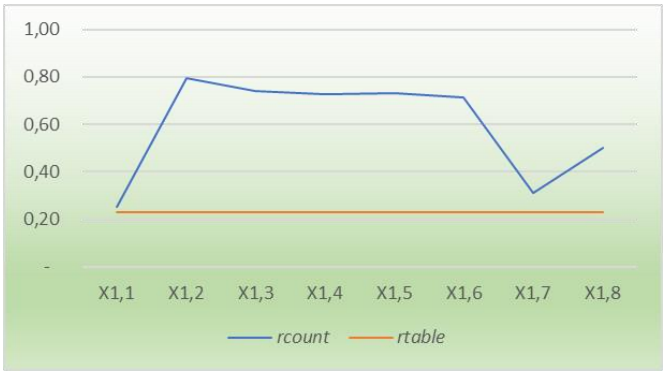

Figure 8: Knowledge Variable Curve

Figure 9 below shows the curve of test results for the validity of attitude variables

Figure 9: Variable Validity Curve

Figure 10 below shows the curve of the validity test results for the PPE facility variable.

Figure 10: PPE Facility Variable Curve

Figure 11: Curve for PPE Supervision Variables.

Figure 11 above shows the curve above. It can be seen that all statements are said to be valid because all calculated r values are greater than rtable values, so all statements can be used in research questionnaires.

4.3 Test of Reliability

In research, the reliability test is used to determine how consistent a questionnaire is. The variable used is considered reliable if its Cronbach's Alpha value is greater than 0.60; if it is less than 0.60, it is considered unreliable [21].

Table 1: Results of Reliability Testing

Variables	*Cronbach's Alpha*	Description
Knowledge (X_1)	0,740	Dependable
Attitude (X_2)	0,804	Dependable
PPE facilities (X_3)	0,883	Dependable
PPE Supervision (X_4)	0,623	Dependable

Table 1 above shows that all of the values obtained have Cronbach's Alpha values greater than 0.60, indicating the reliability of each variable.

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

Determine whether a variable is feasible to process further using factor analysis or not by using the Keiser Meyer Olkin test and Bartlett's test, also known as KMO. The data in this study can be factor analyzed if the KMO test results yielded a KMO value> 0.50 to 1.0 and significant Bartlet's <0.05 [22].

Table 2: Results of the KMO Test and Bartlett's t

Bartlett's Test and KMO		
Kaiser-Meyer-Olkin Sampling Measure Sufficient,		0,732
Bartlett's Examination spherical	*Chi, Approx Square*	1662,4
	Df	52
	Sig,	496
		0,000

Table 2 above shows that the KMO calculation results are 0.732, and the magnitude of the Bartlett's Test of Sphericity value is significant 0.000, according to table 2 above. Because the KMO value is greater than 0.5 and the significant Bartlett's value is less than 0.05, this indicates that the indicators can be predicted and subjected to additional analysis.

4.5 MSA (Measure of Sampling Adequacy) Test

The Measure of Sampling Adequacy test abbreviated as MSA is another measure used to measure the intercorrelation between variables and the suitability of factor analysis. If MSA ≥ 0.50 then the indicator can be analyzed [23].

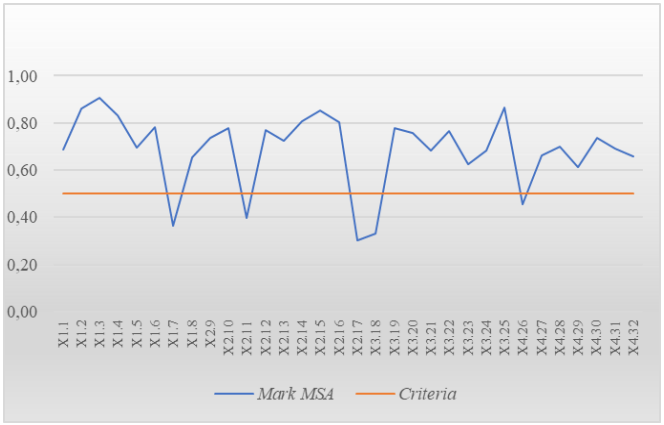

Figure 12: Initial MSA Testing Result Curve

Figure 12 above shows that in the initial MSA test results curve, there are several indicators studied that have a value of <0.5, so researchers need to eliminate sub-factor items and test them again.

Table 3: Results of the KMO Test and Bartlett's Test Following Exclusion

Bartlett's Test and KMO		
KMO Kaiser-Meyer-Olkin Sampling Measure Sufficient,		0,823
Bartlett's Examination spherical	*Chi, Approx Square*	1440,436
	Df	351
	Sig,	0,000

Table 3 above shows the results of the KMO test and Bartlett test following exclusion.

Figure 13 below shows the Second MSA Test Results Curve. It is known that all indicators studied have a value> 0.5, this indicates that the results of this analysis a r e acceptable and the next stage of factor analysis can be carried out.

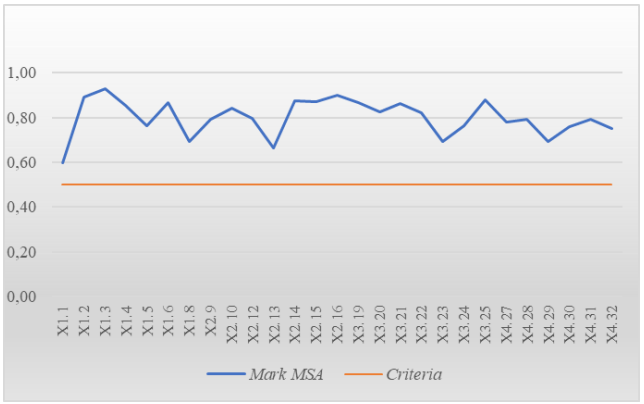

Figure 13: Second MSA Testing Results Curve

4.6 *Estimated Communality*

Communalities is the percentage of an original variable item's variance that can be accounted for by the primary factor; the value requirement for communities is higher than 0.5. The results of the Communalities analysis Extraction value for all variables is greater than 0.50. Figure 14 below shows the curve of community estimation analysis results.

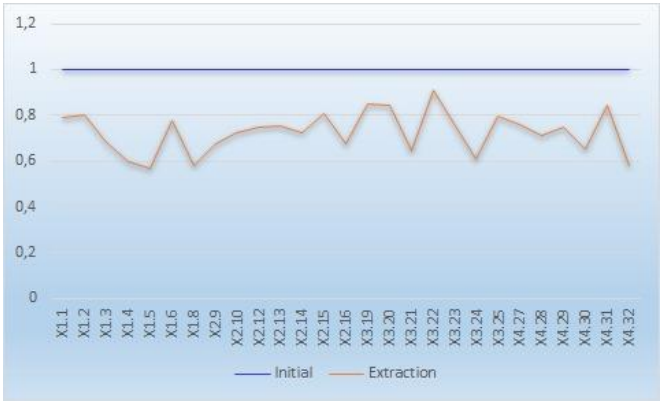

Figure 14: Communality Estimation Analysis Result Curve

4.7 Factor Extraction

Finding out how many factors are used to present the data and how much each factor contributes to the research phenomenon is the aim of factor extraction. Components meeting the requirement of having an eigenvalue greater than one will be used to create factors. To find the number of factors formed from the extraction results, the eigenvalue arrangement is always sorted from largest to smallest. [24]

Table 4 below shows the value of each variable analyzed, for example there are 6 factors formed from 27 sub-factors analyzed, of these 6 factors each has an eigenvalue > 1, namely Component 1 has an eigenvalue of 10.038 > 1.

Table 4: Factor Extraction Results

Total *Variance Explained*						
Component	*Initial Eigenvalues*			*Sums of Squared Extraction*		
	Total	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	10,038	37,176	37,176	10,038	37,176	37,176
2	4,616	17,096	54,273	4,616	17,096	54,273
3	1,455	5,389	59,662	1,455	5,389	59,662
4	1,302	4,821	64,483	1,302	4,821	64,483
5	1,110	4,110	68,592	1,110	4,110	68,592
6	1,070	3,961	72,554	1,070	3,961	72,554
7	0,906	3,354	75,908			
8	0,840	3,110	79,018			
9	0,764	2,830	81,848			
10	0,584	2,162	84,009			
11	0,540	1,999	86,008			
12	0,497	1,842	87,851			
13	0,476	1,764	89,614			
14	0,441	1,634	91,249			
15	0,373	1,383	92,632			
16	0,329	1,218	93,850			
17	0,311	1,153	95,003			
18	0,260	0,962	95,965			
19	0,201	0,745	96,710			
20	0,192	0,712	97,422			
21	0,183	0,677	98,099			
22	0,148	0,547	98,645			
23	0,110	0,407	99,052			
24	0,092	0,339	99,391			
25	0,085	0,314	99,705			
26	0,048	0,178	99,883			
27	0,032	0,117	100,000			

with a variance of 37.176%; Component 2 has eigenvalue of 4.616> 1 with a variance of 17.096%; Component 3 has an eigenvalue of 1.455> 1 with a variance of 5.389%; Component 4 has an eigenvalue of 1.302> 1 with a variance of 4.821%; Component 5 has an eigenvalue of 1.455> 1 with a variance of 4.821%.

Component 6 has an eigenvalue of 4.616> 1 with a variance of 17.096%, and component 1.110> 1 with a variance of 4.110%. The relative significance of each factor in determining the variance of the 27 sub-factors under analysis is shown by the eigenvalue.

To find out the effect of the 6 sub-factors is by summing up the variant values as follows:
37,176%+17,096%+5,389%+4,821%+4,110%+3,961%=72,553%. A scree plot graph, which is a plot of eigenvalues

against the number of factors that have been extracted, is another method to view the number of new factors formed.

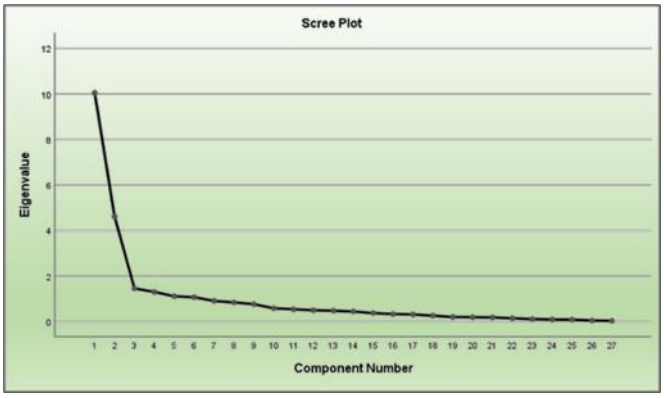

Figure 15: Scree Plot Curve

Figure 15 above shows that in the Scree Plot shows the number of factors that will be formed (Initial Eigenvalues > 1.00) there are 6 component points that have a value of more than 1, so it can be seen that the number of new factors formed is 6 factors.

4.8 Matrix Components and Rotation

The next stage is to determine some of the most dominating items in each section. The extraction results are still difficult to determine the dominant sub-factor or indicator by looking at the highest value of each factor. For this reason, in order to more clearly determine the factors that enter the three factors formed, it is necessary to rotate the factors [25]. Figure 16 below shows the rotation curve of the matrix components.

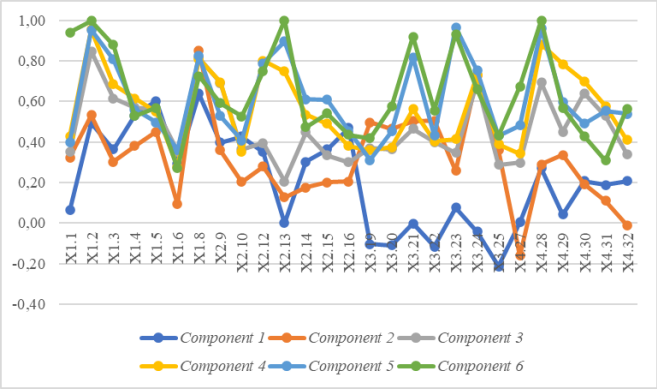

Figure 16: Rotation curve of matrix components

The results indicate that every variable has a loading factor value greater than 0.3, indicating that each and every one of the factors examined has an impact on the Sigi Regency's implementation analysis of the use of PPE during road construction as opposed to other factors.

Six factors that influenced the study's findings were identified based on the factor analysis method research done on 70 respondents.

There are five initial sub-factors that are not thought to be factors that influence the implementation of the use of personal protective equipment on road works in Sigi Regency. The implementation of the use of PPE on road works in Sigi Regency is divided into 27 sub-factors. Figure 17 below shows the number of factors before and after factor analysis.

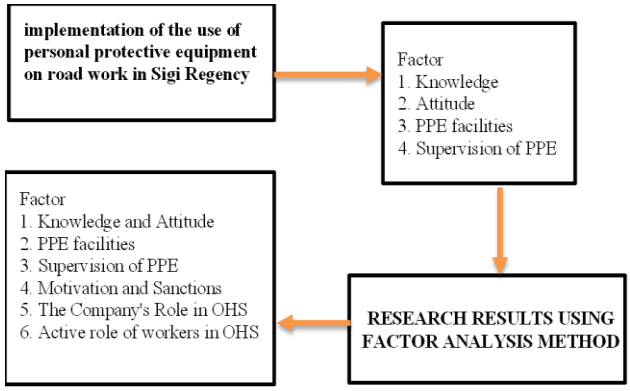

Figure 17: Number of factors before and after factor analysis

4.9 New Factor Formed

Six new factors are formed, namely the Knowledge and Attitude Factor, the PPE Facility factor, the PPE Supervision factor, the Motivation and Sanction Factor, the Company's Role in OHS and the Worker's Active Role in OHS.

First Factor The combination of the two initial factors—knowledge factors and attitude factors—is known as knowledge and attitude. Following the viewing of the knowledge factor's sub-factors and the Rotated Component Matrix results, this was carried out and the sub-factors of the attitude factor were collected into one component. Project workers in Sigi Regency who are used by the Company generally do not have sufficient knowledge about the importance of using PPE. They need to know the benefits of PPE for safety, how to properly wear, remove, and maintain PPE. Some workers usually only use PPE when there is a supervisor from a consultant or from the agency, after the supervisor goes home they do not wear it anymore, so it is important that the companies that employ them take steps to motivate and support workers in complying with PPE use regulations. This will not only improve workers' safety and health, but also help reduce the risk of workplace injuries and accidents [26].

The Motivation and Sanction Factor is the second rising factor. This is evident from the contributing sub-factors. I will remind my friends to wear personal protective equipment when working on Sigi Regency road projects. When employees work on road projects in Sigi Regency without wearing personal protective equipment (PPE), the company or

the foreman imposes sanctions or punishments on them. Based on the Rotated Component Matrix results, these two sub-factors combine to form component 4.

The author has never seen sanctions or consequences for workers not using PPE. Even though this needs to be applied to discipline its workers so that the Company also avoids sanctions or fines given by the owner. The company also lacks motivation for workers to always comply with using PPE [27]. The company needs to take steps to motivate workers to comply with the rules for using PPE [28]. This will help improve safety at the project site and reduce the risk of injury or illness associated with PPE non-compliance. The third increasing factor is the Company's Role in OHS. This is supported for study when conducting fieldwork, namely: PPE (body harness) is provided by the company when workers work on road projects in Sigi Regency;. In general, in Sigi, companies have provided PPE equipment to support OHS, but in the field PPE is not always worn when working, many workers are found not using PPE, this happens for several reasons, for example workers are not comfortable using PPE and workers generally ignore the risks of existing work [29].

The fourth increasing factor is the active role of workers in OHS. The sub-factors included in this factor are: Personal protective equipment is worn by every worker when working on road projects in Sigi Regency; workers in the Sigi Regency road project who were sampled for research when working in the field should use PPE, in addition to the safety of the workers themselves by using PPE in the field workers can be distinguished, which workers are foremen and which builders. Some workers already use PPE such as helmets, vests and septy shoes, some are still not used to using it and are even considered difficult when doing work in the field [30].

5. CONCLUSIONS

The factor analysis used to analyze the Implementation of Using Personal Protective Equipment on Road Works in Sigi Regency showed that the amount of influence generated from all factors reached 72.553% while the remaining 27.447% was influenced by other factors whose influence was not significant, this was obtained from the factor analysis test. The factor that has the highest influence on the implementation The knowledge and attitude component of wearing personal protective equipment during road construction in Sigi Regency, with the highest Variance value of 37.176%. And the least influential factor i s the active role of workers in OHS, with a Variance value of 3.961%.

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