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Original Research Article

The Role of Safety Leadership and Safety Culture in improving Safety Performance

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Abstract: The aim of this paper is to explore the relationship between safety leadership and safety culture, which is influenced by safety behavior. The data included in this analysis is a questionnaire. The sample's selection used a simple random sampling of 161 respondents in the production sector of coal mining contractor companies in the province of East Kalimantan. The research method is structural equation modelling. This study's findings showed that safety leadership, safety culture, and safety behaviour positively affect safety performance. The direct influence of safety leadership and safety culture on safety performance is more significant than when it is mediated by safety behaviour. The direct influence of safety leadership on safety performance is more substantial than its impact on safety performance.

Keywords: Safety Behavior, Safety Culture, Safety Leadership, Safety Performance.

INTRODUCTION

Workplace accidents and undesirable incidents may trigger damages, including health issues, equipment, environmental damage, and business failure [1]. Workplace accidents have transparent and predictable causes to prevent [2] . The prevention of accidents can be carried out by tracking the cause of incidents, including workers, equipment, management, and working environments [3]. The domino accident theory describes the model analysis of the cause of an accident, including the factors that cause sequential accidents, such as lack of control, primary causes, and direct causes [4]. The number of accidents demonstrates company safety performance [5];[6]. Safety performance is influenced by safety leadership [7, 8]. The current safety culture of the company also impacts safety performance [9]. The more mature the company's safety culture is, the better its safety performance [10].

Safety performance is positively affected by internal safety and regulation compliance, such as personal safeguards and compliance with safety protocols [11]. The safety behaviour of employees in chemical processing industries impacts safety performance demonstrated in the number of injuries [6]. The truck drivers' safety behaviour in the US harms accident rates (near-miss) [12]. Research in the aviation industry has different assumptions about safety behaviour. Employee engagement as a safety behaviour predictor positively impacts accident rate, which is a predictor of safety performance [13].

There is an excellent danger of injuries in the mining industry [10]. Based on the statistics from the Republic of Indonesia's Ministry of Energy and Natural Resources, there has been a rising trend in the number of fatal mining incidents between 2012-2019, with 50% of employees in the production department having encountered accidents. The target to be reached by all mining companies is zero-incident. Therefore, the expected target is not yet accomplished. The company's goal is to assess the performance of safety compared to the accident rate [5].

Based on discrepancies in findings of previous studies related to factors influencing safety performance in Indonesia, working safety, and trends of the increasing amount of fatal in the mineral and coal mining industry in Indonesia, this study will analyze and investigate the effect of safety leadership and safety culture at coal mining companies on safety behaviour as a mediating variable.

This paper's theoretical contribution is to develop knowledge, mainly work safety theory, safety leadership, the safety culture, and safety behaviour in enhancing safety performance and the role of safety behaviour as a mediating variable. This study can practically be used as a consideration for a coal mining

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contractor company's leadership in designing policies to improve the company's safety performance.

Theoretical background and hypothesis

The relationship between safety leadership, safety culture and safety performance

Safety performance is a benchmark for an organization's effectiveness in injury prevention, including accident rate, the frequency of accidents, and the severity of accidents [5] . Determining a construction project's safety performance is the same as measuring the project's effectiveness, which is observed from time, quality, and cost [14]. Safety leadership is a leading mechanism in influencing subordinates to carry out safety aspects [8]. Safety leadership is the capacity of leaders to encourage their members always to avoid injuries at work Safety culture is generally defined as an enterprise's approach to safety principles and behaviours which employees should embrace

Safety culture is also a value of beliefs, attitudes, expertise, and actions of the people and communities who implement organizational safety management [15]. Safety culture is a set of metrics, beliefs, and values related to safety implemented by an organization [16]. Safety culture is a collection of values, principles, attitudes, and behaviours to manage safety risks at work [17].

Safety achievement is determined by safety leadership employing safety management indicators carried out by business leaders [8]. Other research in the construction industry has found that security leadership is significantly related to safety performance. Safety performance in businesses is determined by safety culture. If the safety culture is implemented correctly, the safety performance will improve [9]. Increasing safety culture maturity also affects mining companies' safety performance [10].

The mediating role of safety behaviour

Safety behaviour conforms to the employee's acts with its safety rules and procedures [18]. If individual behaviour does not adhere to safety protocols, it will cause an injury [19]. Individuals' unsafe act is an indicator of near misses in companies [20]. Unsafe acts of the employee can lead to injuries at work [4, 21]. 85% of injuries are caused by the unsafe act. Safety behavior has a negative relationship to accident rates [6]. the safety conduct is also negatively correlated with near misses [12]. The accident rates are affected by compliance with personal protective devices, compliance with safety standards and employees' attempts to work safely. Employee engagement and interest, which are safety behaviour indicators, positively affect safety performance in the aviation industry [13].

In this analysis, the conceptual framework is focused on the relationships between safety leadership, safety culture, and safety behaviour. Meanwhile, safety behaviour as a mediation role is based upon discrepancies from the findings of previous studies. The conceptual framework of this study is as follows:

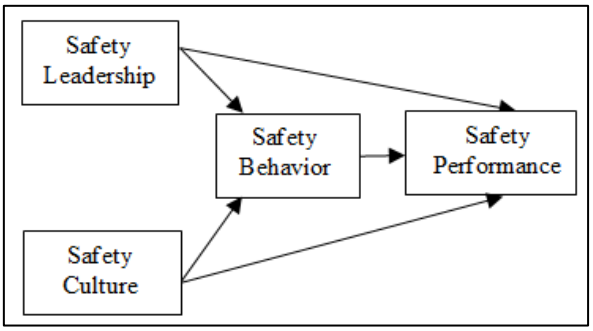

Fig-1: Research Model

The following hypotheses are based on the above conceptual model:

Hypothesis 1. Safety leadership affects safety performance. Any treatments on safety leadership would impact the company's safety performance.

Hypothesis 2. Safety culture affects safety performance. Any treatments on safety culture would impact safety performance.

Hypothesis 3. Safety behaviour affects safety performance. Any treatments on safety behaviour would impact safety performance.

Hypothesis 4. Safety leadership affects safety performance when mediated by safety behaviour. Specifically, it contrasts the direct and the indirect effect (when mediated by safety behaviour) on the relationship between safety leadership and safety performance; and examines whether safety behaviour is regarded as its mediating variable.

Hypothesis 5. The safety culture affects safety performance through safety behaviour. It will mainly compare the direct and indirect effects on the relationship between safety culture and safety performance (when mediated by safety behaviour) and examines whether safety behaviour is a mediating variable in this relationship.

METHODS

Procedure and Sample

This study's instrument was a questionnaire with statements describing any indicators for each variable and explained how it could be done. It was then distributed online to respondents through WhatsApp apps or by supervisors or colleagues. The research population was production staff, including supervisors, operators of heavy equipment, and truck

drivers for hauling, for 286 persons at 11 coal mining contractor companies in East Kalimantan, Indonesia. This study used a proportionate random sampling procedure because of the relatively homogeneous variables used in this analysis, i.e., implementing occupational safety standards in coal mining contracting companies [22]. The number of samples is determined by the Slovin formula, measured in proportion to each coal mining contracting company. There were 170 completed and returned questionnaires, five were not compatible in value, and four were incomplete, so 161 questionnaires were included in this analysis.

Measures

Safety Leadership

Safety leadership is assessed by safety caring, safety controlling, safety motivation, and dan safety policy [23-25, 8]. safety Caring is assessed using four questionnaire statements, safety control by three questionnaire statements, safety motivation by two questionnaire statements, and safety policy by three questionnaire statements. Each item of the statements is loaded with a value between 1 and 5 or from strongly disagree to agree strongly. The validity test findings show that each indicator's values are higher than the critical value (0,1547). Thus the research instrument has been defined as valid [22]. The reliability test result shows a Cronbach's alpha value of 0.824. This is higher than the critical value of 0.70 and is thus declared reliable [26].

Safety Culture

There are four indicators to assess safety culture: management commitment, safety management system, job hazard analysis, and employee involvement [9, 27]. Each indicator is calculated using 2 statement items with a Likert scale of 1 (strongly disagree) to a value of 5 (strongly agree). The research instrument's validity test findings revealed that all r-count significance values were higher than the value for the r-table (0.1547). This research instrument has been defined as valid. The reliability test provides a value of 0.836 for Cronbach Alpha, which is larger than 0.070. Thus the research instrument has been defined as reliable [26].

Safety Behavior

Safety behaviour measurement uses indicators of safety compliance, safety participation, safety initiatives, and safety awareness [18, 11, 25, 28, 19, 29]. Indicators of safety compliance and safety participation are measured using 3 statement items. Indicators of safety initiatives and safety awareness were assessed using a scale from strongly disagree (1) to agree (5) strongly. The validity test of all safety behaviour statement items provides a more excellent r-count value than the r-table value (0.1547) such that any statement item can measure safety behavior [22]. The reliability test findings on the safety behaviour variable statement items lead to a Cronbach Alpha value of 0.873 (above 0.70) so that safety statement items were reliable [26].

Safety Performance

Accident rate, accident frequency rate, accident severity rate, and near-miss are used to measure safety performance [5, 9, 13, 8]. Each predictor is calculated with 2 statement items with a value from 1 to 5, which describes strongly disagree to agree strongly. Each item in the statement is checked for validity. A coefficient correlation value at the significance level (α) of 0.05 exceeds the table correlation coefficient value, meaning that all statement items are valid and can be used to measure safety performance [22]. Reliability tests conducted on all statement items resulted in a Cronbach Alpha value of 0.801. It is greater than the critical value of 0.70 for Cronbach Alpha [26]. Therefore it can be inferred that all statement items are accurate and reliable to measure safety performance.

Analysis

In this research, the study uses descriptive analysis to identify the respondents' behaviour for measuring research variables [22]. Data analysis uses modelling structural equations that describe the causal relationship between the measuring equation variables and structural model equations [30].

Before further analysis, measuring the structural equations model assumptions was performed, that is normality analysis [31-35], outlier analysis [36, 34], multicollinearity analysis [36] and residual analysis [37, 22]. The goodness of fit test is carried out to decide whether the constructed model is approved by considering the various goodness-of-fit criteria [36]. The analysis in the structural equation is confirmatory factor analysis (CFA), which evaluates the convergent validity of latent variables consisting of the factor loading, average variance extract (AVE), and Construct reliability (CR) [34].

The Hypothesis testing is by examining the critical ratio for regression weight at the critical ratio (> 1.96) or the probability value <0.05. If the critical ratio is <1.96, the hypothesis can be accepted. The probability value> 0.05, then the hypothesis is rejected [36-34].

RESULTS

Descriptive analysis

The descriptive study's findings show that the safety policy contributes significantly to safety leadership; the management commitment indicator reflects safety culture immensely; the accident severity rate primarily measures safety performance.

Assumption analysis

The data normality test results revealed a multivariate critical ratio = 2.549, which is also below

the critical value (0.258) [34, 35], No data outliers with probability values (p2) are all higher than 0.000 [34], multicollinearity value = 0.462, which is also below the critical value (0.90) [38], and all Standardized residual Covariances values <2.58 [37, 34].

Confirmatory factor analysis and goodness of fit mode

The following findings were derived from confirmatory factor analyses for exogenous variables:

Table-1: Results of confirmatory factor analysis exogenous variable

Variable	Indicators	Factor Loading	Cut-Off	Prob	Conclusion
Safety Leadership	Safety Caring	0,748	0,50	0,000	Valid
	Safety Controlling	0,838	0,50	0,000	Valid
	Safety Motivation	0,830	0,50	0,000	Valid
	Safety Policy	**0,894**	0,50	0,000	Valid
Average Variance Extract (AVE).:		0,687	cut-off: 0,50		Valid
Construct Reliability (CR):		0,897	cut-off: 0,70		Reliable
Safety Culture	Management Commitment	**0,913**	0,50	0,000	Valid
	Safety Management System	0,909	0,50	0,000	Valid
	Appraisal of Work Hazards	0,835	0,50	0,000	Valid
	Employee Involvement	0,690	0,50	0,000	Valid
Average Variance Extract (AVE):		0,708	cut-off: 0,50		Valid
Construct Reliability CR):		0,995	cut-off: 0,70		Reliable

Source: Primary data processed (2020)

Safety leadership indicators include caring for safety, safety controlling, safety motivation, and safety policy. All factor loading values above the critical value are (0.50). The CR and AVE values are also above their critical values to reflect safety leadership in these four indicators [34, 30]. All values of loading factor on safety culture indicators and AVE and CR values are higher than critical values, so indicators of management commitment, safety management system, appraisal of work hazards, and employee involvement can determine the safety culture [34, 30].

Confirmatory factor analysis for endogenous variables:

Tabel-2: Results of confirmatory factor analysis endogenous variables.

Variable	Indicators	Factor Loading	Cut-Off	Prob	Conclusion
Safety Behavior	Safety Compliance	0,854	0,50	0,000	Valid
	Safety Participation	0,821	0,50	0,000	Valid
	Safety Initiatives	0,950	0,50	0,000	Valid
	Safety Awareness	0,730	0,50	0,000	Valid
Average Variance Extract (AVE):	0,709	cut-off: 0,50			Valid
Construct Reliability (CR):	0,906	cut-off: 0,70			Reliable
Safety Performance	Accident Rate	0,716	0,50	0,000	Valid
	Accident Frequency Rate	0,835	0,50	0,000	Valid
	Accident Severity Rate	0,792	0,50	0,000	Valid
	Near Miss	0,783	0,50	0,000	Valid
Average Variance Extract (AVE):	0,612	cut-off: 0,50			Valid
Construct Reliability (CR):	0,863	cut-off: 0,70			Reliable

Source: Primary data processed (2020)

All safety behaviour indicators have a factor loading value higher than the critical value (050). The safety behaviour value of AVE and CR also exceeds its critical value so that safety compliance, safety participation, safety initiatives, and safety awareness can determine security safety behaviour [34, 30]. The factor loading values for safety performance, AVE, and CR are higher than the critical value. Therefore the indicators of accident rate, accident frequency rate,

accident severity rate, and near-miss can determine work safety performance [34, 30].

This model fitness test for the four variables has resulted in X^2 (chi square) at df = 161 with 185.106, below cut-off value (191.608); probability 0.094 (≥ 0.05); RMSEA = 0.031 (≤ 0.08); GFI = 0.904 (≥ 0.90); CMIN / DF = 1.150 (≤ 2.00); AGFI = 0.875 (≥ 0.90); TLI = 0.987 (≥ 0.90); CFI = 0.989 (≥ 0.90); PGFI = 0.693 (≥ 0.50) and PNFI = 0.780 (≥ 0.60). 9 indexes of the 10 model fitness indices follow the good criteria and 1 model satisfies the marginal criteria to allow adoption of the proposed model. 9 indexes of the 10 models follow the good criteria and 1 model satisfies the marginal criteria to allow approval of the proposed model [36, 33, 35, 39].

Path Analysis and hypothesis testing

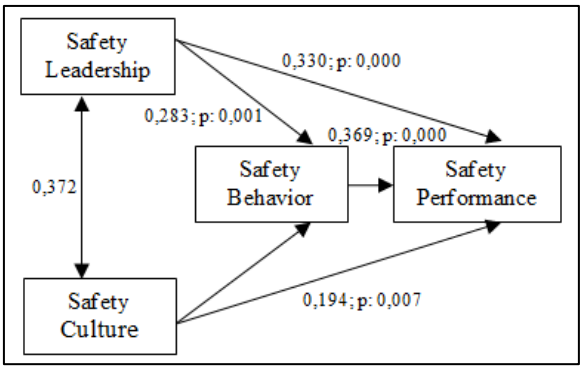

Fig-2: Final path analysis with standardized coefficients

The path analysis findings in Figure 2 above show a regression coefficient value of the relationship between safety leadership's effect on safety performance = 0.330 with a probability of 0.000. It can also be inferred that safety leadership has a positive impact on safety performance. So hypothesis 1 has been proved statistically. This hypothesis's findings are consistent with the previous studies [17, 8], which confirms that safety leadership affects safety performance.

The causal relation between safety culture and safety performance results in a value of regression = 0.194 with a probability of 0.007. The inference can be drawn that safety culture positively impacts safety performance so that hypothesis 2 can be accepted statistically. The study's findings confirm previous research results [9, 10], which found that safety culture influences safety performance.

There is a regression coefficient value of = 0.369 with the probability of 0.000 between the impact of safety behaviour on safety performance. It can then be explained statistically that safety behaviour positively impacts safety performance, so hypothesis 3 can be accepted. This assumption is distinct from the study's findings [6, 12], which has found that safety behaviour harms the injury rate, which in this analysis is a measure of safety performance. However, it supports the study's findings [13], who found that worker participation positively impacts safety performance. Hypothesis 4 about safety leadership affects safety performance through safety behaviour, as shown by a causal relationship between safety leadership and safety behaviour with a value of = 0.283 with probability= 0.001.

In contrast, the causal relationship between safety behaviour and safety performance has a regression coefficient value = 0.369 with probability = 0.000. Thus it can be inferred that safety leadership affects safety performance through safety behaviour. The value of the direct effects on safety performance by safety leadership = 0.330. The impact value by safety behaviour = 0.104 with the overall effect value of 0.434. It can be inferred, thus, that safety behaviour mediates between safety leadership and safety performance. Safety leadership's direct effect on safety performance is higher than through security behaviour.

The safety culture influence through safety behaviour is explained through a regression coefficient value of the causality relationship of 0,275 with a 0,000 probability between safety culture and safety behaviour. The regression coefficient value of the causality relationship between safety behaviour and safety performance is 0.69, with a probability of 0.000. It can be inferred that safety culture affects safety performance through safety behaviour. The immediate effect of safety culture on safety performance is 0.194; through safety behaviour is 0.101, and the cumulative effect is 0.295. Provided that the total effect exceeds the direct effect, the relationship between safety culture and success is mediated by safety behaviour. The immediate impact on safety performance by safety culture is more significant than when mediated by safety behaviour.

DISCUSSION

As far as the production section employees of coal mining consisting of supervisors, heavy machinery operators, and dump truck drivers are concerned, this research explores the direct effect of safety leadership on safety performance and the effect of safety leadership on safety performance through safety behaviour and explores the direct effect of safety culture on safety performance and the effects of safety culture on safety performance through safety behaviour. This study concludes that field leaders' actions implement safety leadership to educate all employees about company safety policies. It will make employees understand safety roles and responsibilities. This awareness would encourage employees to engage in safety programs such as injury prevention. The safety culture reflected by the management team pays attention to work processes and is committed to implementing work accident prevention programs. This

encourages workers to be interested in accident prevention activities, which is useful for minimizing the accident rate. The direct effect of safety leadership and safety culture on safety performance is more significant than safety behaviour.

Theoretical contributions

This research offers a theoretical contribution to safety behaviour's effect on safety performance that safety behaviour positively affects company safety performance. Previous research supports the finding that safety behaviour positively affects safety performance [11, 13]. However, some studies claim that safety behaviour negatively affects safety performance [6, 12]. Earlier research findings indicate that safety behaviour, with indicators of prosocial and proactive behaviour and driving behaviour, harms safety performance. Meanwhile, safety performance uses both accident rates as indicators. In reality, this just differences in how safety performance is measured, whether viewed as a small unit of indicators or viewed as a broader unit.

Implications

Provided that the findings of the analysis confirm past studies that leadership in safety affects safety efficiency [7, 8], safety culture also affects safety performance [9, 10] and safety behaviour has a positive effect on safety performance [13].Therefore action to increase safety performance shall be taken by the management of the mining contracting company. A potential action for safety leadership is to remind employees of the company's safety regulations, describe the safety duties, and set specific and achievable safety goals in the work field. However, the safety culture means that the management is concerned with job outcomes and safe work processes. Management is dedicated to the execution of safety programs. These initiatives require employee participation to represent safety behaviour to prevent accidents for increasing safety performance.

Study limitations

Study limitations include data collection from respondents on the worksite using the google form via the WhatsApp apps. Since there was a pandemic in Covid-19, and the workplace was far distant, no direct interviews were conducted with respondents about the questionnaire statements. If respondents found the questionnaire challenging to fill out, they did not ask the researcher specifically about these challenges, which lead to biased data collection and the need to discard outlier data.

The second limitation is that data on the number of mining accidents used for the initial analysis of research and is data taken from outside parties, namely from the Ministry of Energy and Mineral Resources of the Republic of Indonesia, which is still a combined data on the number of mining accidents, namely accidents at mineral mining companies and coal mining companies, not unique mining accident data. That happens in coal mining companies.

Third, in this study, the findings are generalized for the components of safety management, safety culture, safety behaviour and safety climate of each coal mining company may vary because each company should have its policies and rules for implementing its safety practices.

Future research

After discovering an impact of safety leadership and safety culture on coal mining companies' safety performance, further analysis is needed, both directly and mediated through safety behaviour. Further studies can employ other variables, such as safety management systems and equipment resources as exogenous variables, job incentives and working circumstances as mediator variables, and safety performance as endogenous variables. Other variables not used in the analysis can also be used for further studies, such as safety participation, leading by example, safety coaching on safety leadership, safety strategies, safety practices, work pressure on safety culture, employee prosocial & proactive safety behaviour, as well as near-miss, minor injury, accident investigation on safety performance.

CONCLUSION

The findings of this research reveal that safety leadership has a positive impact on safety performance. The more safety leadership in the company performs, the better the safety performance will be. Safety culture has a positive impact on company safety performance. Safety behaviour also has a positive impact on safety performance. When the safety behaviour of employees improves, the better the safety performance of the company. The direct influence of safety behaviour on safety performance is higher than the direct effect of safety leadership and safety culture on safety performance. Safety leadership and safety culture also affect, by safety behaviour, safety performance. The direct effect on safety performance from safety leadership and safety culture is more significant than the interaction between safety leadership and safety culture by safety behaviour.

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