Improving Safety Culture and Increasing Driver's Safety Awareness of Intercity Bus in The Greater Jakarta Area

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Abstract

Drivers' safety awareness is known to contribute to the integrity of transportation companies. However, for intercity bus drivers, the process of building safety awareness is challenging. Therefore, this research aims to determine other variables that significantly affect drivers' safety awareness. Previous literature studies stated that the variable of safety awareness has a significant relationship with that of culture, knowledge, and behavior. It is also necessary to confirm whether the relationship between these variables applies to intercity bus drivers. This study confirmed the relationship between the safety culture variables among the intercity bus operators and their safety knowledge, behavior, and awareness. The results showed that safety culture improvement helped in the development of knowledge. Besides, increasing the knowledge variable caused an improvement in behavior, which develops safety awareness. The three top factors that caused significant improvement were (1) Provision of adequate fuel supply before bus operation, (2) Providing appreciation in rewards and promotions for drivers who had worked hard to maintain safety while driving, (3) Management should collaborate with contractors for maintenance and repairs, tire supply, and bus washing. A 1-point increase in the performance of the culture variable leads to a rise in the efficiency of safety awareness by 0.679.

Keywords
public transportation, safety culture, safety awareness, intercity bus, Jakarta

1. Introduction
Safety became a critical issue in the study of public transport. According to Greater Jakarta Metro Regional Police, traffic violations, especially in the Jakarta Greater Area, have experienced an increase of 15.47% from 2016-2017. These violations have already been considered a habit for road users, including the city bus drivers demanding a high transportation fee from their passengers. Meanwhile, the occurrence of traffic accidents is due to unsafe behaviors and conditions. Some studies established that the human behavior factors that have led to an accident were between 80-85% (Dhillon, 2007). These statistics were supported by an investigation conducted by a private-owned operator's internal authorities.

Almost all accidents are caused by human errors (drivers). According to (Dhillon, 2011), the main factors associated with these accidents include disregarding the pre-arranged safety procedures (not to the risk of hazardous situations), truancy of actions, and the lack of supportive tools. The study was supported by Neal & Griffin (2006), which stated that safety behavior positively impacts accidents (Neal & Griffin, 2006).

Accidents are prevented by promoting safety cultures in workplaces, as supported by organizational policy. These cultures are known to reflect the perceptions, values, attitudes, and beliefs of organizations and individuals about the concept of safety (Glendon & Stanton, 2000). According to the Advisory Committee on Safety of Nuclear Installation (ACSNI), safety culture is part of the attitude, confidence (belief), and organizational value (norm) on occupational protection and health. Safety culture is reportedly interrelated with three elements, namely organization, worker, and occupation. These elements indicate that all existing resources should implement the safety culture in cooperating. Also, the determinant factor of safety culture is divided into three parts: organizational and employee characteristics and engineering facilities or resources. These organizational characteristics include leadership, commitment, communication, and training. However, the characteristics of employees include attitudes, knowledge, risk awareness, and perception. Moreover, the technical resources include equipment and facilities (Vierendeels, Reniers, van Nunen, & Ponnet, 2018).

This research aims to model the relationship between safety culture, behavior, knowledge and awareness. Also, it aims to provide a recommendation of safety awareness through safety culture. This research provides benefits to the private operator of the intercity bus by recommending increased safety awareness. With improved safety culture, it is expected that the safety awareness and performances of bus drivers are likely to be better, with lower chances of accidental occurrences.

As part of the preliminary study, the variables involved are limited to safety culture, knowledge, behavior, and awareness. Also, in this research, the scientific articles used as references are obtained from online database sources. The criteria for the references used in this study involve articles with older publication years (5-10 years) and consideration of keyword suitability and research contributions.

Safety culture variable originated from an accident report by the International Atomic Energy Authority (IAEA) in 1991, as the discourse of Chernobyl's subsequent hazards was made its method of measurement, which is a part of organizational norms. This safety culture, as an aspect of the organizational norm, affects attitudes and behaviors related to the increase or decrease of risk. An organization's safety culture is known as the product of individual values & groups, attitudes, competencies, and behavioral patterns, which aids in defining commitment, style, and proficiency in the company's safety programs. Safety cultures are also influenced by organizations, individuals, and work environments. Also, organizations with positive safety cultures are characterized by established communication, which emanates from the mutual trust and perception of the worth of protection and confidence in the success of preventive measures (Glendon & Stanton, 2000).

SCEQ (Safety Culture Enactment Questionnaire) is used in the measurement of safety culture. There are three dimensions of the questionnaire, which consists of 21 statements that are divided into strategic decision dimensions, which guarantees safety, human resource driving practices, and daily activities and behaviors that support protection. Each part of this questionnaire represents a climate element of safety, behavior, and performance (de Castro, Gracia, Tomás, & Peiró, 2017). Safety knowledge is a worker's understanding of operational protection practices when confronted with latent hazards and protective orders (Lee & Park, 1997; Safitri, Septiani, Anggraeni, & Alwinny, 2020). The variables of this safety knowledge are also known to influence motivation (Hedlund, Gummesson, Rydell, & Andersson, 2016) and behavior (Safitri, Septiani, et al., 2020; Safitri, Surjandari, & Sumabrata, 2020). Therefore, the more positive knowledge an individual possesses leads to a more remarkable display of affirmative attitude.

Safety behavior involves an employee's attitude towards adhering to standard work procedures, using personal protective equipment, and often avoiding the risk of breaches. Many variables are found to influence the safety behavior of drivers, as previous research on driving attitudes in Indonesia identified job satisfaction as a significant factor (Taylor, n.d.). Also, the safety violation of the workers and managers is probably caused by a lack of knowledge and motivation (Mitropoulos, Abdelhamid, & Howell, 2005). Based on the grouping performed by Vinodkumar & Bhasi (2009), the unsafe behavior in this study was categorized into two groups, namely error and violation (Vinodkumar & Bhasi, 2009). Error is classified as skill-based, decisional, and perceptual, while the violation is categorized as routine and exceptional (Proctor, R., Van Zandt, 1994).

Safety knowledge is workers' understanding of safety operating procedures when they see a potential hazard, training materials, and safety instructions (Jiang & Probst, 2016). Knowledge and understanding of safety have a relationship and influence on safety motivation (Hedlund, Åteg, Andersson, & Rosén, 2010). Safety awareness is the concern of workers to seek personal and passenger safety (Stelmokas, Bieliauskas, Kitchen Andren, Hogikyan, & Alexander, 2017). For this study, the safety awareness measure was adapted. Humans participate in realizing safety because of inherent care (Konijn, Lay, Boot, & Smith, 2017). This study provides a novelty in the paradigm of safety awareness among intercity bus drivers. The hypothesis is formed from a literature study that safety culture influences safety behavior and knowledge, safety behavior is influenced by safety knowledge, and safety behavior influences safety awareness. Safety culture, knowledge, and behavior were assumed to have a relationship and influence on safety awareness. This relationship and influence need to be proven by hypothesis testing.

2. Methods

A literature study led to the discovery and determination of the safety variables in this research. The weaknesses of research and future agendas implied in the references were also analyzed to identify improvements and novelty of this study. Expert opinions were also acknowledged through interviews in order to confirm the suitability of the research variables. The experts' criteria to be used as a resource in this study are based on being the operator of public transportation services. Moreover, the initial research design was a hypothesis model, where the relationship between latent variables was formed based on literary studies. A summary of the relationship between latent variables is shown in the matrix indicated in Table 1.

Table 1 Matrix of Relationship Between Latent Variables Based on Literature Review

	Safety Culture	Safety Knowledge	Safety Behavior	Safety Awareness
Safety Culture		(Hejduk & Tomczyk, 2015)	(Taylor, n.d.), (Wills, Watson, & Biggs, 2006)	
Safety Knowledge			(Vinodkumar & Bhasi, 2010)	(Chang & Liao, 2009), (Konijn et al., 2017), (Walters, Lawrence, & Jalsa, 2017), (Kopperud, Rukke, Kopperud, & Bruzell, 2017)
Safety Behavior				(Chang & Liao, 2009), (Walters et al., 2017)

The hypothetical model of the study was also shown in Figure 1.

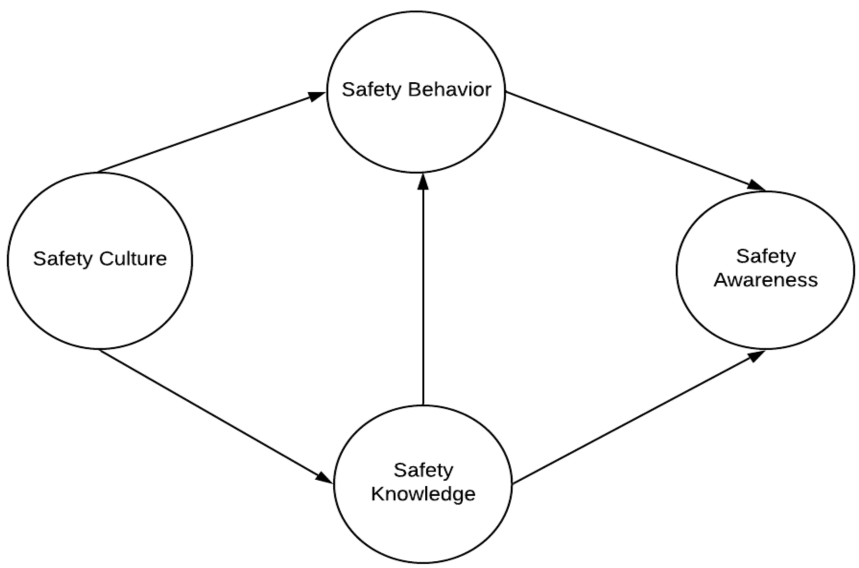

Figure 1. The Hypothetical Model

In this research, the indicators of safety culture variables made use of the factors that were used in the study of behavioral improvements through the protective norms possessed by intercity bus private operators (Safitri, Septiani, et al., 2020). Meanwhile, the indicators of safety behavior, knowledge, and awareness were obtained from (Safitri, Surjandari, et al., 2020). Data were also obtained from observations, interviews, and questionnaires. This questionnaire contained 21, 7, & 10 safety culture, knowledge, and behavior questions, respectively. Also, respondents were observed to reply with a 5-point Likert scale, where,
1 = Not Essential,
2 = Not Important,
3 = Hesitant,
4 = Agree,

5 = Very Important.

The survey was conducted between November 2018 to March 2019, with respondents being the driver of the intercity bus. The operational manager of a private-owned operator company became an expert respondent, which was selected to discuss matters related to the organization's policy on intercity bus operations.

Data processing was also carried out after the entire collection of the research information. Moreover, hypothetical testing was conducted via a multivariate statistical technique of Structural Equation Modeling (SEM), with a Partial least square approach (PLS-SEM). Based on the SEM variance to test the hypothesis, this method was used to determine its relationship with mutual influence. Also, the use of PLS-SEM does not need data normality assumptions, as there was no requirement of sample size. PLS also used bootstrapping or random duplication, as the assumption of normality was not a problem for the technique (PLS). However, small-sampled research was found to have still the ability to use PLS-SEM.

Furthermore, to analyze the safety culture and knowledge factors that influenced awareness, hypothetical testing was carried out. The importance-performance map analysis on PLS-SEM was also used to measure the impact of protective variable improvement on safety awareness. Also, the indicators of safety variables that were prioritized for improvement were determined through the importance-performance analysis. The indicators that also had the most significant total effect (importance) on the value of safety awareness performance were recommended to be increased.

3. Results and Discussion

In the explanation of previous literature studies and matrix relations between variables (shown in Table 1), the proposed research hypothesis was compiled as follows,
H0: There is no relationship between all safety variables
H1: There is a relationship between safety culture and behavior
H2: There is a relationship between safety culture and knowledge
H3: There is a relationship between safety knowledge and behavior
H4: There is a relationship between safety knowledge and awareness
H5: There is a relationship between safety behavior and awareness

Figure 1 showed a hypothesis model that was constructed from a literature study. This construction of structured models, which described the relationship between variables, was completed using the Structural Equation Modelling (SEM) method. This method was used as a confirmatory technique to test the influence of inter-variable relationships (Hair, Hult, Ringle, & Sarstedt, 2014). Each latent variable was also searched for construct factors. A preset variable was also manifested in the questionnaire, where each question was observed to represent a measurement of one specific latent variable. The respondents of this questionnaire were 650 intercity bus drivers, which were reportedly working with the largest private operator companies in Jakarta. Also, the sample needed was 450 respondents due to this research model involving 45 indicators. However, only 91 respondents were obtained. Based on this number of samples, the analysis was carried out with the SEM PLS approach, which was more suitable for studies with small population sizes and relatively complex hypothesis models. A convenience sampling method (accidental sampling) was also used for sample selection, with the procedure emanating from the easiest method to locate and acquired respondents (Hair et al., 2014). Table 2 below is further observed to illustrate the demographics of the respondents.

Table 2 Demographics of respondents

Demographic factors	Average
Age	42.16 years old
Left-handed	1%
Have a habit of smoking	60%
Have a habit of drinking alcohol	1%
Health problems	9%
Working period	3.59 years old
Duration of work experience as a bus driver	11.86 years old
Bodyweight	70.34 kg

Height	168.07 cm
Number of working hours/weeks	48,59 hours

During the initial research, the model was used to conduct a literature study to determine the variables used. In this study, the latent variables used included safety culture, knowledge, and behavior. Also, it was observed that the indicators present in safety culture used climate, performance, and behavior factors. Moreover, the indicators present in safety knowledge and behavior were also observed to use information & experience and fundamental and supporting factors. Also, the manifest factor directly measured the latent variables in the form of questions, which were observed to serve as indicators.

This research instrument was also a questionnaire, with question items compiled based on the results of the latent variable indicator during the literature study process. Gradually, a pilot study was also conducted, as the first stage was to test the validity of the construct in order for the respondents to understand the question item in the questionnaire. Based on the first stage of this pilot study, respondents were observed to serve as transportation and occupational safety experts and operational supervisors of a private-owned operator company. Some of the inputs obtained from this stage were also considered for the preparation of questionnaires. The indicator that measured the safety culture in this study was adapted from the SCEQ (Safety Culture Enactment Questionnaire) (de Castro et al., 2017). The initial draft of the questionnaire was piloted to 10 prospective respondents to determine their comprehensiveness towards the questions.

Furthermore, the initial stage in the PLS-SEM was found to be the measurement of an outer model. This model (Outer Model) helped define the relationship level between the indicators j and constructed variables [20]. This research also aimed to test the relationship between the indicators, valid and reliable question items with latent variables, namely safety climate, motivation, and knowledge. In the evaluation phase of this reflective measurement model, three stages were observed, namely convergent and linear (discriminant) validities and reliability. Convergent validity is a correlation between the reflective indicator and its latent variable scores, calculated via the PLS method. The 0.5 to 0.6 loading values were also considered sufficient in this study. However, the limit of the outer loading value was set at 0.5 (Monecke, A. and Leisch, 2012).

The outer loading value for all indicators above 0.5, as shown in Table 4, had qualified discriminant validity [20, 21], as it also showed the measured correlations in the latent variable. The outer loading value above 0.5 also indicated that each test item/indicator was used as a latent variable gauge. In addition to judging from the value of loading factors, convergent validity was also observed from the Average Variance Extracted (AVE) [20]. AVE was found to be the total average of the squared loading factor, as it attempted to measure the number of variants obtained from the latent variable errors during the measurement. Moreover, the AVE value was also found to be above 0.5. This value described the validity of a sufficient convergent, which indicated that a single latent variable explained more than half of the variant of the indicator. Therefore, Table 3 contains the AVE value on the measurement model.

Table 3 Reliability Test

	Cronbach's Alpha	Composite Reliability	AVE	Reliability
Safety Awareness	0.875	0.88	0.523	Reliable
Safety Behavior	0.88	0.884	0.449	Reliable
Safety Culture	0.866	0.807	0.207	Reliable
Safety Knowledge	0.797	0.814	0.407	Reliable

The next step was the testing phase of discriminant validity, which was conducted to determine the length by which the construct was completely different from the others. This discriminant validity used two criteria, namely Fornell-Larcker and Cross Loadings. The Fornell-Larcker criteria compared the square root value of each construction's AVE with the correlation between other factors present within the model. In this study, the discriminative validity was obtained via the Fornell-Larcker criteria. When the square root of the construct-variable AVE (Average Variance

Extracted) was more significant than the correlation with other constructions, validity was stated to be good, as recommended measurement values should be higher than 0.50. The discriminant validity is further shown in Table 4.

Table 4 Discriminant Validity: Fornell-Larker Criteria

	Safety Awareness	Safety Behavior	Safety Culture	Safety Knowledge
Safety Awareness	0.723			
Safety Behavior	0.982	0.671		
Safety Culture	0.648	0.743	0.455	
Safety Knowledge	0.907	0.912	0.525	0.638

From the results of a discriminant validity test with the Fornell-Larcker criteria, it was observed that the entire value of each variable's AVE was more substantial than the latent variable correlation. Therefore, it was concluded that the measurement model was valid. The second criterion used to test validity was Cross Loadings. The value for each indicator was expected to be higher than its cross-loading.

When a model had been observed to meet the requirements of discriminant validity, the measurement of reliability should be conducted afterward. The reliability test parameters were performed using the Cronbach's Alpha and Composite Reliability indicators. Also, the second value of this test reflected the reliability of all indicators in the model, as the minimum scale for the Cronbach Alpha and Composite Reliability values were 0.7 & 0.8, respectively. Table 5 also showed the Cronbach Alpha and Composite Reliability values on the measurement model. These results also indicated that the entire construction was qualified, as it possessed Cronbach Alpha and Composite Reliability values of 0.7 & 0.8, respectively. Therefore, no reliability issues were found on the model, signifying that the fundamental indicators were feasible to illustrate each constructed variable. Based on the three criteria in the evaluation test stage, it was stated that the Outer Model had good validity and reliability.

Furthermore, a bootstrapping technique was used for the hypothetical tests in this study. This test was conducted in order to determine the influence between indicators and latent variables. The criteria for this test were,

(1) Variable relationship (indicated by the original value of the sample) was consistent or positive with that which was hypothesized,
(2) The value of T-Statistic (Bootstrapping result) > T-table (shown in the T distribution Table), with degrees of confidence (α) = 0.05 and P-value < 0.05 or 5%.

When the criteria were met, the endogenous construction became influential against those that were exogenous. Table 6 and Figure 2 below illustrate the hypothetical test results, which were carried out via the bootstrapping technique.

Table 5 Path Coefficient, T Statistics, and P values

Hypothesis	Path Coefficient	T Statistics	P Values	Significance
Safety behavior → safety awareness	0.694	7.874	0	***
Safety culture → safety behavior	0.373	4.428	0	***
Safety culture → safety knowledge	0.454	5.395	0	***
Safety knowledge → safety awareness	0.239	2.214	0.027	***
Safety knowledge → safety behavior	0.632	7.897	0	***

The value of the path coefficient indicator was found to demonstrate a positive influence relationship. Conversely, when the path coefficient value was negative, the relationships were stated to have no influence. These results showed that the relationship between safety culture and behavior was positive. Also, the relationship between safety culture and knowledge was found to be positive. However, safety knowledge relationships with behavior turned out negative.

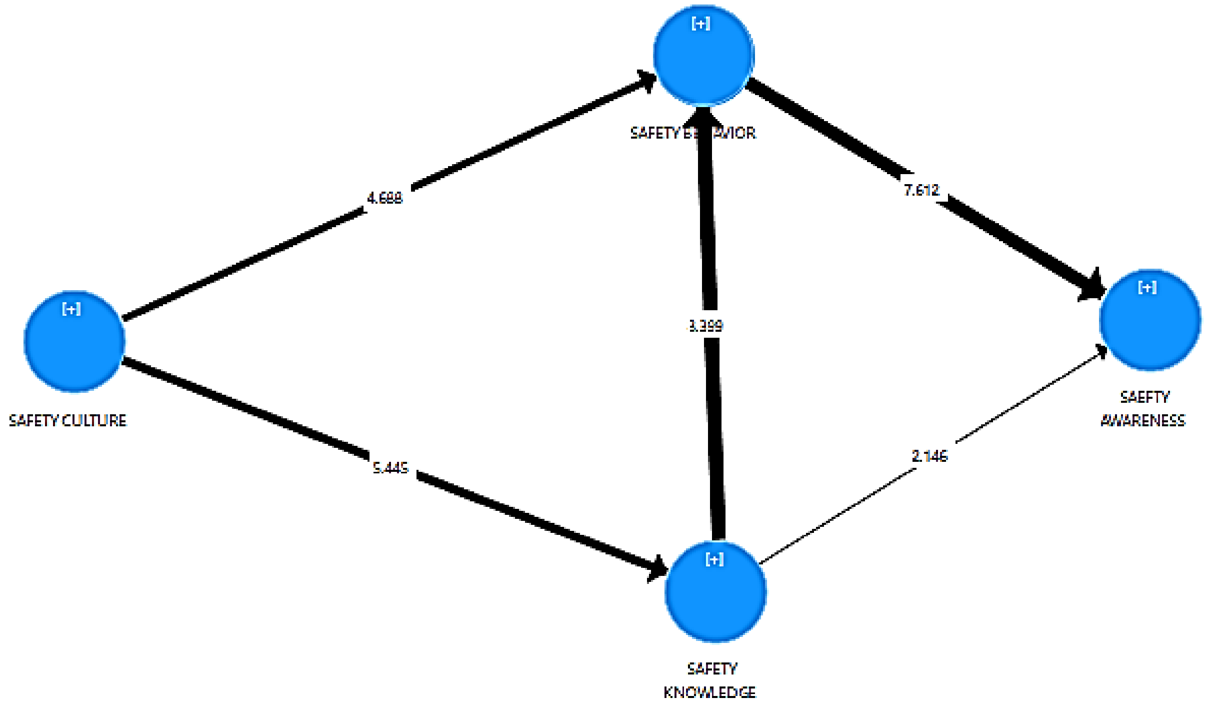

Figure 2 Path Model with Hypotheses Test Results

The value of T-Statistics on the indicator against each variable was higher than that of the T-Table (> 1.984). The P-Value was less than 0.05, signifying that the error possibility or risk of the test result was below 5%. These results indicated that all research indicators were observed to possess a significant influence. Based on the value of T-Statistics, the hypothetical test results showed similar significance with the P-Value.

The evaluation of the model was further performed using the goodness of fit criteria, indicating how the constructed design generated a covariance matrix between the indicator items effectively (Hair et al., 2014). The value of R2 was also found to indicate the coefficient of determination or proximity relationship of models. In order to determine how large the ability of an independent variable is willing to describe the dependent type (bound variable), the adjustment of R2 was conducted and observed. The R2 was stated to be strong, moderate, and weak, when it has a value > 0.75, > 0.5, and > 0.25, respectively (Hair et al., 2014). Table 7 also confirms the coefficient of determination value of R2.

Table 6. Coefficient of Determination R2 and Q^2

	R2	Q^2
Safety Awareness	0.962	0.452
Safety Behavior	0.93	0.364
Safety Knowledge	0.276	0.09

Predictive conformity calculations were not perceived enough from the R^2 values only, as the parameter of the Q^2 sample used was derived from the reuse technique (blindfolding). The Q^2 represents the practical results of the model and its parameter estimation in the reconstruction of measured variables. The value of $Q^2 > 0$ Indicated that the model had predictive relevance. However, when the value of $Q^2 \leq 0$ indicated that the models have less predictive relevance. Table 8 also shows the value of Q^2 derived from the blindfolding technique via Smart PLS 3.0.

The result of a visible blindfolding technique in Table 7 indicated that all latent variables in the model had values of Q^2 above 0, therefore, indicating predictive relevance for each of them. Moreover, the last phase of the hypothetical test was to assess the model's fitness via the Goodness of Fit (GoF) value observations. In PLS-SEM, GoF served as a performance measure for both the outer and structural designs (inner model), as it focused on the total prediction of model efficiency. Unlike the covariant based- SEM, the value of GoF in the PLS-SEM should be searched via the following formula (Hair et al., 2014; Roni, Djajadikerta, & Ahmad, 2015).

$$\text{GOF} = \sqrt{\overline{R^2} x\, \overline{AVE}} = \sqrt{\mathbf{0.2865}} = 0.535.$$

According to Hair et al., (2014), small, moderate, and large GoF values were observed to be 0.1, 0.25, and 0.38, respectively. From the calculation above, the value of GoF in this study was 0.535, as it was concluded that the prediction performance of the total model was good. From the testing of R^2, Q^2, and GoF, the design produced was reasonably powerful, as the hypothesis model was fitting for the phenomenon of relationships between all variables.

4. Managerial Implication

Based on the priorities and correlation values of research indicators with the safety variable, recommendations for further improvements were provided. In the research hypothesis model, the safety culture was an independent variable, which was present in the initial position of the hypothetical path model. The relationship between variables was safety culture → knowledge → behavior → awareness. The relationship indicated that when safety culture was increased, the knowledge variable was also higher. Also, increasing the safety knowledge variable was found to cause an increment in behavior, ultimately improving awareness.

Further assessments regarding the effect of safety indicators and independent variables on other factors were also carried out via the importance-performance map analysis, which was integrated with the PLS-SEM approach. This analytical method was observed to produce an estimate of the weight of effect (Ringle & Sarstedt, 2016). The coordinates of importance-performance were also found to be 0.679 & 64,955. The coordinates indicated that a 1-point performance increase of the safety culture variable improved awareness by 0.679.

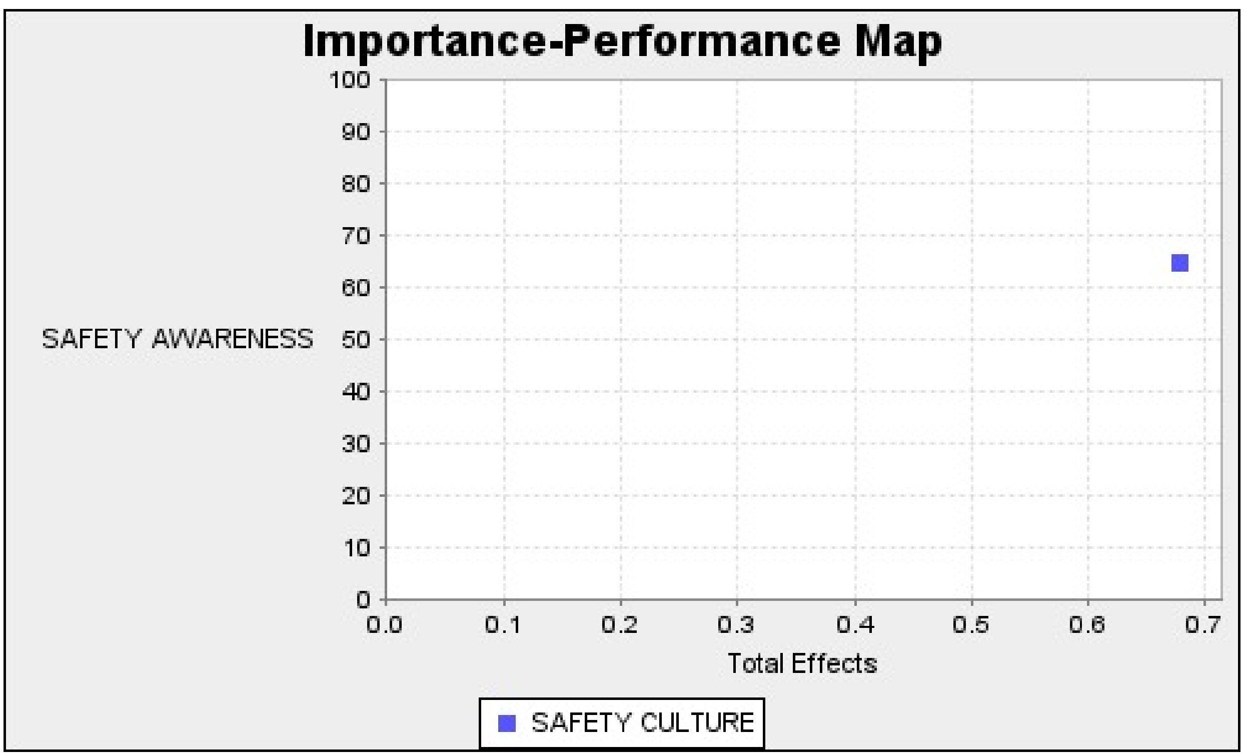

Figure 3 Importance-Performance Map of Safety Awareness Variable

"Which safety culture indicators are likely to be the priority for improvement?" The importance-performance analysis was found to be carried out on indicators of safety culture variables against those of awareness. Furthermore, Figure

4 showed the importance-performance matrix for all safety culture indicators for awareness. It was also understood that the provision of fuel supply before bus operation (SCUL2.7) was an indicator with the most significant importance or total effect value for the safety awareness variable. Therefore, an increase of 1 point in this indicator was expected to improve the performance of safety awareness by 0.0822. When the company assures this fuel supply, drivers admit that they can focus more on their work, including being more motivated in striving for safety.

This improvement in safety culture is the main managerial implication necessary for raising the protective awareness of the intercity bus drivers at private-owned operator companies. The three main priorities are based on the safety culture variable indicator, which has the most significant total effect (importance) value on safety awareness. The three managerial indicators included in the top priority for improvement were,

(1) Provision of adequate fuel supply before bus operation (SCUL2.7),
(2) Providing appreciation in rewards and promotions for drivers who had worked hard to maintain safety while driving (SCUL2.3),
(3) Management should collaborate with contractors for maintenance and repairs, tire supply, and bus washing (SCUL3.4).

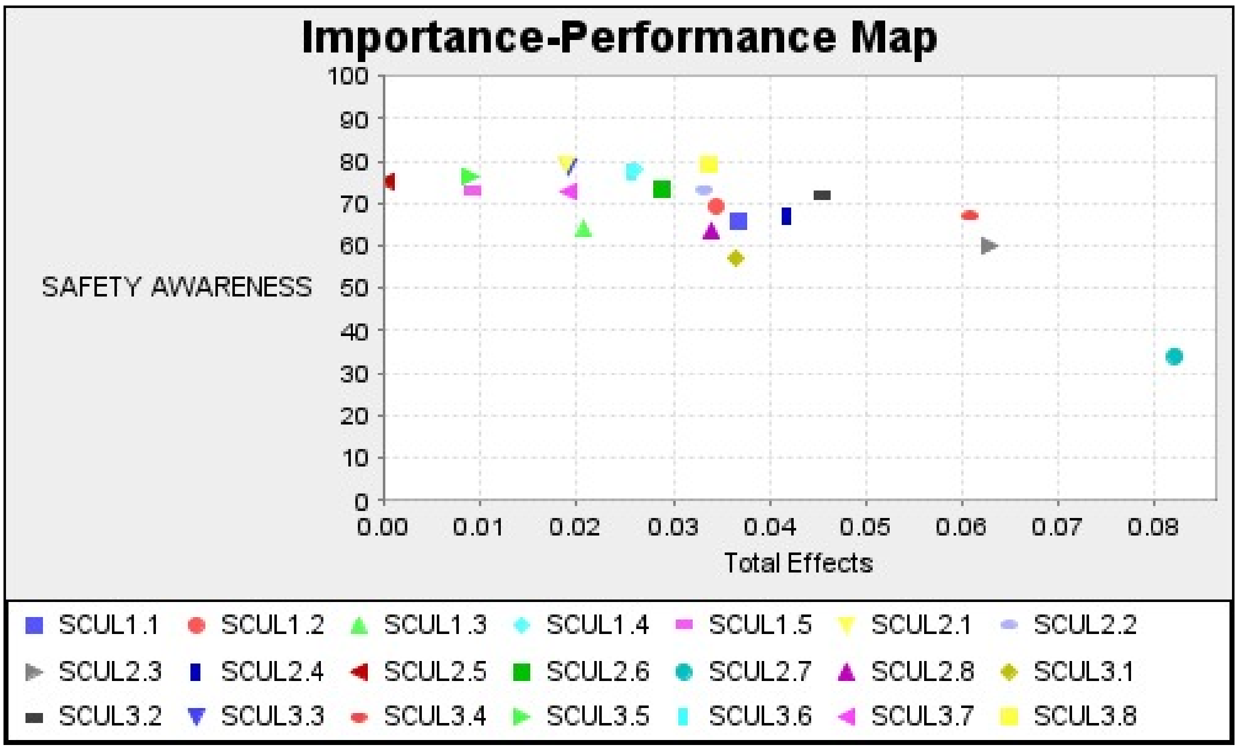

Figure 4 Importance-Performance Map of Safety Culture Indicators

5. Conclusion

The relationship between safety culture variables among the intercity bus operators and drivers' knowledge, behavior, and awareness were confirmed. The safety variable relationship was in the following path, safety culture → safety knowledge → safety behavior → safety awareness. The three indicators that were included in the top priority for improvement were (1) Provision of adequate fuel supply before bus operation, (2) Providing appreciation in rewards and promotions for drivers who had worked hard to maintain safety while driving, (3) Management should collaborate with contractors for maintenance and repairs, tire supply, and bus washing. A 1-point increase in the performance of the safety culture variable was expected to improve the efficiency of awareness by 0.679. The safety culture in an organization affects the safety knowledge of workers. This knowledge of safety influences safety behavior, and this behavior, in turn, build safety awareness. This path model explains that humans will behave safely because they had the safety knowledge. Safety awareness is only developed through behavior, although this behavior may be imposed initially by the organizational culture. An organization with the strength of its culture, assets, and policies is shown to have the most significant influence on safety.

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