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# SAFETY CLIMATE ANALYSIS FACTOR TO IMPROVE OCCUPATIONAL HEALTH AND SAFETY IN CONSTRUCTION WORK AT PT XYZ BUNYU FIELDWORK AREA

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**Abstract:** The oil and gas industry is a workplace with many sources of danger, such as gas pressure, explosions, fire, electricity, moving equipment and transportation. Field observations often result in work being stopped due to findings regarding unsafe conditions and unsafe actions in the workplace. Efforts can be made to protect workers' occupational health and safety by creating a safe climate in the workplace. This research aims to provide improvement solutions based on the safety climate factors that are most important in improving occupational health and safety in construction work. This research uses quantitative research methods. The research was conducted at the PT XYZ Bunyu fieldwork area in Bulungan Regency, North Kalimantan Province. The population used was all construction work employees under the supervision of the operation & surface facilities construction department, totalling 200 workers, while the sample was 180 workers. This research uses the Exploratory Factor Analysis method. The safety climate factor analysis results show that the total variance is 86.538%. Four factors were produced: training and compliance for occupational health and safety at 60.58%, leadership, knowledge and attitude of workers at 15.392%, management commitment and worker initiative at 6.313%, and safety campaign at 4.248%. Implementing the proposed improvements uses one factor, a safety campaign, where observations indicate that field implementation has been carried out well. This research does not analyse the relationship between the influence of safety climate factors on occupational health and safety; the suggestions for further research include examining the relationship between the influence of safety climate factors on occupational health and safety to find out the technical aspects and to apply existing factors directly in the field.

**Keywords:** Exploratory Factor Analysis, Occupational Health and Safety, Safety Climate, Oil and Gas, Construction

## 1. Introduction

The oil and gas industry is a workplace with many sources of danger, such as gas pressure, explosions, fire, electricity, and moving equipment. This, of course, will have an impact on occupational diseases and will cause injuries, which can hurt the economy due to loss of productive hours, as well as loss of labour and savings for work accident victims. Considering the many potential dangers and the high risk of work accidents, this is undoubtedly a challenge. Based on global data released by the International Labor Organization (ILO), it is stated that the number of cases of work accidents and occupational diseases in the world reaches 430 million per year, consisting of 270 million (62.8%) cases of car accidents and 160 million (37.2%) cases of occupational diseases which cause the deaths of 2.78 million workers every year. Meanwhile, data from the *Social Security Administrator* (BPJS) for Employment states that from January to November 2022, the number of work accidents in Indonesia was 263,334. This number increased by 13.26% compared to 2021 when the number was 234,270 cases. Therefore, occupational health and safety for all workers are mandatory indicators of the Company's success, including time, cost, and quality [1].

Occupational health and safety is one of a company's successes in implementing an occupational health and safety management system. Law No. 13 of 2003, article 86 concerning Occupational Health and Safety states that every worker or employee has the right to obtain occupational health and safety protection, morals and decency, appropriate treatment, and religious values. With this, every company must have a good occupational health and safety management system to prevent accidents and work-related diseases that can befall employees [2]. Safety practices that have a lousy reputation will hurt the idea of occupational health and safety management towards a safe work environment [3]. Efforts can be made to protect worker safety by creating a secure climate in the workplace. Safety climate is the psychological aspect of safety culture, which explains how a person feels about the safety management system in the workplace [4]. The safety climate in the industry needs to be analysed to determine workers' perceptions of existing Occupational health and safety policies [5]. Safety climate emphasises the perception held by a worker regarding the importance of occupational health and safety within the Company, as well as the implementation of management that is committed to realising occupational health and safety for workers [6]. Safety climate describes how occupational health and safety rules in the company are implemented, considering that implementing these rules will directly impact worker behaviour, which can be used to predict work accidents [7].

This research uses the factor analysis method. The factor analysis used in this research is Exploratory

Factor Analysis (EFA). Exploratory Factor Analysis (EFA) is used to find factors from several variables used in the analysis based on their similarities. This analysis uses EFA to summarise many original variables into new variables with a smaller number. Exploratory Factor Analysis (EFA) is a data reduction technique that condenses data into more minor summary variables [8]. This research aims to provide improvement solutions based on safety climate factors most important in improving occupational health and safety.

## 2. Research Method

This research uses quantitative methods. The object of this research is a construction field worker under the supervision of the operations & surface facilities construction department. The population used in this research was 200 workers, and the sample was 180. The sampling technique used is judgment sampling (specific considerations), where the researcher selects samples based on assessing several characteristics of the sample members [9]. The consideration in choosing the sample is based on workers who have been trained and no longer require adjustments to their work. The instrument used in this research is a questionnaire, which will be distributed and filled out by employees in the construction field worker under the supervision of the operations & surface facilities construction department. The questionnaire contains questions related to safety climate. This research uses 39 statements related to safety climate. Then, questionnaires were distributed, and the dimensions formed were analysed using factor analysis. The data analysis technique in this research was carried out using instrument tests, validity and reliability tests, and factor analysis using exploratory factor analysis (EFA).

## ~~3.~~ Results

The occupational health and safety factors examined in this research are management commitment and action for safety (X1), worker knowledge and compliance with safety (X2), knowledge of worker attitudes towards safety (X3), worker participation and commitment to safety (X4), safe work environment (X5), organisational preparedness during an emergency (X6), safety priority for productivity of work (X7), risk justification (X8). Conclusions regarding whether the factor analysis is appropriate are carried out using the Kaiser Meyer Olkin (KMO) test, Measures of Sampling Adequacy (MSA), and the Barlett Test of Sphericity.

**Table 1.** Kaiser Meyer Olkin, Measures of Sampling Adequacy and Barlett's Test Results

| Kaiser Meyer Olkin and Barlett's Test | | Result |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 0,923 |
| Barlett's Test of Sphericity | Approx. Chi-Square | 14155,380 |
| | df | 741 |
| | Sig | 0,000 |

Based on data analysis in Table 1, the KMO Measures of Sampling Adequacy figure is 0.923 with a significance of 0.000. The figure is 0.923 > 0.5, and the importance is 0.000 < 0.05, so the variables and data can be analysed further. The Measures of Sampling Adequacy (MSA) is a statistical test used to determine the correlation between variables, as seen in the anti-images correlation matrix table.

**Table 2.** Measure of Sampling Adequacy Calculation Results

| No | Variables | Measures of sampling Adequacy | No | Variables | Measures of sampling Adequacy |
|---|---|---|---|---|---|
| 1 | P1 | 0,905 | 21 | P21 | 0,938 |
| 2 | P2 | 0,947 | 22 | P22 | 0,907 |
| 3 | P3 | 0,962 | 23 | P23 | 0,925 |
| 4 | P4 | 0,967 | 24 | P24 | 0,954 |
| 5 | P5 | 0,900 | 25 | P25 | 0,970 |
| 6 | P6 | 0,936 | 26 | P26 | 0,964 |
| 7 | P7 | 0,927 | 27 | P27 | 0,879 |
| 8 | P8 | 0,916 | 28 | P28 | 0,852 |
| 9 | P9 | 0,937 | 29 | P29 | 0,915 |
| 10 | P10 | 0,873 | 30 | P30 | 0,944 |
| 11 | P11 | 0,849 | 31 | P31 | 0,942 |
| 12 | P12 | 0,929 | 32 | P32 | 0,936 |
| 13 | P13 | 0,965 | 33 | P33 | 0,878 |
| 14 | P14 | 0,876 | 34 | P34 | 0,955 |
| 15 | P15 | 0,908 | 35 | P35 | 0,950 |
| 16 | P16 | 0,896 | 36 | P36 | 0,942 |
| 17 | P17 | 0,939 | 37 | P37 | 0,922 |
| 18 | P18 | 0,917 | 38 | P38 | 0,952 |
| 19 | P19 | 0,952 | 39 | P39 | 0,897 |
| 20 | P20 | 0,903 | | | |

Based on the calculation results in Table 2, it can be seen that all variables have a Measures of Sampling Adequacy value of more than 0.5. After finding variables that can be analysed using the Measures of Sampling Adequacy test, the next step is extracting the existing variables to form one or more factors. After the extraction process is complete, the value of the

communalities will be obtained. Communalities are the amount of variation in a variable that common factors can describe. Based on the communalities figures, the relationship between the variables and the factors that will be formed can be seen.

**Table 3**. Communalities Results

| No | Variables | Initial | Extraction | No | Variables | Initial | Extraction |
|---|---|---|---|---|---|---|---|
| 1 | P1 | 1,000 | 0,931 | 21 | P21 | 1,000 | 0,884 |
| 2 | P2 | 1,000 | 0,868 | 22 | P22 | 1,000 | 0,870 |
| 3 | P3 | 1,000 | 0,805 | 23 | P23 | 1,000 | 0,862 |
| 4 | P4 | 1,000 | 0,904 | 24 | P24 | 1,000 | 0,893 |
| 5 | P5 | 1,000 | 0,875 | 25 | P25 | 1,000 | 0,733 |
| 6 | P6 | 1,000 | 0,877 | 26 | P26 | 1,000 | 0,756 |
| 7 | P7 | 1,000 | 0,920 | 27 | P27 | 1,000 | 0,874 |
| 8 | P8 | 1,000 | 0,939 | 28 | P28 | 1,000 | 0,908 |
| 9 | P9 | 1,000 | 0,864 | 29 | P29 | 1,000 | 0,908 |
| 10 | P10 | 1,000 | 0,872 | 30 | P30 | 1,000 | 0,870 |
| 11 | P11 | 1,000 | 0,919 | 31 | P31 | 1,000 | 0,897 |
| 12 | P12 | 1,000 | 0,871 | 32 | P32 | 1,000 | 0,887 |
| 13 | P13 | 1,000 | 0,628 | 33 | P33 | 1,000 | 0,867 |
| 14 | P14 | 1,000 | 0,881 | 34 | P34 | 1,000 | 0,871 |
| 15 | P15 | 1,000 | 0,911 | 35 | P35 | 1,000 | 0,840 |
| 16 | P16 | 1,000 | 0,910 | 36 | P36 | 1,000 | 0,848 |
| 17 | P17 | 1,000 | 0,923 | 37 | P37 | 1,000 | 0,843 |
| 18 | P18 | 1,000 | 0,850 | 38 | P38 | 1,000 | 0,856 |
| 19 | P19 | 1,000 | 0,833 | 39 | P39 | 1,000 | 0,853 |
| 20 | P20 | 1,000 | 0,852 | | | | |

Table 3 shows that the safety climate variable on occupational safety and health in construction work in the Bunyu Field area has the most considerable communalities value, namely 0.939, which means that around 93.9% of the variables from item 8 on the commitment factor and management actions for safety can be explained by factors that will be formed. Meanwhile, the variable with the smallest communalities value is the knowledge of workers' attitudes towards safety of 0.733, which means around 7.33% in item 25 and can be explained by factors that will be formed. The lower the commonalities value of a variable, the Bunyu Field work area has the most significant commonalities value, namely 0.939, which means that around 93.9% of the variables from item 8 on the commitment factor and management actions for safety can be explained by factors that will be formed. Meanwhile, the variable with the smallest communalities value is knowledge of workers' attitudes towards safety at 0.733, which means around 7.33% found in item 25 and can be explained by the factors formed. The lower the communalities value of a variable, the weaker the relationship with the factors that will be formed. Conversely, the higher the communalities value of a variable, the stronger the relationship between the factors that will be formed.

After knowing the value of communalities, the next stage identifies the total variance explained, which will explain the basis of the number of factors formed. In the total variance explained, there are eigenvalues. Eigenvalues can show the relative importance of each factor in calculating the diversity of all variables analysed. The eigenvalues are always sorted from the most significant value to the smallest value with the criterion that if they are below 1, they will not be used to calculate the number of factors formed.

**Table 4**. Eigenvalues and Variance Values

| Factor | Eigenvalues | Variance (%) |
|---|---|---|
| 1 | 23,628 | 60,585 |
| 2 | 6,003 | 15,392 |
| 3 | 2,462 | 6,313 |
| 4 | 1,657 | 4,248 |

The research results, based on Table 4, show that 4 factors, which have eigenvalues> 1, are included in the safety climate regarding occupational health and safety.

**Table 5.** Factor Loading Values

| No | Factor | Total Variance | Statements involved in core factors | | Eigenvalues | Cronbach's Alpha |
|---|---|---|---|---|---|---|
| 1 | Training and Compliance for Occupational Health and Safety | 60,585 | P2 | 0,879 | 23,628 | 0,989 |
| | | | P5 | 0,892 | | |
| | | | P6 | 0,891 | | |
| | | | P9 | 0,876 | | |
| | | | P12 | 0,888 | | |
| | | | P14 | 0,894 | | |
| | | | P18 | 0,862 | | |
| | | | P20 | 0,871 | | |
| | | | P26 | 0,811 | | |

| No | Factor | Total Variance | Statements involved in core factors | | Eigenvalues | Cronbach's Alpha |
|---|---|---|---|---|---|---|
| | | | P32 | 0,888 | | |
| | | | P33 | 0,890 | | |
| | | | P34 | 0,888 | | |
| | | | P35 | 0,866 | | |
| | | | P36 | 0,868 | | |
| | | | P37 | 0,865 | | |
| | | | P38 | 0,861 | | |
| | | | P39 | 0,876 | | |
| 2 | Leadership, Knowledge and Attitudes of Workers | 15,392 | P7 | 0,856 | 6,003 | 0,981 |
| | | | P15 | 0,860 | | |
| | | | P16 | 0,854 | | |
| | | | P17 | 0,860 | | |
| | | | P19 | 0,815 | | |
| | | | P21 | 0,730 | | |
| | | | P22 | 0,720 | | |
| | | | P23 | 0,724 | | |
| | | | P24 | 0,735 | | |
| | | | P30 | 0,725 | | |
| | | | P31 | 0,746 | | |
| 3 | Management Commitment and Worker Initiative | 6,313 | P1 | 0,837 | 2,462 | 0,983 |
| | | | P4 | 0,856 | | |
| | | | P8 | 0,845 | | |
| | | | P11 | 0,852 | | |
| | | | P28 | 0,847 | | |
| | | | P29 | 0,843 | | |
| 4 | Safety Campaign | 4,248 | P31 | 0,772 | 1,657 | 0,930 |
| | | | P10 | 0,830 | | |
| | | | P13 | 0,516 | | |
| | | | P25 | 0,540 | | |
| | | | P27 | 0,829 | | |

Table 5 presents the factor loading values for each indicator that has been rotated using the varimax method. This orthogonal rotation method summarises the columns of the factor matrix to obtain the highest factor loading for each variable. The results of factor analysis obtained four factors: safety climate, occupational health, and safety in construction work.

The research results obtained four factors from summarising the variables considered in management actions regarding occupational health and safety: Training and Compliance for Occupational Health and Safety, Leadership, Knowledge and Attitudes of Workers, management commitment and worker initiative, and safety campaign. Following conditions occurring in the field, improvements to occupational safety and health are proposed [10,11].

First: Leadership, Knowledge and Attitudes of Workers. So, the improvement solution provided is that the role of workers with a leadership spirit in implementing occupational health and safety is significant. A leadership spirit can provide work instructions well and clearly while creating a balance with the supervisory process, and it must be able to make decisions when solving problems. Workers must have a positive work attitude to improve and maintain occupational health and safety implementation in the company. Workers with a good work attitude will provide a sense of security for management. The application of rewards and punishments needs to be carried out to increase workers' sense of responsibility so that they can be more active in their work by paying attention to occupational health and safety aspects and avoiding all unsafe situations that can cause work accidents. Workers can involve occupational health and safety aspects in each job, such as conveying safety moments before work to their work team, reprimanding and reporting if they see unsafe conditions and actions in the workplace. The expected rewards include crowning the employee as a model employee, giving souvenirs (t-shirts, Tumblrs, hats, bags, etc.) and giving money. Meanwhile, punishment is given to workers who violate safety, health, security and environmental protection policies and company regulations, where the sentence can be in the form of heavy sanctions, namely giving warning letters and ending employment relations.

Second: Management Commitment and Worker Initiative. The solution given is that in implementing occupational health and safety, management must implement policies that have been made in writing regarding commitments regarding safety, health, and environmental policies. These policies must always be disseminated to all workers in the work area during worker induction, toolbox meetings, weekly meetings, monthly meetings, and safety talks.

Third: Training and Compliance for Occupational Health and Safety. So, the solution for companies and workers to implement OHS at work should be improved, especially regarding compliance with existing policies, regulations, and work procedures. Workers are expected to be able to remind each other of the dangers of

violating OHS rules at work. Workers also have the right to receive OHS socialisation or training. Companies need to provide training because OHS training helps increase workers' awareness about their safety in working correctly so that accidents do not occur in the workplace. The training in question includes basic safety training, operator training, etc.

Fourth: promotion of occupational health and safety. So, the solution is that promotion must be carried out consistently, both verbally and in writing, promoting occupational health and safety. An effort to promote occupational health and safety verbally is that companies must hold safety talks every day before workers start their work, where the work supervisor and HSE are the ones responsible for carrying out these activities. This is useful for motivating workers to behave safely at work. Furthermore, occupational health and safety promotion is carried out in writing by installing occupational health and safety posters containing information regarding the rules for using PPE, etc.

## 4. Conclusion

Based on the analysis of safety climate factors, it can be concluded that four new factors have been formed: training and compliance for occupational health and safety, leadership, knowledge and attitudes of workers, management commitment and worker initiative, and safety campaign. Of the four factors, the improvement proposal was implemented for 20 days using one of the factors formed, namely the safety campaign; the safety campaign factor was chosen to be applied to the improvement proposal because it was the most likely factor to be carried out and had a direct impact on workers in the field, implementation This proposed improvement is carried out by making observations using an observation sheet. The results of the observations indicate that implementation in the field has been carried out. The implementation of the proposed improvements was carried out in a measurable manner using an understanding sheet about the material which was delivered to 30 workers.

Based on the recapitulation of the understanding sheet provided before and after the safety campaign material was delivered, the implementation of the safety campaign influenced workers' understanding of occupational health and safety in the workplace, with an increase of 36.90%.

This research does not analyse the relationship between the influence of safety climate factors and occupational health and safety. The suggestions for further research include analysing this relationship to determine its technical aspects and applying existing factors directly in the field.

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