Commuter Train Passenger Safety Model Using Positive Behavior Approach: The Case Study in Suburban Area

D A Suryanto[1], S A Adisasmita[2], S Hamid[3] and M Hustim[4]
[1]*Doctoral Student,* Hasanuddin University, Makassar, Indonesia
[2,3,4]*Lecturer,* Hasanuddin University, Makassar, Indonesia

E-mail: doddy.civeng2010@gmail.com

Abstract. Currently, Train passanger safety measures are more predominantly measurable using negative dimensions in user mode behavior, such as accident rate, accident intensity and accident impact. This condition suggests that safety improvements aim only to reduce accidents. Therefore, this study aims to measure the safety level of light train transit modes (KRL) through the dimensions of traveling safety on commuters based on positive safety indicators with severel condition departure times and returns for work purposes and long trip rates above KRL. The primary survey were used in data collection methods. Structural Equation Modeling (SEM) were used in data analysis. The results show that there are different models of the safety level of departure and return journey. The highest difference is in the security dimension which is the internal variable of KRL users.

1. Introduction

At this time, the improvement of the safety level, especially road safety is done with many approaches like accident intensity, accident index and the impact of accidents on both the road network and the mode of transportation. This can be seen from the research conducted by [11] which shows that 77% aspect to assess safety level is negative aspect, such as accident intensity [15], hit-and-run level [16], badly risk related to transportation mode, number of accidents [3], impact of collision [5]. This shows the lack of a positive behaviour approach taken when measuring the safety level before taking improvement action.

Positive Psychology movement experienced rapid development since five years after the Seligman and Csikszentmihalyi fill a special edition on [9]. Nevertheless, the positive psychological influence is not very developed in the world of transportation, especially in terms of safety measurements. According to [13], one concept relevant to safety measurement is reliensi. By definition, reliance is the resilience that a person has to survive or recover quickly in difficult conditions, such as sickness, disasters, so the other word of resiliency. Currently, resiliency has been studied by researchers in many disciplines, because resiliency refers to positive adaptation or the ability to repair themselves out of trouble, so the perception generated is an improvement on the things that are positive in terms of potentials of resources around them [2].

Currently, DKI Jakarta is one of Metropolitan City which became the center of government and trade center in Indonesia. The Jakarta area is supported by 4 buffer zones (Suburban area), namely Bogor, Depok, Tangerang and Bekasi or often called Bodetabek. As the center of government and commerce, every day there is movement 3.6 million people commuting from the area Bodetabek to Jakarta [18]. This movement of the peak occurred between the hours of 06:00 to 08:00 and back

toward Bodetabek which peak in the afternoon between the hours of 17:00 to 19:00. One of the most favored vehicle by commuters is the mode of Electric Train called KRL Jabodetabek Route, here in after called KRL (Kereta Rel Listrik). Until August 2017, the average of 993,804 people every day with the activities carried out at 75 existing stations and reaches a length of 418.5 km services. Commuters using the KRL to perform activities, work, school, and so on. KRL has two types of carriage, namely women-only carriages which officially launched in 2012 called Kereta Khusus Wanita (KKW) and the mixture carriages which operates from 4:00 AM until 00:30 AM each day.

This research study was conducted in Depok City area which is one of suburban area directly adjacent to City of Jakarta in the North. Depok City become the locus of this study as compared with other buffer zones, as an alternative mode of Depok City has the most varied, so that the pattern is more complex mode choice. The total movement of KRL users in Depok region reaches more than 75 thousand per day spread over four stations. Depok City has four stations, namely Depok station, Depok Baru Station, Pondok China Station and Universitas Indonesia Stations.

In this study, an analysis of the variables of safety measurement results are applied empirically in the suburban community journey into work using the KRL mode. The purpose of this study is to prove empirically the effect of a security dimension, the dimension of sense security, the dimensions of safety, the dimensions of the equipment safety, and the dimension of awareness commuter passenger based on time and distance of the station and origin to the destination station when leaving for work and returning of the workplace.

2. Research methods

2.1. Conceptual Model

The research variables used in the study were divided into two exogenous dimensions consisting of (i) security; (ii) safety equipment and 3 endogenous variables, consisting of (i) sense of security; (ii) safety; and (iii) awareness (Figure 1).

The research method divided into two methods, namely (i) data retrieval method and (ii) method of data analysis. Data retrieval method used in this study were divided into two types of data, namely primary data and secondary data. Primary data was collected by interview method. Interviews were conducted using questionnaires. The number of respondents are 130 people with the provisions of (i) the KRL users; (ii) Living in the city of Depok and working in Jakarta. Primary data collection methods used *random sampling* method. Secondary data was taken from several agencies such as BPS and PT. Jabodetabek commuter.

The Variable safety modes of transportation used in this study were divided into many variable such as (i) Security variables, consisting of (X_1) Security Vehicle [15], Security-Management (X_2) [15] [16], Security-mobility (X_3) [10] [12] [17], User-security (X_4)[12] [17], Security-perception (X_5) [5], and Security-Taste (X_6) [7]; (ii) sense of security variables, consisting of Confident (y_1) [4], good attention (y_2) [12], protected by the facility (y_3) [12], Can feel relaxed (y_4) [1], feel easy (y_5) [1]; (iii) safety variables, consisting of Safety-management (y_6) [13], Safety-protection (Y_7) [1] [12], Safety-responsibility (y_8) [14]; (iv) safety equipment variables [14], consisting of Emergency exit equipment (X_7), Emergency window Equipment (X_8) , Emergency brake equipment (X_9); (v) awareness variables [3] [4], consisting of Awareness-passenger (y_9), Awareness-driver (y_{10}); and (vi) Primary survey result for safety moda level variables, consisting of Presence at destination (Z_1), Performance improvements (Z_2), Physical health (Z_3), Desire to use KRL Back (Z_4).
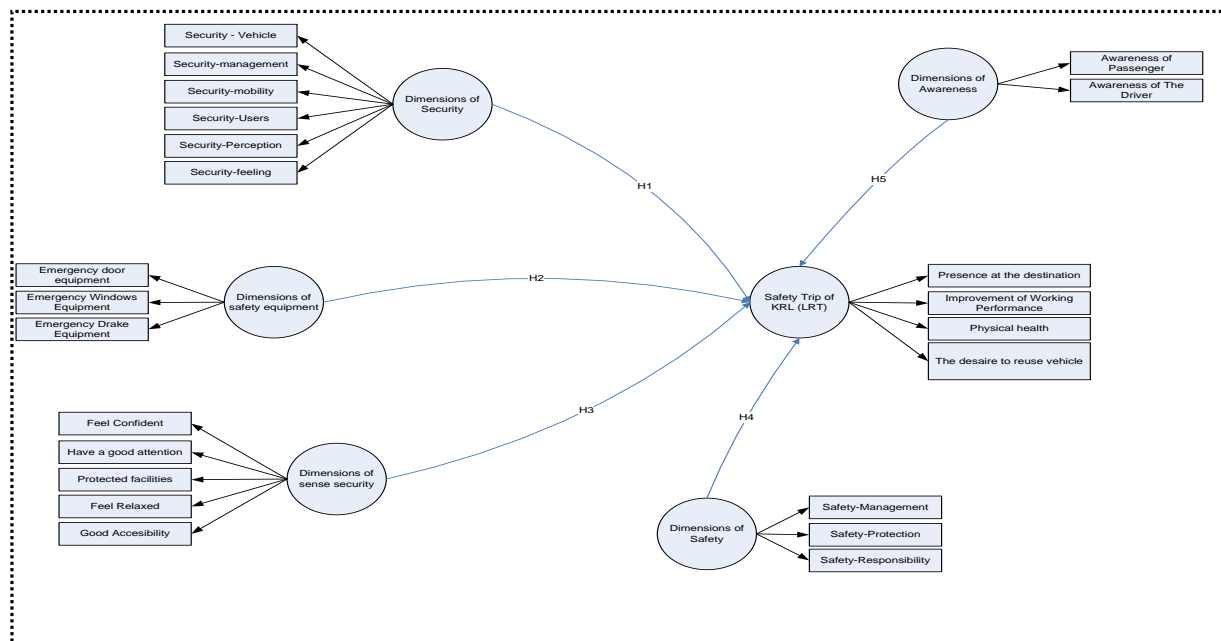
Figure 1. Conceptual Model

2.2 Research Steps

Partial Least Square (PLS) is a multivariate analysis technique that can be used to describe the inter-relationship of linear simultaneous observation variables. Which also involves a latent variable that cannot be measured directly could be analyzed using analytical methods with confirmatory factor. The data processing in this research was done with second order factor analysis model which repeated indicators approach, so the outer model analysis were done on first order construct and second order construct. The steps analysis used in this study were divided into two methods: 1) Analysis of measurement model (outer model or also called measurement model) to evaluate the relationship between construct variables with indicator or manifest variable, 2) structural analysis (inner model) to evaluate the result of parameter estimation path coefficient and its significance level

3. Results and Discussion

Table 1 shows the characteristics of survey. 44.6% of the respondents were female, fell into the 26 to 40 age group, who earned 2-5 million rupiah each month and 42.3% were employees. 65.3% of respondents have 1 motorcycle unit with 54.7% live 500 m-2 km. New Depok Station into the departure station 42.4% 61.5% of respondents at the time of departure 6:00 to 08:00. 43, 2% of respondents have a journey towards the destination station within 10-15 stations with 22.7% in the women-only carriages.

At the time of departure, 84.3% of respondents are at 16.00-20.00 with 42% of the workplace is 2-3 km to Return station. At home the woman carriages users increased 25.4%. More data can be seen in table 1.

Table 1. Sample characteristics of survey

Items	Categories	Effective percentage
Gender	male	55, 4%
	female	44.6%
Age (year-old)	18-25	25.1%
	26-40	56.9%
	> 40	18.0%
Education	High school	10.5%
	Bachelor degree	41.0%
	Graduate degree	43.5%
	Post graduate degree	5.0%
Monthly income	Less than 2 million	25.4%
	2 - 5 million	47.5%
	Above 5 million	27.1%
Occupation	Non resident worker	32.5%
	Employee	42.3%
	Civil Servant	25.2%
motorcycle ownership	1	65.3%
	2 or more	34.7%
Departure Time	<06 .00	22.3%
	6:00 to 8:00	61.5%
	8: 00-16: 00	16.2%
Wagon Type	Woman	22.7%
	Mixed	77.3%
Distance of Home-Station	<500 m	23.4%
	500m-2km	54.7%
	2 - 3 km	12.2%
	> 5km	9.7%
Departure Station	Sta Depok	31.2%
	Sta Depok Baru	42.4%
	Sta Pocin	15.3%
	Sta UI	11.1%
Distance to destination stasion	<5 stations	2.3%
	5-10 stations	20.6%
	10-15 stations	43.2%
	> 15 stations	33.9%
Return Time	<16.00	3.2%
	16:00 to 20:00	84.3%
	20.00-30.30	12.5%
Working-Station Distance	<500 m	12.7%
	500m-2km	34.5%
	2 - 3 km	42%
	> 5km	10.8%
Wagon type	Woman	25.4%
	Mixed	74.6%

3 .1 Result of Assessment of Outer Model

The Outer ring model is called an outer relation or measurement model that defines each indicator in terms of its latent variables. There are three criteria to assess the outer model of Convergent Validity, Discriminant Validity and Composite Reliability [6]

The model is divided into a number of conditions, the first is the model of departures, namely (i) the departure time peak hours (06.00-08.00) and a distance away (more than 15 station stops) abbreviated DPL; (ii) the time set out peak hours (06:00 to 08:00) and the travel distance is close (less

than 15 station stops) abbreviated DPS; and (iii) time to go off hours (before 06:00 and after 08:00) and the travel distance away (more than 15 station stops) DOL abbreviated.

The second is a model home coming, namely: (i) a return of peak hours (17.00-20.00) and a distance away (more than 15 station stops) abbreviated APL; (ii) peak hours (17.00-20.00) and close travel distance (less than 15 stations) abbreviated APS; and (iii) time to go off hours (before 17:00 and after 20:00) and a distance away (more than 15 station stops) abbreviated to AOL. Here is the result of calculating the outer model using SmartPLS 2.0 software.

Table 2. Variables in the equation model SEM-PLS for Departure

Variables	DPL			DPS			DOL		
	M	SD	SL	M	SD	SL	M	SD	SL
Security (ξ_1)			**0.95**			**0.94**			**0.94**
(X_1)	3.37	1.05	0.81	3.35	1.03	0.8	3.34	1.02	0.82
(X_2)	3.32	1.18	0.84	3.31	1.16	0.83	3.3	1.15	0.82
(X_3)	3.22	1.02	0.83	3.23	1.03	0.83	3.24	1.04	0.81
(X_4)	3.4	1.11	0.81	3.4	1.12	0.8	3.41	1.1	0.8
(X_5)	3.35	1.19	0.82	3.33	1.19	0.81	3.3	1.17	0.84
(X_6)	3.44	1.18	0.8	3.41	1.16	0.84	3.4	1.15	0.81
Safety Equipment (ξ_2)			**0.93**			**0.92**			**0.92**
(X_7)	3.23	1.1	0.81	3.22	1.13	0.8	3.2	1.15	0.8
(X_8)	3.25	1.15	0.83	3.24	1.1	0.85	3.23	1.13	0.81
(X_9)	3.35	1.04	0.84	3.31	1.01	0.82	3.33	1.03	0.82
Sense of Security (η_1)			**0.94**			**0.95**			**0.93**
(y_1)	3.34	1.02	0.84	3.3	1.01	0.83	3.31	1.04	0.83
(y_2)	3.33	1.02	0.81	3.32	1.02	0.82	3.33	1.01	0.8
(y_3)	3.51	0.98	0.82	3.49	0.96	0.82	3.5	0.97	0.84
(y_4)	3.25	0.97	0.83	3.21	0.95	0.81	3.23	0.93	0.81
(y_5)	3.32	1.05	0.82	3.29	1.01	0.8	3.31	1.03	0.81
Safety (η_2)			**0.94**			**0.95**			**0.93**
(y_6)	3.42	1.14	0.84	3.41	1.13	0.85	3.41	1.13	0.83
(y_7)	3.51	1.11	0.83	3.49	1.1	0.81	3.5	1.12	0.83
(y_8)	3.48	1.13	0.81	3.46	1.12	0.83	3.45	1.1	0.8
Consciousness (η_3)			**0.93**			**0.94**			**0.94**
(y_9)	3.33	1.04	0.83	3.32	1.03	0.81	3.32	1.02	0.82
(y_{10})	3.32	1.03	0.81	3.31	1.01	0.82	3.3	1.01	0.8
Safety (Z)			**0.94**			**0.95**			**0.92**
(Z_1)	3.32	1.12	0.81	3.33	1.11	0.82	3.31	1.11	0.82
(Z_2)	3.44	1.14	0.82	3.41	1.12	0.82	3.4	1.12	0.83
(Z_3)	3.42	1.11	0.81	3.4	1.1	0.8	3.4	1.1	0.8
(Z_4)	3.45	1.13	0.8	3.43	1.15	0.83	3.43	1.14	0.82

Table 3. Variables in SEM-PLS equation model for Return

Variables	A PL			A PS			A OL		
	M	SD	SL	M	SD	SL	M	SD	SL
Security (ξ_1)			**0.92**			**0.95**			**0.93**
(X_1)	3.24	1.04	0.82	3.22	1.02	0.81	3.22	1.05	0.82
(X_2)	3.33	1.17	0.83	3.31	1.13	0.85	3.31	1.15	0.81
(X_3)	3.43	1.04	0.82	3.4	1.01	0.81	3.42	1.02	0.82
(X_4)	3.35	1.12	0.81	3.32	1.1	0.81	3.36	1.13	0.81
(X_5)	3.41	1.17	0.8	3.43	1.17	0.8	3.4	1.15	0.85
(X_6)	3.38	1.16	0.84	3.37	1.19	0.82	3.37	1.14	0.82
Safety Equipment (ξ_2)			**0.92**			**0.94**			**0.92**
(X_7)	3.45	1.13	0.83	3.42	1.12	0.85	3.42	1.1	0.83
(X_8)	3.43	1.11	0.84	3.41	1.13	0.81	3.41	1.16	0.82
(X_9)	3.40	1.03	0.81	3.45	1.02	0.82	3.45	1.04	0.81
Sense of Security (η_1)			**0.93**			**0.95**			**0.93**
(y_1)	3.33	1.01	0.8	3.31	1.01	0.83	3.32	1.03	0.82
(y_2)	3.44	1.05	0.83	3.42	1.02	0.82	3.45	1.01	0.81
(y_3)	3.35	0.96	0.8	3.33	0.97	0.85	3.33	0.98	0.84
(y_4)	3.36	0.99	0.84	3.35	0.93	0.82	3.33	0.98	0.82
(y_5)	3.41	1.02	0.81	3.42	1.02	0.81	3.42	1.02	0.82
Safety (η_2)			**0.92**			**0.95**			**0.95**
(y_6)	3.63	1.12	0.82	3.62	1.12	0.82	3.62	1.15	0.82
(y_7)	3.54	1.14	0.84	3.51	1.11	0.81	3.52	1.12	0.84
(y_8)	3.45	1.11	0.82	3.46	1.14	0.82	3.43	1.12	0.82
Consciousness (η_3)			**0.92**			**0.94**			**0.94**
(y_9)	3.41	1.02	0.81	3.42	1.02	0.82	3.4	1.03	0.83
(y_{10})	3.48	1.03	0.82	3.41	1.01	0.8	3.45	1.02	0.83
Safety (Z)			**0.93**			**0.92**			**0.95**
(Z_1)	3.31	1.14	0.82	3.32	1.11	0.85	3.33	1.11	0.82
(Z_2)	3.33	1.14	0.83	3.34	1.12	0.83	3.32	1.15	0.84
(Z_3)	3.54	1.12	0.8	3.51	1.16	0.8	3.52	1.12	0.83
(Z_4)	3.44	1.11	0.83	3.42	1.12	0.82	3.41	1.12	0.82

3 .2 Result of Inner Model Rating

Inner models (structural model) can be evaluated by looking at *R-Square* to construct dependent, as well as shown by T*Value-and* the *path-coefficient* does have influence substantive [6] outer testing the model against Dimension of Security, safety Dimensions, Dimensional sense of security, safety dimension, and the dimension Awareness and Safety Level has meet the *convergent validity* value by a factor loading ≥ 0.70 where values are shown in *Standardized Loading.*

Some trips of model conditions can described below, the first is the departure (table 2) of the model is divided into (i) the condition of external factors DPL security-management (X_2) emergency brake equipment (X_9) has a standardized loading of 0.84, this gives the intent that the security management and emergency brake equipment is very important to note for the safety of travel. DPL

condition of the internal factors of safety-management (Y_6) has the highest loading standardized worth 0.84, it indicates that the safety management of each personal be important to increase the overall safety of the KRL trip, especially during rush hour; (ii) Conditions DPS external factors (X_8) has a standardized loading of 0.85 and is the largest internal factors (Y_6) with a standardized loading of 0.85, which shows that the condition of the emergency window into important equipment for safety support from the outside and is still associated with personal safety management is still important though short trips taken; (iii) the conditions DOL external factors (X_5) have the largest loading standardized value of 0.84 and internal factors (Y_3) it is stated that in the course of not peak feeling of security and feeling protected by security facility. The second condition (table 3) is divided into (i) the condition of APL external factors (X_6 and X_9) also has the largest loading standardized value of 0.84, the condition of the return trip with the busy time is also still showing factor security management and emergency brake condition which can increase travel safety; (ii) the condition of the APS biggest external factors (X_7) with a loading of 0.85 and an internal standardized facto (Y_3) with a standardized loading of 0.85, it is clear that the condition of the emergency exit and feeling protected by the safety facilities to be important on a short trip busy time ; and (iii) the condition of the AOL external factors (X_5) with a standardized loading of 0.85 and internal factors (Y_3) with a standardized loading of 0.84, with the perception of travel safety and feeling protected by the safety facilities at the KRL become essential to the passage of time is not busy at a distance. While Discriminant Validity is achieved because the value of the square root of the AVE each construct is greater than 0.7. Composite Reliability throughout the study variables is ≥ 0.70, this indicates that the variables in this study have met the criteria Composite Reliability So it was concluded that, all data in the full model diagram is valid and has good convergence. And overall, the models already meet the criteria Outer models (Model measurements) and Criteria Inner Model (Structural models).

   In this study, the test used is the Goodness of Fit Test which is a test suitability that aims to test whether the observed results fit with that model used in research. And based on the calculation obtained the value of Goodness of Fit of 0.758. So it could be concluded that the observation results were done in accordance with the model used or a substantial fit / good fit. Testing the hypothesis derived from testing Bootstrap with the help of SmartPLS 2.0 software. Based on calculations using smartPLS the software presented in Table 4, where the overall value of the conceptual model This study based on hypothesis testing of the path coefficient value and the value of the t-value

Table 4. Hypothesis Testing Results

Path	Path Coefficient	Standard Error	T-Value	Information
H_1	0.931	0.004	65397	Significant
H_2	0.358	0.113	3.972	Significant
H_3	0.592	0.112	5.266	Significant
H_4	0.471	0.102	4.271	Significant
H_5	0.815	0.005	53224	Significant

Based on the results of the hypothesis presented in table 5, Hypothesis 1 testing is of magnitude direct influence on the security dimension of travel safety level is equal to 0.931 with a t-value of 65.397. So it can be explained that there is a direct influence of the security dimension of the level of travel safety. In Hypothesis 2 the magnitude of influence direct dimension of safety equipment on the level of travel safety is at 0.358 with a value of 3.9 *TValue* 72. Because *TValue* value $\geq \pm 1.96$ 0 then the hypothesis is rejected, so it can be explained that there is a direct effect of the dimensions of the safety equipment on the level of travel safety. Hypothesis 3 magnitude on a direct influence on the direct effect of dimensional sense of the level of travel safety is at 0.592 with a t-value of 5.266. Because the value of t-value $\geq \pm 1.96$ then Hypothesis 0 is rejected, so it is explained that there is a direct effect of the dimensions of a sense of security to the level of travel safety. Hypothesis 4 magnitude on a direct influence on the level of safety dimension of travel safety is at 0, 471 with the value of the t-value of

4.271. Because the value of the t-value $\geq \pm$ 1.96 0 then the hypothesis is rejected, thus explained that there is a direct influence of the dimensions of the safety of the level of travel safety. Hypothesis 5 magnitude on a direct influence on the level of consciousness dimension safety trip amounted to 0.815 with a t-value of 53.224. Because the value of the t-value $\geq \pm$ 1.96 0 then the hypothesis is rejected, thus explained that there is a direct influence of the dimension of awareness of the level of safety of the trip. The coefficient is positive so it can be concluded that the influence of the fifth dimension has a direct influence on the level of safety of travel by KRL. The most dominant dimension of influence is the security dimension.

4. Conclusion

Triple-level transport models with varying departure times and returns for work purposes and long trip rates above KRL provide a variety of prominent indicators that have a great impact on the safety level of KRL users. At peak hours the condition with the condition of long trips (DPL) dimension of security has a tendency more influential, it is associated with performance conditions expected at the time was already at work. Conditions peak hours at the destination station a short distance (DPS) security dimensions that stand out mainly security dimension of mobility as well as APL and APS condition that occurs in conditions when the return to work mainly on the passengers who return to work above 21.00.

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