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The Role of Safety Leadership in Shaping Safety Culture: The Mediating Role of Communication and Commitment

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ABSTRACT

This study aims to link safety leadership to safety culture and safety climate as intermediaries. The research method used is a survey. Statistical analysis used to test the hypothesis with SEM-PLS, a sample of 317 was taken with a saturated sampling technique and used second-order data processing. The results of the study indicate a positive correlation between safety leadership and safety culture and safety climate. The conclusion of this study is that safety leadership plays a role in shaping safety climate and maintaining safety culture in the workplace. This research is important because cultivating a positive safety climate and culture can lead to reduced accidents in the workplace, higher employee morale, and overall organizational performance.

ABSTRAK

Penelitian ini bertujuan untuk menghubungkan safety leadership terhadap safety culture dan safety climate menjadi perantara. metode penelitian yang digunakan adalah survey. Analisis statistik yang digunakan untuk menguji hipotesis dengan SEM-PLS, Sampel sebanyak 317 diambil dengan teknik sampling jenuh dan menggunakan pengolahan data orde kedua. Hasil penelitian menunjukkan adanya korelasi positif antara safety leadership terhadap safety culture dan safety climate. Kesimpulan penelitian ini adalah safety leadership memainkan peran dalam membentuk safety climate dan memelihara safety culture di lingkungan kerja. Penelitian ini penting karena menumbuhkan iklim dan budaya keselamatan yang positif dapat menyebabkan berkurangnya kecelakaan di tempat kerja, moral karyawan yang lebih tinggi, dan kinerja organisasi secara keseluruhan.

INTRODUCTION

In modern industry, there are various kinds of jobs, and each job has a level of risk that can easily harm employees. In order to minimize the level of safety risk, companies are required to provide training related to work safety procedures. Ensuring prosperity in the work environment can advance work safety and support the achievement of expected results. In the workplace there are various kinds of jobs and some can trigger risks and work accidents. (Publication et al., 2024) .

Figure 1 *Work Accident Data in Indonesia*

Based on the statement of the Social Security Administering Agency (BPJS) Employment, each period, the number of work accidents continues to increase. This started in 2019, which found 182,835 cases, then in 2020 221,740 cases were found, in 2021 234,370 cases were found, in 2022 it increased to 297,725 cases, and in 2023 it was 360,635 cases. Thus, it can be concluded that work accident cases have continued to increase over the past five years, namely from 2019 to 2023 (BPJS Employment, 2016) .

Table 1 *Work accident at PT. PLN Nusantara Power UP Muara Tawar Bekasi*

Saverity Level	Number of Victims
Dead	4
Seriously Injered	10
Lightly Injured	24

Can be seen and seen in table 1. explains that work accidents experienced by the company PT. PLN Nusantara Power UP Muara Tawar Bekasi from 2019-2023 were recorded severity level of death number of victims reached 4 employees, serious injuries 10 employees, lightly injuries 24 employees. It can be underlined that one of the causes of work accidents is the implementation and supervision of K3 and industrial employee safety measures that are not optimal. The main trigger for work accidents is negligence in operation due to carelessness of management that socializes with unsafe behavior and situations (Mendoza et al., 2020) . In general, work accidents are caused by two main factors, namely behavior and an unsafe environment. Therefore, leaders, climate, and culture are required to implement concrete work safety efforts in order to prevent work accidents. Work accident control efforts can be implemented when fostering a safety climate for all workers. (Asokawati et al., 2023) . The definition of a work accident is a behavior or condition whose safety cannot be predicted, resulting in an accident at work. Work safety is a step to overcome work accidents, namely eliminating accidents to carrying out strict controls. Work safety is useful for employees, namely to provide work safety guarantees that include physical, social, and psychological aspects for each employee (Lahlouh et al., 2023) .

Leadership is one of the elements that form the safety culture of employees or staff. In addition, employee safety culture is also formed by elements of teamwork in work units, communication, management support and belief in the importance of safety culture (AlShemeili et al., 2024) . Leadership in employees is one of the factors that influences safety and quality of service at PT. PLN Nusantara Power UP Muara Tawar Bekasi. The creation of a company safety culture cannot be separated from the element of leadership (Draghici et al., 2022) . From previous studies that found that leadership has an influence on the implementation of safety culture as found in the study (Makiah et al., 2023) .

Safety climate is also no less important as a strong indicator in the context of occupational safety (Yeboah et al., 2024) . The general assumptions of employees and company staff about safety policies, protocols, and processes are characterized by safety climate (Ahmad et al., 2023) . Thus, identifying a significant and positive relationship to safety climate and fewer accidents in the workplace. However, previous studies have mostly focused on

identifying the relationship between leadership and climate to maintain a safe environment (AlShemeili et al., 2024) . Although there are many studies on leadership, safety climate and safety culture, few studies are fully aware (Palendeng & Bernarto, 2022) . How these three important phenomena for safety can be linked together is still unknown. The mediation model that conceptualizes the mechanisms through which safety climate has not been tested in previous studies, so it can be considered a unique contribution of this study (Wang, Mao, et al., 2023) .

In previous research, it was stated that safety leadership has a significant influence on safety culture (Makiah et al., 2023) . Even other research agrees with this statement (Dedy et al., 2018) . And research (Ayu Syafitri & Trunojoyo Madura, 2024) strengthens the opinion that safety leadership has a significant influence on safety culture. The aim of this research is that managers are expected to improve safety policies and create a safe environment for visitors and prevent further work accidents from occurring.

In previous research safety leadership is influential regarding safety climate matters that due to by the more the good thing is safety leadership a company embedded in mind employees , then the more tall level safety climate to safety employee and vice versa the more bad the safety climate that is owned by embedded company in mind employees , then will the more low level too safety a company (Dedy et al., 2018) . The influence of safety leadership to safety climate reinforced with results study (AlShemeili et al., 2024) which is positive and significant leading on improvement level safety .

In previous research (Palendeng & Bernarto, 2022)to argue that perceptions that are owned employee about demands work , available resources and level participation they can influence safety culture , so that in his research to reveal that safety climate own significant relationship to safety culture. (Rodríguez, Velastequí, 2019)study it also conveys that safety climate is professional perception of commitment organization for safety. Where study the strengthen that safety climate influential significant to safety culture. Based on from results study the previous one said that safety climate influential significant to safety culture to argue that perceptions that are owned employee about demands work , available resources and level participation they can influence safety culture , so that in his research to reveal that safety climate own significant relationship to safety culture. (Rodríguez, Velastequí, 2019) study it also conveys that safety climate is professional perception of commitment organization for safety. Where study the strengthen that safety climate influential significant to safety culture. Based on from results study the previous one said that safety climate influential significant to safety culture

Over the past four years, safety leadership has played a vital role in reducing workplace accidents. This is because effective safety leadership not only promotes rules and procedures but also touches the hearts of employees, fostering a culture of safety (Dedy et al., 2018). A positive safety climate, shaped by such leadership, significantly improves safety performance, leading to fewer workplace accidents and encouraging stronger compliance and active involvement from employees (AlShemeili et al., 2024). Similarly, Palendeng and Bernarto (2022) emphasize that employees' perceptions of job demands,

available resources, and their participation levels can influence the development of a safety culture, showing that safety climate is closely linked to safety culture.

Safety climate also serves as a mediating factor. For instance, Wang, Mao, et al. (2023) found that it mediates the relationship between transformational safety leadership and compliance behavior, with significant positive effects. Likewise, Mezentseva et al. (2023) demonstrated that safety climate mediates the link between empowering leadership and organizational outcomes. Building on these insights, the present study predicts that safety climate mediates the relationship between safety leadership and safety culture. The uniqueness of this study lies in its attempt to connect three critical elements—leadership, safety climate, and safety culture—into a mediation model. Although many studies have explored these constructs separately, the mechanisms linking them remain underexplored. This study thus offers a conceptual framework that positions safety climate as the mediating mechanism, a perspective not yet widely tested in prior research.

Despite extensive research exploring the individual relationships among safety leadership, safety climate, and safety culture, a notable gap remains in fully understanding how these three critical constructs interconnect within organizations, particularly in high-risk industries such as power generation. Most existing studies tend to focus on direct effects, such as leadership's influence on climate or climate's impact on culture, without empirically examining the mediating role that safety climate may play between safety leadership and safety culture. This omission limits the depth of insight into the mechanisms by which leadership behaviors translate into enduring cultural change through climate perceptions among employees. Additionally, previous research has often been conducted in isolated contexts or industries, which affects the generalizability of findings. Therefore, the current study addresses this gap by proposing and testing a mediation model that explicitly links safety leadership, safety climate, and safety culture within PT. PLN Nusantara Power UP Muara Tawar Bekasi, offering a more integrated understanding that can inform both theory development and practical safety management interventions. This approach contributes uniquely to the literature by clarifying the pathways through which leadership practices shape organizational safety culture via the intermediate influence of safety climate, enriching strategic frameworks for accident prevention and employee well-being.

The purpose of this study is to analyze the influence of safety leadership on safety culture and safety climate , the influence of safety climate on safety culture and safety climate mediates the influence of safety leadership on safety culture on employees of PT. PLN Nusantara Power UP Muara Tawar Bekasi. The benefits of this study are expected to contribute to reducing work accidents, especially in improving work safety for employees. Safety leadership has influence towards safety culture on employee and employee a company because all over employee will avoid accident increased work for 4 years lately this is because safety leadership provides a very thing interesting and touch the hearts of the employees so that can to form safety culture with good (Dedy et al., 2018) . By because that , safety leadership is wrong one element former safety culture patient. Besides that safety culture is also formed by element element cooperation team in work units, communication, support management, commitment to safety as well as belief to

importance safety culture (Makiah et al., 2023) . With existence findings from study previously cited by researcher (Makiah et al., 2023) which states that safety leadership influential towards safety culture. Then can withdrawn conclusion temporary that safety leadership influential to safety culture. Safety leadership will avoid accident increased work for 4 years lately this is because safety leadership provides a very thing interesting and touch the hearts of the employees so that can to form safety culture with good delivered from research (Dedy et al., 2018). As well as safety leadership towards a positive safety climate and significant leading on improvement level safety. Study the say that safety climate give effect profitable on safety in a company, as well as climate good safety produce more a little accident in place work. More far again, thing that produce compliance safety and involvement more safety large (AlShemeili et al., 2024) . Besides that, (Palendeng & Bernarto, 2022) argues that perceptions that are owned employee about demands work, available resources and level participation they can influence safety culture, so that in his research to reveal that safety climate own significant relationship to safety culture.

H1: The Influence of Safety Leadership on Safety Culture

Safety leadership is influential regarding safety climate matters that due to by the more the good thing is safety leadership a company embedded in mind employees , then the more tall level safety climate to safety employee and vice versa the more bad the safety climate that is owned by embedded company in mind employees , then will the more low level too safety a company (Dedy et al., 2018) . The influence of safety leadership to safety climate reinforced with results study (AlShemeili et al., 2024) which is positive and significant leading on improvement level safety . Research the say that safety climate give effect profitable on safety in a company , as well as climate good safety produce more a little accident in place work . More far again , thing that produce compliance safety And involvement more safety large (AlShemeili et al., 2024) . Based on from results study the previous one said that safety leadership influential significant to safety climate, then for temporary can concluded that safety leadership influential and significant to safety climate.

H2: The Influence of Safety Leadership on Safety Climate

Safety climate is also no less important as a strong indicator in the context of occupational safety (Yeboah et al., 2024) . The general assumptions of employees and company staff about safety policies, protocols, and processes are characterized by safety climate (Ahmad et al., 2023) . Thus, identifying a significant and positive relationship to safety climate and fewer accidents in the workplace. However, previous studies have mostly focused on identifying the relationship between leadership and climate to maintain a safe environment (AlShemeili et al., 2024) . Although there are many studies on leadership, safety climate and safety culture, few studies are fully aware (Palendeng & Bernarto, 2022) . How these three important phenomena for safety can be linked together is still unknown. The mediation model that conceptualizes the mechanisms through which safety climate has not been tested in previous studies, so it can be considered a unique contribution of this study (Wang, Mao, et al., 2023) . Safety climate in general is the employee's response to management's attitude towards occupational safety and the response to the level of occupational safety participation in the production process (Huang et al., 2024) occupational safety climate can be defined as the employee's response to organizational policies, procedures, and practices

in relevance to the actual safety values provided in the workplace, expressing similar interpretations, namely including employee responses to safety measures, company policies and management commitment that must be proven for employee safety and well-being (Wang, Sun, et al., 2023) . By using measurement indicators: procedures, work pressure, safety competence. Safety climate is description belief employee related problem problem in safety , safety climate nature subjective because relate with thoughts, perceptions and behavior . Climate is also a perception from an employee in in evaluate safety in environment Work . (Palendeng & Bernardo, 2022) to argue that perceptions that are owned employee about demands work , available resources and level participation they can influence safety culture , so that in his research to reveal that safety climate own significant relationship to safety culture. (Rodríguez, Velastequí, 2019) study it also conveys that safety climate is professional perception of commitment organization for safety. Where study the strengthen that safety climate influential significant to safety culture. Based on from results study the previous one said that safety climate influential significant to safety culture, then for temporary can concluded that safety leadership influential and significant to safety climate .

H3: The Influence of Safety Climate on Safety Culture

In recent years, safety leadership has proven effective in reducing workplace accidents. This is because safety leadership not only enforces rules but also inspires and touches employees' hearts, fostering a strong culture of safety (Dedy et al., 2018). Such leadership contributes to a positive safety climate, which significantly improves safety performance. Studies show that a well-developed safety climate has a beneficial effect on organizational safety, resulting in fewer accidents in the workplace. Moreover, it enhances compliance and increases active employee involvement in safety practices (AlShemeili et al., 2024).

Palendeng and Bernarto (2022) further argue that employees' perceptions of job demands, available resources, and participation levels strongly influence safety culture, demonstrating that safety climate has a significant relationship with safety culture. Research also identifies the mediating role of safety climate. Wang, Mao, et al. (2023) found that safety climate mediates the indirect relationship between transformational safety leadership and compliance, with significant influence. Likewise, Mezentseva et al. (2023) revealed that safety climate mediates the link between empowering leadership and organizational outcomes, producing significant results.

Based on these findings, this study proposes that safety climate mediates the relationship between safety leadership and safety culture. The novelty of this research lies in connecting three key elements—leadership, safety climate, and safety culture—into a mediation model. While many studies have explored these variables separately, the mechanisms linking them remain underexplored. This study introduces a new conceptual framework that positions safety climate as the mediating mechanism, offering insights not yet widely tested in previous research.

H4: The Mediating Effect of Safety Climate The Relationship Between Safety Leadership and Safety Culture

Framework

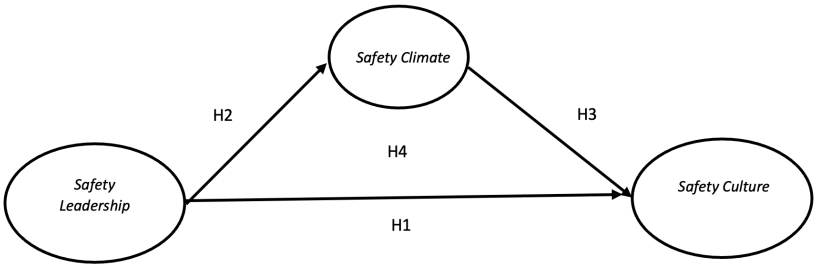

Figure 2 *Theoritical Framework*

1. H1 : The Influence of *Safety Leadership* on *Safety Culture*
2. H2 : The influence of *safety leadership* on *safety climate*
3. H3 : The Influence of *Safety Climate* on *Safety Culture*
4. H4 : The Influence of *Safety Climate* Mediates the Influence of *Safety Leadership* on *Safety Culture*

RESEARCH METHOD

Based on the background, formulation of the problem and research objectives that have been explained above, this study uses a quantitative descriptive method to obtain the desired research results. Quantitative research is research that requires a lot of data from the population and can be easily analyzed using software or statistical formulas. (Ward et al., 2018) . According to Taniredja and Mustafidah, the population is the entire object of research. The population in this study is the total number of employees of PT. PLN Nusantara Power UP Muara Tawar Bekasi, which is 317 employees obtained from the company's database (*This Book Was Written by a Lecturer at the University of Medan Area, Copyright is Protected by Law, Has Been Deposited to the UMA Repository on January 27, 2022* , 2022) . Determination of the sample for this study will use non-probability sampling by purposive sampling. This method is used because it prioritizes research objectives. The sample in this study was all employees of PT. PLN Nusantara Power UP Muara Tawar Bekasi. In addition, the selected sample were those who had been appointed as permanent employees and the sample in this study was 317 employees at PT. PLN Nusantara Power UP Muara Tawar Bekasi (Rashid, 2022) . And this study measures responsible safety leadership with 7 dimensions and 1 item, safety culture is measured using a safety culture scale consisting of 4 dimensions and 1 item and a safety climate measurement scale with 3 dimensions and 1 item. as the table below, because this study confirms that both variables can affect the safety of organizational members in the workplace.

Table 2 *Research Variables*

Definition	Indicator
Safety leadership	Safety leadership
1. Safety leadership is the ability of leaders to influence employee safety behavior and attitudes, which in turn can result in better safety outcomes such as reduced accident rates and improved safety performance(Sumanth et al., 2024).	Credibility Action orientation Vision Accountability Communication
2. Safety leadership is a process where leaders and followers interact and empower leaders to use their	Collaboration Feedback and recognition

power to influence followers to achieve the organization's safety goals.(Omidi et al., 2024) 3. Safety leadership or safety leadership is a type of leadership that shows the importance of safety-related issues attached to the leader, motivating members to have a positive impact on work safety(Wei & Kuo, 2023).	
Safety climate 1. Safety climate in general is the employee's response to management's attitude towards work safety and the response to the level of work safety participation in the production process.(Huang et al., 2024) 2. Occupational safety climate can be defined as the employee's response to organizational policies, procedures, and practices in relation to the actual safety values provided in the workplace, expressing similar interpretations, including employee responses to safety measures, company policies, and management commitment that must be demonstrated for employee safety and well-being.(D. Wang, Sun, et al., 2023) 3. Climate stems from a collective meaning-making process where employees try to better understand the workplace by interacting directly with one another and exchanging information. (G. Wang et al., 2023)	Safety climate procedures work pressure safety competencies
Safety culture 1. Safety culture or safety culture in general is almost similar to organizational culture, several studies have defined and assessed safety culture that safety culture can be observed through the existence of safety behavior and attitudes in an organization. (Asad et al., 2022) 2. Safety culture can be defined as the result of the values, attitudes, perceptions, competencies and behavioral patterns of individuals and groups that determine the safety commitment and style of an organization or company(Seljemo et al., 2020). 3. Safety culture is a shared idea about the risks, accidents and damage that occur due to safety problems faced by all members of an organization or company(Gogalniceanu et al., 2024).	Safety culture information culture reporting culture learning culture flexibility culture

The data sources in this study consisted of primary and secondary data. Primary data were obtained through questionnaires distributed to respondents, while secondary data came from research articles related to the same variables (Sugiyono, 2020). Primary data are defined as first-hand data collected directly from the field, whereas secondary data are drawn from other sources. The questionnaire used a five-point Likert scale, with response options ranging from Strongly Disagree (STS = 1) to Strongly Agree (SS = 5) (Asep, 2018).

As explained by Hardani et al. (2020), a questionnaire is a systematically arranged set of questions delivered to respondents for completion, making it a suitable method for collecting data in this study.

For data analysis, the study employed Structural Equation Modeling (SEM) with the Partial Least Squares (PLS) approach. SEM is flexible in linking theory and data, while PLS, which is variance-based, serves as an alternative to covariance-based SEM (Ambarwati et al., 2019). The evaluation consisted of outer and inner models. The outer model included convergent validity, discriminant validity, composite reliability, and second-order confirmatory factor analysis. Convergent validity was assessed using factor loadings (> 0.7) and Average Variance Extracted (AVE > 0.6). Reliability was measured with Cronbach's alpha (≥ 0.5), while discriminant validity applied the Fornell–Larcker criterion (> 0.6) (Sihombing & Arsani, 2022).

The inner model was assessed using R^2, Q^2, and path coefficients. R^2 values of 0.25, 0.50, and 0.75 indicate weak, moderate, and strong predictive power, respectively (Rahadi, 2023). Hypothesis testing employed bootstrapping with 200–1000 resamples, using significance levels of 10% (1.65), 5% (1.96), and 1% (2.58). Mediation effects were further tested using the Baron and Kenny three-step procedure: (1) testing the effect of the independent variable on the dependent variable, (2) testing the effect of the independent variable on the mediator, and (3) testing the simultaneous effects of the independent variable and mediator on the dependent variable (Mezentseva et al., 2023).

RESULT and DISCUSSION

Measurement model test results (outer model)

The analysis of this study uses Partial Least Square (PLS). Testing the outer model begins with the PLS algorithm shown in the image below. From the output results, the analysis can then be evaluated with a measurement model (outer model) by testing convergent validity, validity of realism and discriminant validity.

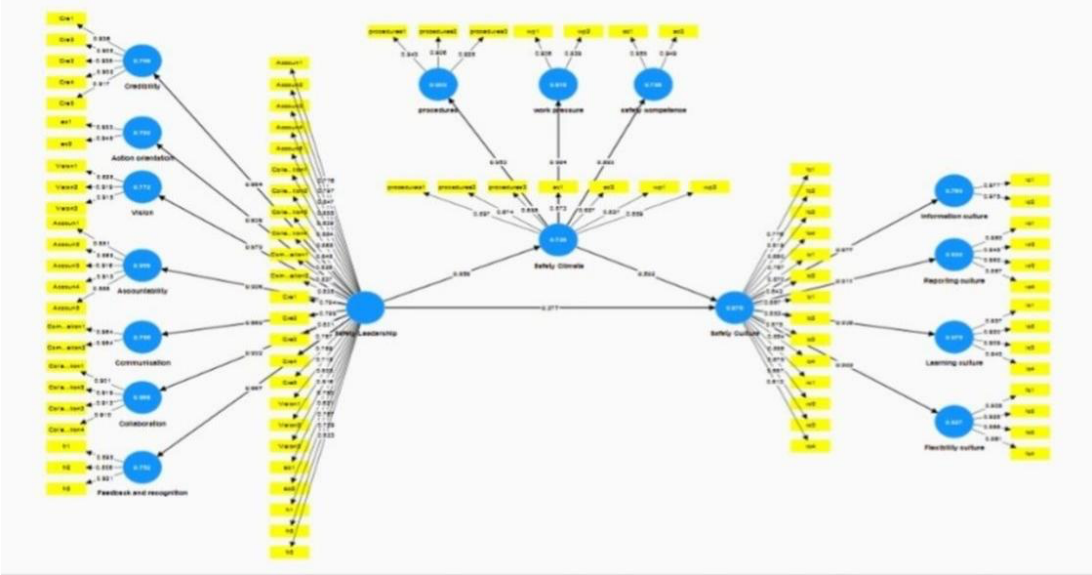

Figure 3 *PLS SEM Second Order Algorithm*

Convegent Validity

Convergent Validity is one of the criteria in testing data analysis with smart PLS. The following test results can be seen in the image above Referring to figure 2, of the 45 items of all variables, all of them have a value above 0,7. The analysis shows that the loading factor value of the independent construct (safety leadership) has an overall value above 0,7 totaling 24 items. The loading factor value for the dependent construct (safety culture) has an overall value above 0,7 totaling 14 items. And for the loading factor value of the mediating variable (safety climate) has an overall value above 0,7 totaling 7 items. And referring to figure 2, of the 14 dimensions of the entire variable, all of them have a value above 0,7. The analysis shows that the loading factor value of the safety leadership, safety culture and safety climate constructs has an overall value above 0,7 totaling 14 dimensions.

Table 3 *Outer Loading*

	Outer loadings
Accoun1 <- Safety Leadership	0,776
Accoun1 <- Accountability	0,851
Accoun2 <- Safety Leadership	0,797
Accoun2 <- Accountability	0,868
Accoun3 <- Accountability	0,916
Accoun3 <- Safety Leadership	0,847
Accoun4 <- Safety Leadership	0,855
Accoun4 <- Accountability	0,913
Accoun5 <- Accountability	0,885
Accoun5 <- Safety Leadership	0,829
Collaboration1 <- Safety Leadership	0,854
Collaboration1 <- Collaboration	0,901
Collaboration2 <- Safety Leadership	0,865
Collaboration2 <- Collaboration	0,919
Collaboration3 <- Collaboration	0,912
Collaboration3 <- Safety Leadership	0,848
Collaboration4 <- Collaboration	0,910
Collaboration4 <- Safety Leadership	0,826
Communication1 <- Safety Leadership	0,837
Communication1 <- Communication	0,964
Communication2 <- Communication	0,964
Communication2 <- Safety Leadership	0,838
Cre1 <- Credibility	0,936
Cre1 <- Safety Leadership	0,794
Cre2 <- Credibility	0,908
Cre2 <- Safety Leadership	0,799

Cre3 <- Safety Leadership	0,801
Cre3 <- Credibility	0,935
Cre4 <- Safety Leadership	0,787
Cre4 <- Credibility	0,902
Cre5 <- Safety Leadership	0,789
Cre5 <- Credibility	0,917
Vision1 <- Vision	0,828
Vision1 <- Safety Leadership	0,719
Vision2 <- Vision	0,919
Vision2 <- Safety Leadership	0,803
Vision3 <- Safety Leadership	0,816
Vision3 <- Vision	0,915
ao1 <- Action orientation	0,933
ao1 <- Safety Leadership	0,750
ao2 <- Action orientation	0,945
ao2 <- Safety Leadership	0,821
fc1 <- Safety Culture	0,776
fc1 <- Flexibility culture	0,905
fc2 <- Safety Culture	0,819
fc2 <- Flexibility culture	0,928
fc3 <- Safety Culture	0,850
fc3 <- Flexibility culture	0,866
fc4 <- Safety Culture	0,787
fc4 <- Flexibility culture	0,861
fr1 <- Feedback and recognition	0,895
fr1 <- Safety Leadership	0,787
fr2 <- Feedback and recognition	0,886
fr2 <- Safety Leadership	0,729
fr3 <- Feedback and recognition	0,921
fr3 <- Safety Leadership	0,823
ic1 <- Safety Culture	0,870
ic1 <- Information culture	0,977
ic2 <- Safety Culture	0,842
ic2 <- Information culture	0,975
lc1 <- Safety Culture	0,867
lc1 <- Learning culture	0,937
lc2 <- Learning culture	0,930

lc2 <- Safety Culture	0,853
lc3 <- Safety Culture	0,875
lc3 <- Learning culture	0,909
lc4 <- Learning culture	0,943
lc4 <- Safety Culture	0,884
procedures1 <- procedures	0,943
procedures1 <- Safety Climate	0,897
procedures2 <- procedures	0,926
procedures2 <- Safety Climate	0,874
procedures3 <- procedures	0,928
procedures3 <- Safety Climate	0,895
rc1 <- Safety Culture	0,856
rc1 <- Reporting culture	0,950
rc2 <- Safety Culture	0,875
rc2 <- Reporting culture	0,945
rc3 <- Reporting culture	0,952
rc3 <- Safety Culture	0,857
rc4 <- Safety Culture	0,813
rc4 <- Reporting culture	0,887
sc1 <- safety competence	0,955
sc1 <- Safety Climate	0,873
sc2 <- safety competence	0,949
sc2 <- Safety Climate	0,827
wp1 <- work pressure	0,936
wp1 <- Safety Climate	0,837
wp2 <- Safety Climate	0,859
wp2 <- work pressure	0,939

The following are the test results that can be seen in the table above Referring to table 3, of the 45 items of all variables, all have values above 0,7. The results of the analysis show that the outer loading value of the latent safety leadership variable has an overall value above 0,7 with a total of 24 items. The outer loading value of the latent safety culture variable has an overall value above 0,7 with a total of 14 items. And for the outer loading value of the mediation variable safety climate has an overall value above 0,7 with a total of 7 items. And referring to table 3, of the 14 dimensions of all variables, all have values above 0,7. The results of the analysis show that the outer loading value of the safety leadership, safety culture and safety climate variables has an overall value above 0,7 with a total of 14 dimensions.

Composite Realibility

In addition to considering the value of the loading factor of each construct for validity testing, the measurement model was also tested for realism. In PLS-SEM using SmartPLS, the reliability of the structure can be measured in two ways, namely using Cronbach's Alpha and Composite Reality, but using Cronbach's Alpha for construct realism test will make the value lower, so it is recommended to use Composite Reality. and to meet the convergence, an Averege Variance Extacted (AVE) value is required for each construct. The value from the results of the PLS Algorithm is presented as follows:

Table 4 *Construct Reability and Validity*

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Accountability	0,932	0,933	0,948	0,787
Action orientation	0,866	0,872	0,937	0,882
Collaboration	0,931	0,932	0,951	0,829
Communication	0,924	0,924	0,963	0,929
Credibility	0,954	0,954	0,965	0,846
Feedback and recognition	0,884	0,887	0,928	0,811
Flexibility culture	0,912	0,913	0,939	0,793
Information culture	0,950	0,951	0,976	0,953
Learning culture	0,948	0,948	0,962	0,864
Reporting culture	0,951	0,952	0,965	0,872
Safety Climate	0,944	0,945	0,955	0,750
Safety Culture	0,969	0,970	0,972	0,714
Safety Leadership	0,977	0,978	0,978	0,654
Vision	0,865	0,872	0,918	0,789
procedures	0,925	0,925	0,952	0,869
safety competence	0,896	0,898	0,951	0,906
work pressure	0,863	0,863	0,936	0,879

From the results of table 4, it can be seen that the cronbach alpha value and the composite reliability value of each variable are above 0,70 which means that each construct variable is reliable and valid in this study, and shows that the value (AVE) of each construct is above 0.6. It can be concluded that the convergent validity and the validity of the data realism have the potential for validity for further testing.

Discriminant Validity

Based on the measurement of discriminant validity with the construct, the discriminant validity of the measurement model with reflective indicators was evaluated. The method of discriminant validity evaluation is to test the discriminant validity using reflective

indicators, namely with the fornell larcker of each variable greater than 0,7, the discriminant validity value means that each dimension is appropriate to explain the respective dependent construct and prove that all items assessed with discriminant validity are valid.

Table 5 *Discriminant Validity – fornell larcker*

	Accountability	Action orientation	Collaboration	Communication	Credibility	Feedback and recognition	Flexibility culture	Information culture	Learning culture	Reporting culture	Safety Climate	Safety Culture	Safety Leadership	Vision	procedures	safety competence	work pressure
Accountability	0,887																
Action orientation	0,730	0,939															
Collaboration	0,828	0,722	0,911														
Communication	0,785	0,631	0,878	0,964													
Credibility	0,749	0,740	0,704	0,652	0,920												
Feedback and recognition	0,806	0,694	0,852	0,752	0,622	0,901											
Flexibility culture	0,765	0,610	0,782	0,708	0,618	0,805	0,890										
Information culture	0,757	0,639	0,793	0,725	0,619	0,834	0,790	0,976									
Learning culture	0,791	0,632	0,853	0,804	0,645	0,787	0,788	0,776	0,930								
Reporting culture	0,729	0,600	0,775	0,744	0,601	0,699	0,739	0,725	0,806	0,934							
Safety Climate	0,777	0,635	0,875	0,831	0,656	0,813	0,810	0,815	0,869	0,835	0,866						
Safety Culture	0,834	0,677	0,880	0,821	0,681	0,848	0,909	0,877	0,936	0,911	0,916	0,845					
Safety Leadership	0,926	0,838	0,932	0,869	0,864	0,867	0,797	0,812	0,846	0,774	0,858	0,885	0,809				
Vision	0,752	0,779	0,787	0,731	0,770	0,670	0,623	0,664	0,722	0,641	0,730	0,728	0,879	0,888			
procedures	0,760	0,605	0,853	0,797	0,639	0,753	0,744	0,777	0,839	0,825	0,953	0,877	0,830	0,723	0,932		
safety competence	0,669	0,540	0,759	0,729	0,577	0,751	0,776	0,722	0,758	0,692	0,893	0,809	0,750	0,622	0,774	0,952	
work pressure	0,698	0,602	0,785	0,759	0,579	0,743	0,722	0,743	0,786	0,767	0,904	0,830	0,773	0,648	0,800	0,722	0,938

From the results of table 5, shows that the root value (AVE) > between other latent variables, so that it has good discriminant validity. So, it can be concluded that safety climate has good discriminant validity, safety culture has good discriminant validity, and safety leadership has good discriminant validity.

Test results (inner model)

R-Square

The R Square test is carried out to explain exogenous latent variables to endogenous variables that have a substantial influence, The results of the PLS algorithm process for the R Square value can be seen as follows :

Table 6 *R-Square*

	R-square	R-square adjusted
Accountability	0,858	0,858
Action orientation	0,702	0,701
Collaboration	0,868	0,867
Communication	0,755	0,754
Credibility	0,746	0,745
Feedback and recognition	0,752	0,751

Flexibility culture	0,827	0,826
Information culture	0,769	0,768
Learning culture	0,875	0,875
Reporting culture	0,830	0,829
Safety Climate	0,736	0,735
Safety Culture	0,876	0,875
Vision	0,772	0,771
procedures	0,909	0,909
safety competence	0,798	0,797
work pressure	0,818	0,817

Based on the R-Square result table, it shows that the value of the latent variable safety climate is 0,736. This value shows that 73,6% of the safety leadership variables have an effect on the safety climate variables and the rest are influenced by variables outside this study. R Square at safety culture 0,876. This value shows that 87,6% of the variables of safety leadership and safety climate have an effect on safety culture and the rest are influenced by other variables outside of the variables in this study.

Significance test (Boostraping)

This section serves as an assessment of the significance of the influence between variables or is said to be a hypothesis test between variables, this procedure uses all the original samples for resampling. Ghozali and Latan say that in some literature, the number of bootstrapped samples of 200-1000 is enough to correct the standard of error estimation. The significance values used in the bootstrap resampling method were p-value 1,65 (significance level=10%), p-value 1,96 (significance level=5%), and p-value 2,58 (significance level=1%). It can be concluded that the higher the p-value, the lower the significant level.

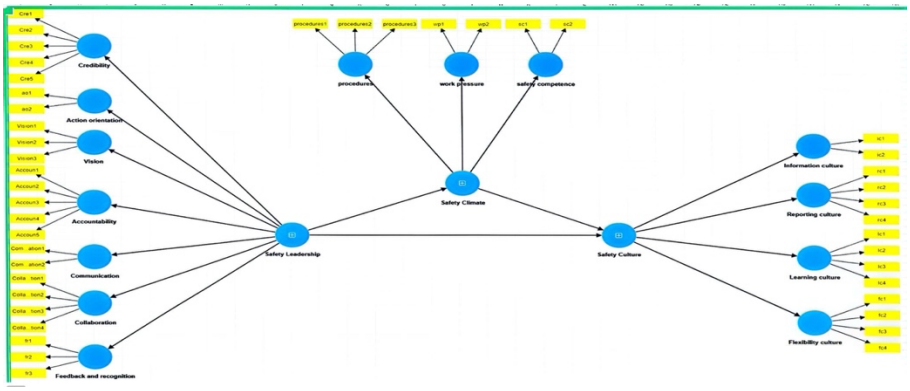

Figure 4 *Path diagram safety leadership, safety climate and safety culture*

Direct Effect

The direct effect test is used to assess the direct impact of an exogenous construct or latent variable on an endogenous latent variable. The direct effect test can be examined based on the path coefficient results from bootstrapping. The results of the direct effect test for this study are presented in Table below.

Table 7 *Path Coefficients*

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Safety Climate -> Safety Culture	0,592	0,594	0,091	6,526	0,000
Safety Climate -> procedures	0,953	0,953	0,009	102,930	0,000
Safety Climate -> safety competence	0,893	0,893	0,024	37,143	0,000
Safety Climate -> work pressure	0,904	0,904	0,018	49,968	0,000
Safety Culture -> Flexibility culture	0,909	0,909	0,018	50,318	0,000
Safety Culture -> Information culture	0,877	0,876	0,023	38,481	0,000
Safety Culture -> Learning culture	0,936	0,934	0,013	70,160	0,000
Safety Culture -> Reporting culture	0,911	0,909	0,019	48,909	0,000
Safety Leadership -> Accountability	0,926	0,926	0,018	51,573	0,000
Safety Leadership -> Action orientation	0,838	0,836	0,031	27,215	0,000
Safety Leadership -> Collaboration	0,932	0,932	0,017	55,444	0,000
Safety Leadership -> Communication	0,869	0,868	0,027	32,127	0,000
Safety Leadership -> Credibility	0,864	0,862	0,048	18,104	0,000
Safety Leadership -> Feedback and recognition	0,867	0,867	0,024	36,214	0,000
Safety Leadership -> Safety Climate	0,858	0,855	0,034	25,036	0,000
Safety Leadership -> Safety Culture	0,377	0,374	0,092	4,109	0,000
Safety Leadership -> Vision	0,879	0,877	0,033	27,020	0,000

1. Safety leadership (X) has a direct influence on safety culture (Y) with a T-statistic of 4.109 (significance level > 1.96) and a P-value of 0.000 (significance level < 0.05). Therefore, the direct influence of safety leadership on safety culture is significant.
2. Safety leadership (X) has a direct influence on safety climate (Z) with a T-statistic of 25.036 (significance level > 1.96) and a P-value of 0.000 (significance level < 0.05). Therefore, the direct influence of safety leadership on safety climate is significant.
3. Safety climate (Z) has a direct influence on safety culture (Y) with a T-statistic of 6.526 (significance level > 1.96) and a P-value of 0.000 (significance level < 0.05). Therefore, the direct influence of safety climate on safety culture is significant.

Indirect Effect

The indirect effect test is used to assess the indirect impact of an exogenous construct or latent variable on an endogenous latent variable through a mediating variable. The indirect effect test can be examined based on the results of specific indirect effects from the bootstrap output. The results of the indirect effect test for this study are presented in Table below.

Table 8 *Specific indirect effects*

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Safety Climate -> Safety Culture -> Flexibility culture	0,539	0,540	0,083	6,491	0,000

Safety Climate -> Safety Culture -> Information culture	0,519	0,521	0,083	6,233	0,000
Safety Climate -> Safety Culture -> Learning culture	0,554	0,555	0,086	6,459	0,000
Safety Climate -> Safety Culture -> Reporting culture	0,539	0,540	0,085	6,361	0,000
Safety Leadership -> Safety Climate -> Safety Culture -> Flexibility culture	0,462	0,462	0,077	5,963	0,000
Safety Climate -> Safety Culture -> Flexibility culture	0,539	0,540	0,083	6,491	0,000
Safety Leadership -> Safety Climate -> Safety Culture -> Information culture	0,445	0,446	0,078	5,727	0,000
Safety Climate -> Safety Culture -> Information culture	0,519	0,521	0,083	6,233	0,000
Safety Leadership -> Safety Climate -> Safety Culture -> Learning culture	0,475	0,475	0,080	5,962	0,000
Safety Climate -> Safety Culture -> Learning culture	0,554	0,555	0,086	6,459	0,000
Safety Leadership -> Safety Climate -> Safety Culture -> Reporting culture	0,463	0,463	0,079	5,868	0,000
Safety Climate -> Safety Culture -> Reporting culture	0,539	0,540	0,085	6,361	0,000
Safety Leadership -> Safety Climate -> procedures	0,818	0,815	0,037	22,397	0,000
Safety Leadership -> Safety Climate -> safety competence	0,766	0,764	0,044	17,516	0,000
Safety Leadership -> Safety Climate -> work pressure	0,776	0,774	0,040	19,226	0,000
Safety Leadership -> Safety Culture -> Flexibility culture	0,343	0,340	0,084	4,077	0,000
Safety Leadership -> Safety Culture -> Information culture	0,331	0,327	0,079	4,171	0,000
Safety Leadership -> Safety Culture -> Learning culture	0,353	0,349	0,086	4,118	0,000
Safety Leadership -> Safety Culture -> Reporting culture	0,343	0,340	0,083	4,145	0,000

Based on Table 8 above, the results of the indirect influence test can be interpreted as follows: Safety leadership (X) has an indirect influence on Safety Culture (Y) mediated by Safety Climate (Z), with a T-Statistic of 5.963 (significance level > 1.96) and a P-Value of 0.000 (significance level < 0.05). Therefore, the indirect influence of Safety Leadership on Safety Culture through Safety Climate is significant.

Discussion

After the analysis is completed, the next step is to discuss the results of the analysis that has been carried out. With the aim of providing an explanation and understanding of the variables that affect safety culture

Safety Leadership Has an Impact and Significant on Safety Culture

The findings of this study reinforce and deepen the understanding established by prior research regarding the pivotal role of safety leadership in shaping a robust safety culture within high-risk work environments. Consistent with (Dedy et al., 2018), who highlighted the inherent dangers and accident risks in power plants, this study confirms that effective safety leadership is essential for cultivating a climate and culture that prioritize occupational safety. Similarly, the alignment with (Makiah et al., 2023) underscores the cross-sectoral significance of leadership as a strategic lever not only in industrial settings like power plants but also in healthcare environments to enhance safety culture and outcomes. This convergence of findings across different industries strengthens the theoretical premise that leadership is a universal catalyst for improving safety behaviors and organizational safety climates.

Delving into the SmartPLS analysis, the prominence of the collaboration indicator as the strongest reflection of safety leadership highlights the critical managerial element of fostering interpersonal and inter-organizational cooperation. This finding resonates with contemporary safety management theories that emphasize the role of collective engagement and shared responsibility in safety performance. The lower but still relevant loading of credibility suggests that while leader trustworthiness remains important, it may not be the dominant factor driving safety culture in this context; instead, active collaboration and communication take precedence. The emphasis on feedback and recognition mechanisms further illustrates that managerial practices which value employee contributions and encourage dialogue significantly reinforce safety leadership effectiveness. This dynamic contributes to employees' psychological ownership of safety processes, promoting participative behavior that can preempt accidents and hazards.

This study advances theoretical frameworks on safety culture by empirically validating safety leadership's multifaceted role, particularly emphasizing collaboration as a core dimension. It highlights the nuanced interplay between leadership behaviors and organizational safety constructs, contributing to the discourse beyond traditional views that primarily spotlight leader credibility or authority. Additionally, by integrating insights from diverse sectors such as power generation and healthcare, the study supports a broader applicability of leadership theories to safety science. It also provides evidence supporting the mediating influence of safety climate elements like feedback and recognition, suggesting new pathways for future research to further unpack the mechanisms through which leadership translates into safety outcomes. This contributes to enriching models of occupational safety with more granular conceptualizations of leadership dynamics and their operationalization in real-world settings.

Safety Leadership Has an Effect and Significance on Safety Climate

The data analysis results indicate that safety leadership has a significant effect on the safety climate at PT. PLN Nusantara Power UP Muara Tawar Bekasi. This finding aligns with the study by (Dedy et al., 2018), which found that safety leadership directly and positively influences the safety climate in coal mining companies through clear safety policies and transparent communication. Similarly, (AlShemeili et al., 2024) reinforce the importance of safety leadership in shaping the safety climate within nuclear power plants.

The work pressure indicator, specifically the prohibition of employees working in hazardous conditions, emerged as the most critical factor reflecting the safety climate, highlighting management's proactive response to incidents over the past four years. However, the safety competency indicator, related to routine refresher training, showed the lowest outer loading, indicating the need to enhance the frequency and quality of safety training, especially for high-risk jobs, to improve workers' safety awareness and preparedness.

From a managerial perspective, these findings emphasize the importance of developing safety leadership that not only enforces policies and supervision but also actively manages work pressure and continuously builds employee competencies through ongoing training. Managers should maintain open and transparent communication channels and encourage employee participation in safety activities to foster trust and strengthen the overall safety culture. Theoretically, this study contributes to the understanding of how safety leadership shapes safety climate through both structural and psychosocial dimensions, highlighting the often-overlooked role of competency development. This contribution opens avenues for future research to further explore the complex interactions between policies, work pressure, training, and leadership in creating an effective safety climate across various industrial settings.

Safety Climate Has a Positive and Significant Effect on Safety Culture

The results of this study demonstrate a significant and positive relationship between safety climate and safety culture at PT. PLN Nusantara Power UP Muara Tawar Bekasi, confirming that a well-communicated and effectively implemented safety climate can reduce workplace accidents and foster a strong safety culture. This finding aligns with (Rodríguez, Velastequí, 2019), who emphasized the influence of safety climate on patient safety culture, and further corroborates previous research showing that safety climate reflects the behavioral manifestation of safety culture among individuals, as seen in the study of clinic staff at Gunung Maria Hospital. Notably, the learning culture indicator management's commitment to investigating work accidents was identified as the most critical aspect of safety culture, underlining its role in enhancing employees' understanding of accident prevention and response. Additionally, the flexible culture indicator, which addresses management actions during emergencies, also showed significant importance, highlighting the need for adaptive responses to unforeseen safety challenges. However, the relatively low score of the reporting culture indicator reflecting employees' hesitance to report safety issues for fear of blame signifies a persistent barrier to fully realizing a proactive safety culture.

From a managerial standpoint, these findings underscore the importance of cultivating a learning-oriented and adaptable safety culture driven by transparent accident investigations and emergency preparedness. Management should prioritize systems that encourage open communication and active employee engagement in safety practices, while simultaneously addressing the fear associated with reporting safety concerns. Creating a "no-blame" environment is essential to empower employees to confidently participate in safety reporting, which is crucial for identifying hazards and preventing future incidents.

Theoretically, this study advances safety management literature by empirically linking safety climate as a precursor to safety culture development, emphasizing the behavioral and procedural dimensions that underpin this relationship. Furthermore, it highlights gaps in reporting culture that warrant further exploration to develop comprehensive models encompassing psychological safety and employee empowerment as core facets of a robust safety culture.Based on the results of the data analysis that has been carried out, it is proven that the safety climate has a significant effect on safety culture.

Safety Leadership Has an Influence and Significance on Safety Culture Mediated by Safety Climate

Based on the results of the analysis that has been carried out, it is proven that safety leadership has a positive and significant effect on safety culture and safety climate. Safety leadership indirectly influences safety culture through the safety climate. The better the safety leadership carried out by PT. PLN Nusantara Power UP Muara Tawar Bekasi will also improve the safety climate owned by PT. PLN Nusantara Power UP Muara Tawar Bekasi. Safety leadership that is carried out by the company's leaders with a clear vision with important qualities in building good and professional relationships will have a good impact on employee safety, all employees will believe that the company has a good safety climate because it meets their expectations, this will continue to be remembered by all employees and make the safety climate owned by PT. PLN Nusantara Power UP Muara Tawar Bekasi is getting better. After carrying out the procedure correctly and being careful in doing everything, it can increase safety so as to minimize work accidents. If leadership is successful, it will indirectly improve the safety culture through a better safety climate. The results of this study are in line with the results of previous research which said that the safety climate is influential and significant as a mediating role(D. Wang, Mao, et al., 2023)(Mezentseva et al., 2023).

Practical Implications

The results of this study also have many practical implications that can help managers optimize the benefits of safety leadership when applied to companies in the future. Specifically, regarding the safety leadership that employees may encounter, the study results indicate that safety leadership is crucial. Therefore, the authors suggest that managers adopt both transformational and transactional safety leadership styles during their work. From a transformational perspective, they can demonstrate more adaptive safety concerns to their employees, such as communicating protective measures and providing safety materials. They can also guide their followers by setting examples of safety behavior and explaining the importance of safety to the entire organization. From a transactional perspective, managers should increase employee engagement and participation in safety systems by establishing safety motivation systems and rewarding employees for their contributions to safety efforts. For safety control, managers can establish and communicate explicit norms of safety behavior throughout the organization. Additionally, as part of the safety control process, leaders who monitor the implementation of safe behaviors and correct misbehavior send a clear message to employees that they prioritize health and safety, which can serve as a resource for reducing workplace accidents.

Managers should continually update their safety knowledge and skills, enabling them to provide tailored resources to their followers that can help them address safety issues.

Furthermore, the study findings demonstrate the boundary role of safety climate in shaping the indirect effect of safety leadership on safety culture through perceived severity. Organizations can leverage these findings by paying attention to the congruence between the safety leadership practiced by their managers and the safety culture. Therefore, to avoid the "dark side" of safety leadership, organizations must understand safety leadership as part of a pre-existing safety climate that must be consistently implemented, nurtured, and promoted among employees. To this end, a clear and well-recognized safety policy can be effective in implementing a safety culture, helping employees recognize the importance of the organization's safety policies and the potential consequences of any violations. In addition to policy implementation, organizations may also benefit from encouraging employees at all levels to become active stakeholders in a safety culture. Both employee safety-related input and top management commitment to safety are significant antecedents of a safety climate. Furthermore, to raise manager awareness of the importance of a safety culture, its principles should be integrated into ongoing education and training programs.

CONCLUSIONS and SUGGESTION

Based on the findings of this study, practitioners should prioritize the development of effective safety leadership within their organizations. This can be achieved by providing targeted training to leaders and supervisors on how to positively influence employee safety behaviors and attitudes. It is also essential to foster open communication and collaboration between management and staff, focusing on improving employees' perception of safety procedures, managing work pressure, and enhancing safety competencies. Regularly assessing the safety climate and culture through surveys or feedback mechanisms can help identify areas for improvement and sustain a proactive, safety-oriented workplace. These steps can serve to minimize workplace accidents, enhance overall employee well-being, and strengthen organizational performance.

The generalizability of these findings is limited, as the study focused exclusively on employees at PT. PLN Nusantara Power UP Muara Tawar Bekasi with a specific sample size. Further research is recommended in other companies and different sectors to validate and extend these insights. Additionally, while this study examined safety climate as a mediator in the relationship between safety leadership and safety culture, future researchers may wish to explore this mechanism more deeply and consider additional mediating or moderating variables.

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