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Measuring Influence from Safety Climate to Safety Behavior in Bus Rapid Transit Drivers

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Abstract. Safety climate and safety behavior has an essential contribution to safety in all forms of the organizations. This research aimed to measure the impact of safety climate on safety behavior on bus rapid transit drivers in Jakarta. Bus rapid transit accident occurred inside and outside the bus lane. The incidence of the accident indicates that the risk is real. The measurement of the safety climate was using Nordic Safety Climate Questionnaire (NOSACQ-50). The NOSACQ-50 was adapted to fit the characteristics of transportation object. The questionnaire was distributed to 100 bus rapid transit drivers in Jakarta. Structural Equation Modelling – Partial Least Square (SEM-PLS) method was used to determine the influence safety climate to safety behavior among bus rapid transit drivers. The testing on the outer and inner model was conducted by bootstrapping and blindfolding process using Smart PLS software on the significance level of 0.05. The results of the study are that the workers’ safety commitment and safety communication, learning, and trust in co-workers’ safety competence had a positive and significant influence on safety behavior.

Keywords: safety climate, safety behavior, bus rapid transit

1. Introduction
The research model built through a literature study. Some studies suggested that the incidence of accidents was usually related to the safety behavior of workers [1], [2]. The safety climate also influenced safety behavior [3], [4]. Based on these findings, the literature study was conducted using a specific keyword that was the safety climate and safety behavior. This systematic literature study yields the outcomes of indicators for the safety climate and safety behavior research variables. These safety variables and indicators would form the research model in the form of the hypothetical model.

Safety was one indicator of the quality of transportation services so that public transport operators are very concerned about safety issues. The government as a regulator of public transport services was also very concerned about safety. Research on transportation safety has a high urgency because its services are responsible for more lives than private vehicles. Safety climate was the perception of workers against policy and all efforts of management or organization in seeking safety [2].

Safety climate was the worker's perception of concern for the safety of the organization in which he works. Previous research states that safety climate has a relationship with safety behavior [5]–[9]. This research aimed to assess the relationship between safety climate and safety behavior on bus rapid transit operator in Indonesia. Safety climate research has been done in many organizations and companies. Among them were in hospitals and health services [2], [10]–[12], construction [5], [13]–[16], manufacturing industry [17]–[23], and chemical industry [24]. More specifically, safety climate research...
was conducted on the public transport by involving the driver as respondents as done by [3], [6], [25]–[29].

Several major cities in Indonesia have bus rapid transit (BRT) services to support community mobility. Jakarta was one of the cities in Indonesia that has a BRT system called Transjakarta Busway. Transjakarta Busway was operated by private and state-owned companies. The Jakarta government was very concerned with the safety of public transport. In the year 2017, there were many accidents involving Transjakarta buses. The accident occurred inside and outside the bus lane. The incidence of the accident indicates that the risk of an accident was existing. So it was necessary to assess the factors that cause the accident.

Human factors were mentioned to be the primary cause of traffic accidents. Human error was usually referred to as an issue that was hard to be solved in an accident prevention effort. Blaming people was unfair because, in the system point of view, transport safety was a hierarchical system. Elements in the transport safety system include the organization and the human. Organizations had a role in transport safety systems. In the system, the organization occupies the highest hierarchy that has a significant influence on the safety of public transport services. The human factor held the authority beneath it. Organizational factors and human factors have interrelated relationships [30]. In the study, organizational factors were represented by safety climate variables, while safety behavior variables represented human factors. This study aimed to explain the relationship between safety climate and safety behavior in Bus Rapid Transit operators in Jakarta.

2. Methods

Literature studies show that several tools can be used to measure safety climate including NOSACQ-50 [31]. Other researchers designed the questionnaire for safety climate measurements on each object. The safety climate measurements in the study adopted the NOSACQ-50 survey. Adaptation of item tests on NOSACQ-50 needed to be done to fit the context of public transport objects. The terms for production and manufacturing were adjusted for the activities of the bus driver. At this stage also added the safety climate variables in the NOSACQ-50 variable set based on a literature study. According to [31], Safety Climate had 7 dimensions of; (1) management safety priority, commitment, and competence (SC1); (2) management safety empowerment (SC2); (3) management safety justice; as well as shared perceptions of (SC3) (4) workers’ safety commitment (SC4); (5) workers’ safety priority and risk non-acceptance (SC5); (6) safety communication, learning, and trust in co-workers’ safety competence (SC6); and (7) workers’ trust in the efficacy of safety systems (SC7).

The process of adaptation of the questionnaire was needed because the variables obtained from previous research were not in the field of public transport. Pilot studies were conducted to improve the constructs of the test items. Expert opinions were used to consider the process of adaptation of item test questionnaires from industrial objects to transportation objects. Each question item in the questionnaire was assessed using a Likert scale of 1 through 5. The value one stated strongly disagree, while the value 5 stated strongly agree with the statement in the questionnaire. The measurement of safety behavior in the study used a set of questions in the survey used by [9].

PLS-SEM is a variance-based multivariate analysis method which overcomes the shortcomings in the research that couldn't obtain relatively large samples [32]. Compared to Covariance-Based SEM, PLS-SEM is suitable for predictive oriented research with quite a high model complexity. PLS-SEM uses nonparametric testing, where the latent value variable is explicitly estimated [32], [33].

3. Result and Discussion

Testing the hypothetical model with SEM PLS consists of two stages. The first was the outer model test phase. At this stage, correlation of indicators with latent variables was analyzed. A valid indicator was determined using the loading factor value. The second stage was hypothesis testing on the inner model. Hypotheses Test using T-test. Data processing was done by using Smart PLS 3 software.

According to [34], in determining outer loading relevance testing, it was determined that if the outer loading value were below 0.4, then the inductor would be eliminated. If the outer loading value were above 0.7, the indicator would be maintained. If the value were between 0.4 and 0.7, then the value of
the Average Variance Extracted (AVE) would be considered. If AVE were below 0.5, then the indicator would be discarded, and if above 0.5 will be maintained. Construct indicators SC1.1, SC1.3, SC1.5, SC3.1, SC3.2, SC5.1, SC5.2, SC6.4, SC7.1, SC7.2 had factor loading values below 0.6 and should be eliminated from the hypothetical model. In addition to the value of the loading factor, convergent validity could also be seen from the Average Variance Extracted (AVE). In the study, the AVE value of each construct was above 0.5. Variables SC1, SC3, SC5, and SC7 had the AVE value below 0.50; it indicates that the indicator has a higher average error rate [34]. However, in this study, these variables will still be used in the reliability test because the value of outer loading meets the validity requirements. Reliability Test was done by considering Cronbach’s Alpha Value. The variable was declared reliable if it has Cronbach’s alpha value above 0.6. Based on the Cronbach’s alpha value, then the SC3, SC5, and SC7 latent variables will be excluded from the model. The final hypothetical model is as shown in Figure 1.

Table 1 Cronbach’s Alpha and Average Variance Extracted Value

| Variables                                         | Number of items based on literature | Adapted number of items based on a pilot study | Cronbach’s Alpha | Average Variance Extracted (AVE) |
|---------------------------------------------------|-------------------------------------|-----------------------------------------------|------------------|----------------------------------|
| Safety Behavior                                   | 10                                  | 10                                            | 0.922            | 0.589                            |
| Management safety priority, commitment, and competence (SC1) | 9                                   | 7                                             | 0.612            | 0.404                            |
| Management safety empowerment (SC2)               | 4                                   | 6                                             | 0.811            | 0.507                            |
| Management safety justice; as well as shared perceptions of (SC3) | 4                                   | 4                                             | 0.195            | 0.407                            |
| Workers’ safety commitment (SC4)                  | 6                                   | 4                                             | 0.958            | 0.888                            |
| Workers’ safety priority and risk non-acceptance (SC5) | 7                                   | 4                                             | 0.422            | 0.418                            |
| Safety communication, learning, and trust in co-workers’ safety competence (SC6) | 8                                   | 4                                             | 0.782            | 0.617                            |
| Workers’ trust in the efficacy of safety systems (SC7) | 7                                   | 3                                             | -1.910           | 0.456                            |

The relationship of influence between variables was exposed to T-value written above the arrow line. T Value above 1.96 indicates that the impact of one variable on another variable was significant. Table 1 shows that the effect of all safety climate variables has a positive influence on safety behavior. A positive original sample value indicated the positive controls. The value of T-statistics presented the level of significance of the importance of independent variables on the dependent variable. Based on the table, 5% significance has a T value = 1.96. The T-Statistics score above 1.96 indicates that the effect was significant. Workers’ safety commitment (SC4) and safety communication, learning, and trust in co-workers’ safety competence (SC6) have a positive and significant influence on safety behavior. While management safety priority, commitment, and competence (SC1) and management safety empowerment although influence safety behavior (SC2), but the impact was not significant. The value of P-value can also indicate the level of significance of the influence. P-value values smaller than 0.05 indicate a meaningful relationship. From the output of the calculation, it was known that the conclusion of the P-value was in line with the result shown by the value of T-statistics. The Path Coefficient, T-Statistics, and P-Value are as shown in Table 3. The item test for assessing the relationship between safety climate and safety behavior for bus rapid transit drivers is as shown in Table 2.

PLS-SEM method was established for prediction determinations. The R2 values (i.e., coefficients of determination) represent the amount of explained variance of the endogenous constructs in the structural model. A well-built path model to explain specific fundamental target constructs should deliver satisfactorily high R2 values. In general, R2 values of 0.25, 0.50, and 0.75 for target constructs were considered as weak, medium, and substantial, respectively [32]. The calculation of the Q2 value for measuring predictive significance used the prediction error. The path model would have a predictive
weight for a selected reflective endogenous construct if the Q2 value were above zero. From Table 4, the R2 and Q2 value indicate that the target construct was medium, and the path delivered an excellent predictive implication.

**Table 2 Item Tests List**

| Latent Variable | Item Test |
|-----------------|-----------|
| Management safety priority, commitment, and competence (SC1) | Management guarantees every driver receives the required information regarding his or her safety and passengers. Management prioritizes the safety of drivers and passengers on public transport services. I am confident in management's ability to handle safety-related issues. Management takes immediate action on any accident, and occupational health risks found during inspection/audit. |
| Workers' safety commitment (SC4) | We work hard together to achieve a high level of safety. We care about the safety of ourselves and others. We help each other to work safely. We are responsible for the safety of ourselves and others. |
| Safety communication, learning, and trust in co-workers’ safety competence (SC6) | We always discuss to find a solution if someone finds a potential risk of accident. We seriously consider the advice and opinions of others regarding the prevention of accidents. We have high confidence in the ability of colleagues to ensure safety. |
| Safety Behavior (SB) | I adhere to safety procedures before, during and after driving. I am used to the use of safety equipment (seat belts, indicators on the dashboard, fire extinguishers, and so forth) in the vehicle. I qualify with knowledge and job skills. I am always cautious and alert when driving. I always check the vehicle before driving to make sure the bus condition I operate is well worth the way. I always do document checking and Standard Operation Procedure before driving. I adhere to traffic signs for my self and passenger safety. I will report according to the procedure if it finds unsafe condition. I set the temperature of the bus cabin where I work comfortably enough to stay concentrated. I make sure all the safety equipment in the vehicle is available. |

**Table 3 Path Coefficient, T-Statistics, and P-Value**

| Latent Variable | Original Sample (O) | T-Statistics | P-value |
|-----------------|---------------------|--------------|---------|
| SC1 \(\rightarrow\) SB | 0.086 | 0.743 | 0.448 |
| SC2 \(\rightarrow\) SB | 0.250 | 1.539 | 0.104 |
| SC4 \(\rightarrow\) SB | 0.247 | 2.360 | 0.020 |
| SC6 \(\rightarrow\) SB | 0.246 | 1.806 | 0.048 |

**Table 4. R² and Q² Value of the Endogenous Latent Variable**

| Endogenous latent variable | R² value | Q² value |
|---------------------------|----------|----------|
| Safety behavior           | 0.527    | 0.245    |
Figure 1: Graphics Output from A Hypothetical Test Of SEM-PLS Method using Smart PLS Software

4. Conclusion
Model of the relationship between safety climate to safety behavior in this research can represent a phenomenon in a real system. Two safety climate variables have a positive and significant influence on safety behavior. For prevention of accident, safety behavior improvement can be focused on improvement of safety climate, especially on the dimension of workers' safety and safety communication, learning, and trust in co-workers' safety competence indicators. This research opens opportunities for development, especially in the addition of other latent variables related to transport safety. Safety behavior is not the only variable of the human factor that can cause an accident. Further study should include the influence of other variables such as safety awareness, safety participation, safety knowledge, and safety motivation.

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