

# **Development of Big Five Personality Traits Moderation That Affecting Safety Leadership, Safety Knowledge, and Safety Culture on Safety Performance Models to Reduce Accidents in The Chemical Industry**

**Mega Cattleya Prameswari Anissa Islami**  
Industrial Engineering Department, Faculty of Engineering  
Universitas Pembangunan Nasional “Veteran” Jawa Timur  
Surabaya, Indonesia  
mega.cattleya.ti@upnjatim.ac.id

**Adhitya Sudiarno**  
Industrial and Systems Engineering Department  
Institut Teknologi Sepuluh Nopember  
Surabaya, Indonesia  
adhitya.sudiarno@gmail.com  
adhitya\_sudiarno@ie.its.ac.id

## **Abstract**

This study develops a model that examines the relationship between safety leadership, safety knowledge, and safety culture on safety performance by moderating the personality traits of workers. This model is further evaluated to determine whether the latent variables of leadership attitudes about safety, the knowledge they have of safety by workers, the formed safety culture and personality as defined in the safety theory and personality traits theory, can significantly influence safety performance. The research model was empirically tested using data collected from 70 workers. To know the relationship between latent variables and interactions with moderation variables, this study uses the structural equation model (SEM) method. The results show that all variables have a significant relationship to safety performance, but personality traits cannot moderate the relationship between all independent variables on safety performance.

## **Keywords**

Personality traits, safety performance, safety leadership, safety knowledge, and Safety culture

## **1. Introduction**

An accident is a phenomenon that threatens the health of the workforce which has been expanded by technological advances and caused financial losses for social communities (Barkhordari et al. 2019). The cause of work accidents is the presence of unsafe actions and unsafe behavior (Guglielmi et al. 2022). Unsafe behavior factors cause 76% of accidents in various industries in the USA (Wang et al. 2019). One of the causes of unsafe behavior and unsafe conditions is poor safety leadership. Without effective safety leadership, a person will not have good safety performance (Moosa and Oriet 2022). One of the roles of safety leadership is to coordinate workers to participate in discussions by providing input and information related to activities in the workplace so that leaders can find out about faulty work system problems and determine strategies to solve these problems. In the process of forming a strategy, knowledge about the safety of workers is needed. Safety knowledge is an understanding of theoretical safety by applying it to creating safety behaviors at work (Ghasemi et al. 2022). Good safety knowledge will result in a healthy work environment and workers who prioritize work safety. The work environment reflects how the safety culture in the industry is formed. No matter how good a company provides protection or builds a safe work environment, does not always result in better safety performance without an increase in safety culture (Mohammadi et al. 2018). Psychological aspects are not only part of organizational culture but can also determine an individual's safety

performance. The personality of the worker will greatly influence how the safety factors in the workplace are formed and affect the way workers interact with their environment. So it is also important to consider safety performance from a personality point of view. There are personal characteristics consisting of (extraversion, agreeableness, conscientiousness, neuroticism, and openness) called The Big Five Personality Traits (Smartt et al. 2022). This research was conducted in one of the chemical industries in Indonesia. Safety leadership, safety knowledge, safety culture, and personality traits are factors that can affect good or bad safety performance. So that the problem to be discussed in this study is to determine the model of the relationship between safety performance, safety leadership, safety knowledge, safety culture, and personality traits as well as knowing how the moderation effect of personality traits variables is. The purpose of this study is to analyze the relationship model that is formed. Data processing will use the Structural Equation Model (SEM) method. The structural Equation Model is a stronger analysis technique because it considers interaction modeling, non-linearity, correlated independent variables, measurement errors, correlated error terms, and multiple latent variables where each is measured using many manifest variables. The basic reason for using SEM is because of its ability to estimate the relationship between variables with multiple relationships. This relationship is formed in a structural model (the relationship between the independent and dependent variables). SEM can describe the pattern of the relationship between latent variables and manifest variables. In addition, the selection of Lisrel is because Lisrel has better goodness of fit criteria, and the resulting bias is also smaller (Steenkamp and Maydeu-Olivares 2022).

## **2. Literature Review**

### **2.1 Safety Performance**

In general safety performance is the behavior of an individual shown at work to promote the safety and health of workers, customers, and the surrounding environment. Safety performance refers to actions or behavior done by employees to support the safety of themselves and their colleagues. This is usually explained in safety compliance and safety participation. Employees who show good safety compliance and safety participation are more likely to have fewer accidents and injuries at work (Zhang et al. 2022).

### **2.2 Safety Leadership**

Safety leadership is a leadership system that prioritizes occupational safety and health principles. safety leadership is divided into three factors that are believed to be safety motivation which refers to the extent to which leaders encourage for workers to behave by safety procedures. Safety policy refers to the extent to which leaders set clear missions, responsibilities, and objectives to provide standards of safety behavior. Safety concern which refers to the extent to which leaders provide direction on the importance of matters relating to the safety system (Lyubykh et al. 2022).

### **2.3 Safety Knowledge**

Safety knowledge is about how workers understand the safety procedures, training, and safety instructions that exist (Jiang and Probst 2014). From these notions concerning it can be concluded that safety knowledge is a theoretical understanding of workers' safety which is supported by the implementation to create safe behavior while working. Several factors shape a person's safety knowledge. These factors consist of the extent to which workers can use safety equipment, the extent to which workers know the types of hazards in the workplace, and how to deal with them when an emergency occurs (Aristei et al. 2022).

### **2.4 Safety Culture**

Safety culture is described through shared values (what is important) and beliefs (how things work), which have interactions with organizational structures and control systems to produce norms or behavior. In addition to values and norms, some factors are often used by other researchers to measure safety culture in an organization, these factors are work rules and procedures, communication, competence, work environment, and employee involvement (Aburumman et al. 2019).

### **2.5 Personality Traits**

Big Five Personality Traits are theories that represent personality traits at a broader level of abstraction (Mammadov 2022). Big Five Personality Traits are personality traits that are formed by five factors or factors consist Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Alexander et al. 2022). Extraversion is predicting many individual social behaviors. Individuals with high extraversion tend to be more affectionate, carefree, actively talking, easy to join, fun, and interact with (Hall et al. 2019). Agreeableness is also called social adaptability or

likability. Individuals with high agreeableness traits tend to have the sincerity and subtlety of feeling in dealing with others (Hall et al. 2019). Conscientiousness is a trait that refers to the level of regularity of an individual. Conscientiousness describes individuals who are organized, controlled, organized, ambitious, and focused on results and discipline (Hall et al. 2019). Neuroticism known as "anxiety" explains that neuroticism is dominated by negative emotions such as worry, tension, and fear (Troisi et al. 2021). Openness is also called open-mindedness or openness to experience. This trait is closely related to the openness of insight and originality of ideas (Troisi et al. 2021).

## 2.6 Moderating Effects of Personality Traits on Safety Performance

If a variable affects the strength of the relationship between the independent variable and the dependent variable, then that variable is a moderator variable. The effect of moderation is understood as the result of the interaction between the independent variable and the moderator variable. The interaction variable is obtained from the multiplication of the average between the independent variables and the moderator variables. So that the effect of the independent variable in measuring the dependent variable will depend on how the level of the moderator. Therefore, the moderator variable is a variable that can strengthen or weaken the influence between the independent variable and the dependent variable. Figure 1 represents the conceptual and statistical models for moderation analysis (Memon et al. 2019).

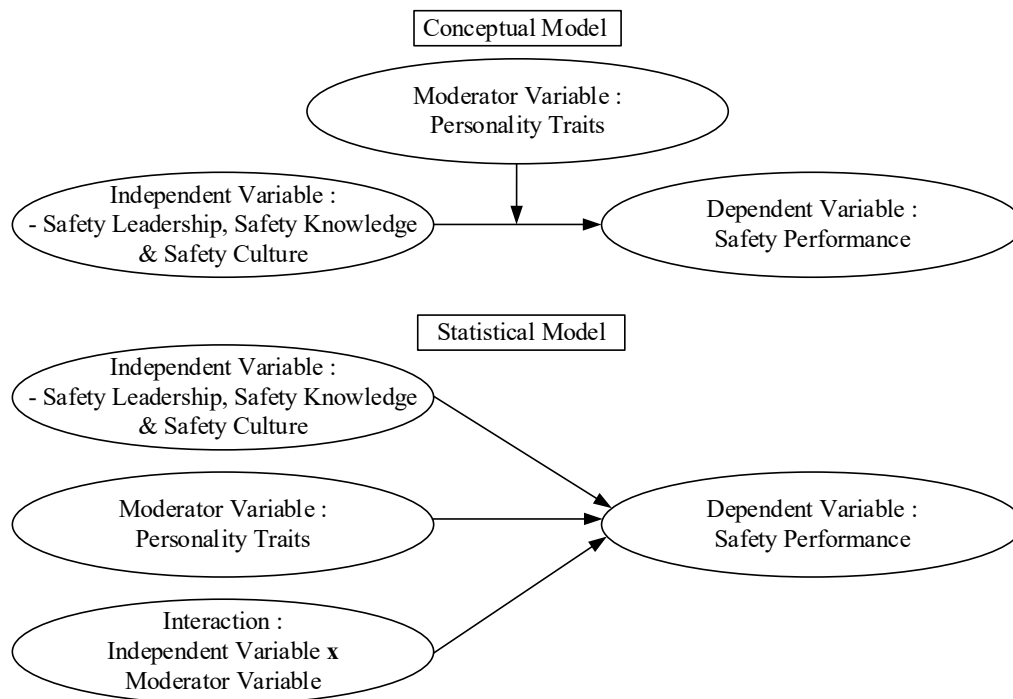


Figure 1. Conceptual and statistical model for moderation

In this study, personality traits will act as a moderating variable. So, personality traits will affect the relationship between safety leadership, safety knowledge, and safety culture on safety performance. Behaviour reflects a person's personality, so in other words, this behaviour tendency causes the risk of human error in the workplace to increase. In general, accidents will be seen as the impact of design and process failures, but, the human error factor also contributes to the occurrence of work accidents. Behaviour in individuals involves the interaction between the underlying personality in a person with situational variables. Personal traits consist of (extraversion, friendliness, awareness, neuroticism, and openness) and are called The Big Five Personality Traits. The relationship between safety leadership and safety performance is moderated by the Big Five Personality Traits (Frieder et al. 2018). The motivation mechanism carried out by the leader to workers who have attend conscientious, such as hard work, discipline and persistence will produce better performance, and individuals with a high tendency towards extraversion will be more optimistic and active so that they can achieve the stated goals to improve performance. There is a relationship between safety knowledge and safety performance which is moderated by the Big Five Personality Traits (Manaf et al. 2018). Individuals with high conformity tend to exchange knowledge so that the knowledge they have will increase and this

can have a good impact on performance. There is a relationship between safety culture and safety performance which is moderated by the Big Five Personality Traits (Desmaryani 2018). These values and rules will be strong if workers tend positive traits in the Big Five Personality Traits.

### 3. Methods

#### 3.1 Analysis

Lisrel is a statistical method used to study or construct linear models. Lisrel can simultaneously process endogenous and exogenous sets of variables. This research uses LISREL 8.80 software to analyze the measurement and structural models. Although this study only had 70 respondents, Lisrel was chosen as an analysis method due to producing a model that has a smaller bias than the model feasibility test. Data processing techniques in this study consisted of developing a model with the conceptual elaboration of existing theories to support the latent and manifest variables used. After that, questionnaires were distributed to respondents according to the variables used (safety performance, safety leadership, safety knowledge, safety culture, and personality traits). Then carried out descriptive data processing to determine the characteristics of the respondents (age, last study, and working period). After that, testing the measurement model with the Confirmatory Factor Analysis (CFA) method to evaluate each variable has the appropriate indicator. The last stage is to test the structural model to see the relationship between latent variables.

#### 3.2 Instrument Tools

This study uses a paper-based survey by distributing questionnaire papers to the respondents. The questionnaire survey was conducted during workers' rest periods. The questionnaire survey takes about one month. The questionnaire consisted of 82 questions consisting of 22 questions regarding exogenous and endogenous variables and 60 questions regarding the assessment of personality traits. The questionnaire scale assessment used was a Likert scale with a score of 1 to 5 starting from strongly disagreeing to strongly agreeing.

#### 3.3 Participant Profiles

Respondents used in the study were all workers (population) in PT. Petrowidada. But from the population used workers will be selected who are directly related to the production system or workers whose work location is in the field rather than workers in the office. This is because, safety values will be more used by workers whose work environment is in the field or directly related to tools or machines. So that there are 70 respondents used as data in this study. Of the 70 respondents conducted research through questionnaires that have been obtained. (Table 1)

Table 1. Statistics of research participants

Variable	Type	Number	Percentage (%)
Age	18 – 26 years old	9	13
	27 – 35 years old	11	16
	36 - 44 years old	15	21
	45 – 53 years old	30	43
	> 53 years old	5	7
Last study	Elementary school	-	-
	Middle school	-	-
	High school	49	70
	Diploma	-	-
	Bachelor	21	30
Variable	Type	Number	Percentage (%)
Working period	< 2 years	4	6
	2 – 5 years	9	13
	6 – 10 years	9	13
	11 – 15 years	5	7
	> 15 years	43	61

#### 4. Data Collection

Respondents used in the study were all workers (population) in the chemical company Gresik Indonesia. But from the population used workers will be selected who are directly related to the production system or workers whose work location is in the field rather than workers in the office. This is because safety values will be more used by workers whose work environment is in the field or directly related to tools or machines. So that there are 70 respondents used as data in this study. 70 respondents conducted research through questionnaires that have been obtained.

#### 5. Results and Discussion

##### 5.1 Validity and Reliability

This test is carried out to see how good the level of accuracy is. Indicators can be said to be good or have a good accuracy value if it meets the predetermined standard, the t-value  $\geq 1.96$  and the SLF value  $\geq 0.30$ . Reliability testing is carried out to assess the consistency of the indicators used in compiling the variables. Reliability testing is done by using a Variance Extracted value  $> 0.50$  which means the indicator meets the requirements. Based on the test results, the indicators used in this study can be said to be valid and reliable. This can be interpreted that the indicators used have a good level of accuracy and consistency in explaining the variables used. (Table 2)

Table 2. Validity and reliability indicators of the proposed model

Variable	Indicator	SLF	T - value	CR
Safety performance	SP1	0.49	6.50	1
	SP2	0.18	3.45	
Safety leadership	SL1	0.52	3.30	0.7
	SL2	0.46	2.70	
	SL3	0.40	8.90	
Safety knowledge	SK1	0.29	3.21	0.73
	SK2	0.40	2.78	
	SK3	0.35	3.40	
Safety culture	SC1	0.55	3.34	0.58
	SC2	0.64	2.30	
	SC3	0.78	3.20	
	SC4	0.59	2.80	
Personality traits	PT1	0.54	2.45	0.92
	PT2	0.49	6.79	
	PT3	0.60	2.56	
	PT4	0.57	5.78	
	PT5	0.17	4.67	

The effect of moderation is assessed from the interaction between the independent variable and the moderator variable in predicting the dependent variable. In this research, there are two stages of processing. The first stage is processing all the independent variables and interaction variables in one model to predict the dependent variable using the Lisrel 8.80 method. The following is a model for the first processing. The results of the processing state that the t-value of all interaction variables cannot meet the criteria for a t-value  $\geq 1.96$ . (Figure 2)

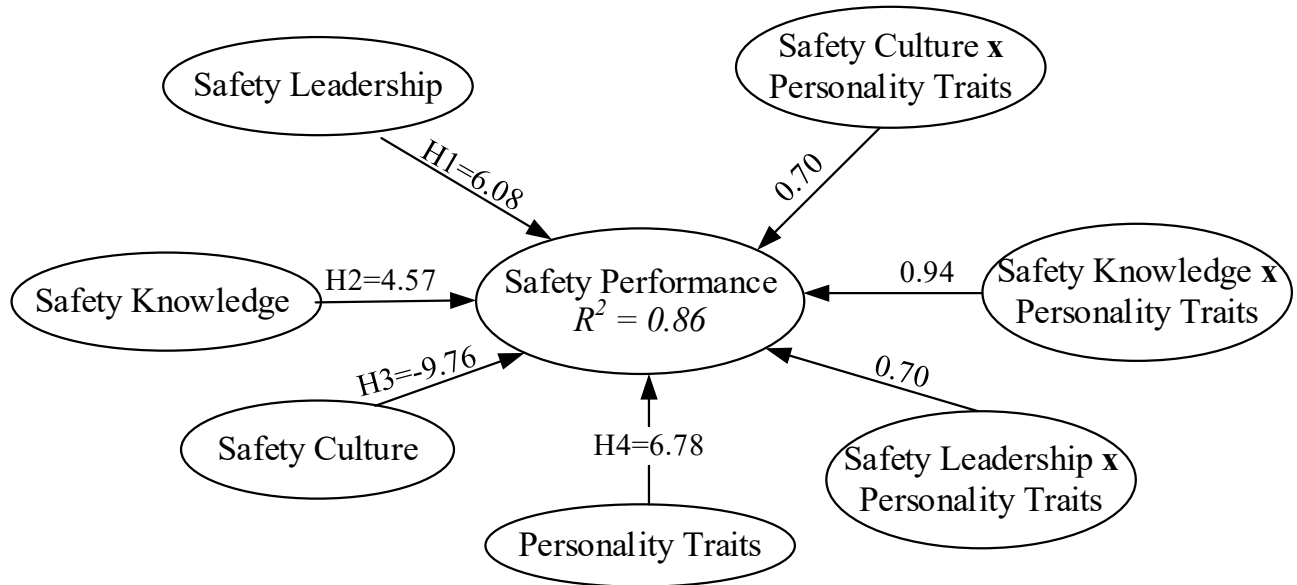


Figure 2. Path relationships of the proposed model

This study also uses the Goodness of Fit (GOF) index criteria. Several GOF criteria need to be considered and each criterion has a standard value that must be achieved in a structural model. Based on the result, there are two criteria for goodness of fit, consisting of RMSEA and PGFI that do not meet the set cut-off value. Because the results of the t-value and goodness of fit did not meet the provisions, it was decided to do a second test without using interaction variables. Figure 3 is a path relationship model without interaction variables.

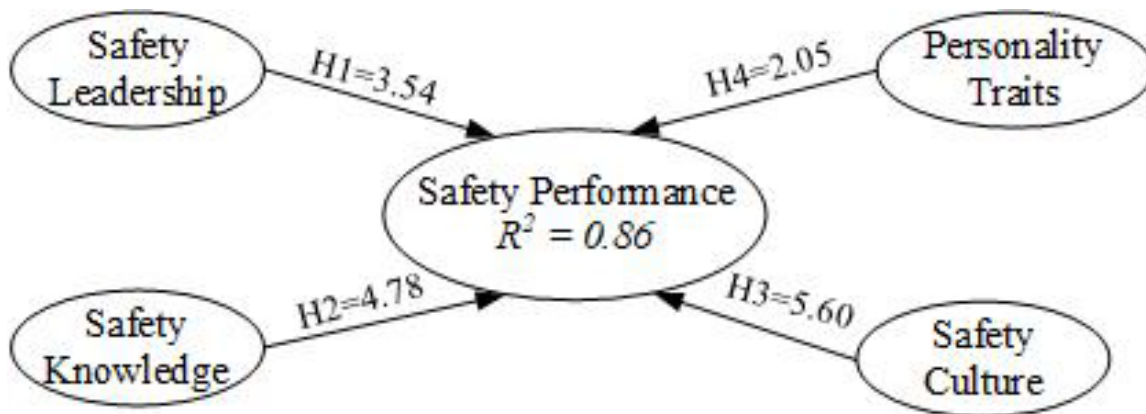


Figure 3. Path relationship of the model without the interaction variable

Based on the results of the second test, all variables have a t-value > 1.96, so it can be concluded that there is a relationship between the variables of safety leadership, safety knowledge, safety culture, and personality traits on safety performance

Table 3. Name of the table

Goodness of fit measure	Cut off value	Testing result	Decision
Absolute fit indices			
GFI	≥ 0.70	0.084	Good fit
AGFI	≥ 0.70	0.75	Good fit
RMR	≤ 0.10	0.025	Good fit

RMSEA	$0.05 < \text{RMSEA} \leq 0.08$	0.053	Good fit
Incremental fit indices			
NNFI	$\geq 0.90$	0.96	Good fit
NFI	$\geq 0.90$	0.90	Good fit
RFI	$\geq 0.90$	0.98	Good fit
IFI	$\geq 0.90$	0.97	Good fit
CFI	$\geq 0.90$	0.97	Good fit
Parsimony fit indices			
PGFI	$\geq 0.50$	0.58	Good fit
PNFI	$\geq 0.50$	0.74	Good fit

Based on Table 3, it can be concluded that all goodness of fit values in the structural model testing meet the goodness of fit index criteria, both in the absolute fit indices, incremental fit indices, and parsimony fit indices. So that the model in this study can be said to be fit. Among the nine proposed hypotheses, six hypotheses reached a significant level determined ( $t\text{-value} \geq 1.96$ ), which consists of safety leadership which has a significant effect on safety performance (H1, 3.54). These results indicate that in general, the leadership in the company has increased workers' awareness of the importance of safety. This is reflected in the company's leadership who has provided written procedures to workers and provided encouragement in the form of briefings, conducted field monitoring, and had discussions with workers to improve safety performance. Safety knowledge significantly influences safety performance (H2, 4.78). The significant relationship between safety knowledge and safety performance shows that workers already understand safety knowledge. This can be seen in workers who are active in maintaining the safety and health of the work environment by understanding what hazards may occur in the workplace and identifying hazards such as assessing risk levels and reporting each incident to the relevant management for follow-up. Safety culture has a significant effect on safety performance (H3, 5.60). The significant relationship between safety culture and safety performance shows that the value of safety is now a company priority that must be carried out. This can be seen from the creation of work instructions that can be understood by workers, the existence of concern for safety values by emphasizing workers' competence in operating and maintaining tools and machines and being consistent in measuring the work environment. Personality traits significantly influence safety performance (H4, 2.05). Based on the results of data processing and observations made, workers tend to behave more positively which has a good impact on safety performance. It can be indicated that 36% of the measurement results are dominated by trait agreeableness. People with strong agreeableness traits will tend to be helpful, friendly, empathetic, kind, and easy to forgive. This tendency is seen by most workers who have concerns about the safety of their colleagues by reminding coworkers who behave or see unsafe work areas. The second reason is trait conscientiousness with a percentage of 30% with a tendency to be careful, reliable, efficient, detailed, prefer routine and predictive procedures, and have a strong sense of responsibility. It can be seen from workers who have a sense of responsibility for safety in the company by complying with work rules and procedures and reporting every form of incident or damage in the work environment. The last reason is the trait of extraversion with the tendency to have a sociable behavior so that it is easier to make friends and have positive emotions that can be seen from the discipline of workers to join safety programs that require interaction. Safety leadership significantly influences safety knowledge (H5, 2.80). These results indicate that direction and encouragement from the leadership can have a positive effect on workers' understanding of safety. This can be seen from the leadership being open and responsive to follow-up on unsafe conditions, conducting sustainable idea programs by discussing and providing opportunities for workers to provide solutions to safety problems, and holding knowledge-sharing programs for all workers to gain insight into how to improve safety performance from multiple points of view. Safety leadership has a significant effect on safety culture (H6, 2.80). The results of data processing and observations made show that leaders who provide safety motivation as a safety leadership factor in the form of encouragement about safety will directly build a better safety culture in the company. This can be seen from company leaders who have encouraged for workers to increase worker responsibilities by knowing the importance of safety aspects such as holding programs for the importance of using PPE and firefight training programs as well as training on the operation of tools and machines to improve worker competence. Three hypotheses that did not reach a significant value are hypotheses related to moderation interactions where personality traits cannot moderate the relationship between safety leadership, safety knowledge, and safety culture on safety performance (H7, H8, H9) with  $t\text{-values}$  of 0.70, respectively; 0.94 and 0.70.

### **5.3 Personality Traits Moderation**

An assessment of personality traits is important to see how the respondent's behavior tends to be. Personality traits are divided into five factors which consist of Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. The assessment is done by calculating the norm categorization. (Figure 4)

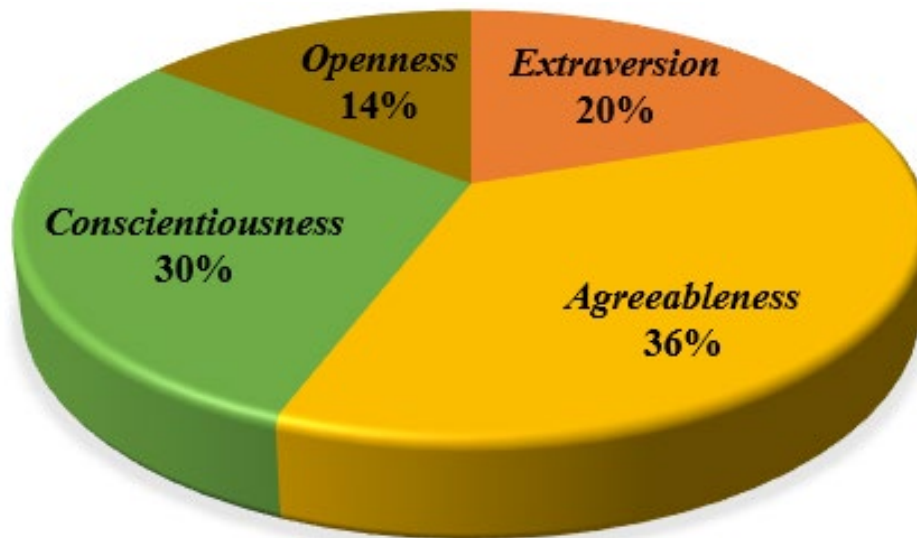


Figure 4. Personality traits category of research participant

Based on the results of the hypothesis (H7, H8, and H9), show that the interaction between personality traits and independent variables does not have a significant relationship with safety performance. The results of this test do not support previous research. Based on the results of processing the t-value value on the interaction variable has a positive value, which means that there is a unidirectional relationship or positive effect even though it is not significant. This can be caused by several reasons, such as the dominant trait of agreeableness owned by workers. someone with a high level of agreeableness also has a negative side, which is likely to have shortcomings when facing a conflict, namely a decrease in their self-esteem where the level of confidence in their ability to resolve conflicts is reduced so they need help from others in problem-solving and become independent and dependent on people. other. This will interfere with the application or application of safety values. The second reason is the dominant trait of conscientiousness possessed by workers. On the other hand, a person with high conscientiousness traits will tend to be a perfectionist, compulsive and workaholic. So it is inflexible and rigid and has difficulty in discussing, exchanging ideas, or accepting opinions from other people, while a compulsive person will tend to be anxious and interfere with functioning. it can distract workers from implementing or applying safety norms that require discussion. The last reason is the lack of workers with strong trait openness. Someone with a strong openness trait will tend to focus and be easy to tolerate and absorb information and have broad thinking, love to learn, and will find it easier to find solutions. This trait can increase the significance because workers can contribute by applying safety norms through a process of understanding and learning. So, it takes someone with a character of high curiosity, likes to learn, adds information to resolve a conflict or safety problem, and improve safety performance. Although the hypothesis related to personality traits interaction as a moderating variable is not significant, personality can be said to be a predictor of moderation because it has a significant relationship to the independent variables in the modeling. So that although in this study personality traits cannot be moderate, it can also be concluded that personality traits can be moderating variables because they have significant values with independent variables and individually have significance as predictors of the dependent variable.

### **6. Conclusion**

This research was conducted to develop a model of the effect of the relationship between the variables of leadership, safety knowledge and safety culture on safety performance and see how personality traits moderate the influence. From the research results, it is known that all variables have a significant value on safety performance while the interaction of personality traits as a moderating variable with an independent variable produces insignificant values



on safety performance so that it can be said in this study personality traits cannot moderate the relationship between safety leadership, safety knowledge and safety culture to safety performance. Even so, the personality traits variable can be considered a predictor of moderation because it has significance to all independent variables. To get a more comprehensive result on construction safety performance, further research is suggested to use a larger population and come from several other types of industries such as construction, oil and gas or manufacturing, which are among the industries with the highest accident rates. In addition, it is necessary to pay attention to the use of safety leadership variables and safety culture variables in one model because there are other references which state that safety leadership is part of safety culture, which is reflected in the management commitment, so this needs to be considered to avoid redundancy.

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## **Biographies**

**Mega Cattleya Prameswari Anissa Islami** is a Lecturer of Ergonomic and Product Design at Department of Industrial Engineering, Universitas Pembangunan Nasional Veteran Jawa Timur, Surabaya, Indonesia. She received her magister degree from the Institut Teknologi Sepuluh Nopember in 2020 and bachelor's degree from Politeknik Perkapalan Negeri Surabaya in 2017. Her main research interests are in ergonomics on the production floor, ergonomic product design, facility planning & layout, workstation design, cognitive ergonomics, physiology and biomechanics, industrial psychology, occupational safety and health, etc.

**Adithya Sudiarno** a lecturer at the Faculty of Industrial Technology and Systems Engineering, and part of the Ergonomics Laboratory and Work System Design, at the Institut Teknologi Sepuluh Nopember. His expertise is in Occupational Health and Safety Engineering, Healthcare system management, Workload Assessment, Safety Maturity Assessment