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Challenges and Perception on Purchase Intention of EVs in Indonesian Distribution Logistics

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Abstract: In the context of green logistics, the adoption of electric vehicles (EVs) to replace conventional vehicles is considered a strategic step to reduce greenhouse gas emissions. However, distribution actors are faced with challenges and perceptions of electric vehicles that can affect their purchase intentions. This study aims to analyze the indicators of these challenges and perceptions of purchase intention. Data was collected through a quantitative approach by distributing a survey to 100 operational logistics distributors in Indonesia and processed using SmartPLS 3 to draw conclusions. The study concludes that while challenges in adopting EV do not significantly impact EV purchase intention, positive perceptions of EVs account for 48.9% of the influence, with other factors contributing the remaining 51.1%. The results provide insights into the challenges and perceptions of distributors towards EVs, offering valuable reference material for stakeholders to develop solutions and support the implementation of sustainable logistics.

Keywords: electric vehicle, challenges, perception, logistics distribution, SmartPLS

INTRODUCTION

The problem of heat in the atmosphere that leading to global warming caused by green gas emission has become a common and even a global problem. According to (United Nations Environment Program (UNEP), n.d.) Urban activities are significant contributors to greenhouse gas emissions; estimates effect urban areas at 70% of global CO2 emissions. Moreover, rising temperatures enhance sea levels, increase the frequency of extreme weather like storms, floods, and droughts, and accelerate the spread of tropical diseases. The production of green gas emissions certainly has several identified contributors. The operational activities of companies, including transportation and logistics, can have significant effects on it (Mubarak & Rahman, 2020).

Based on study written by Muhammad Saifuddin et al. (2019), regarding to the National Greenhouse Gas (GHG) Inventory submitted to the UNFCCC, the transportation industry has continuously been the nation's second-largest source of greenhouse gas emissions. In 2014, it accounted for 20% of the nation's total GHG emissions, of which roughly 18% came from road transportation. Meanwhile, a report by the European Union states that the transport sector is accountable for nearly 28% of the overall emissions of carbon dioxide (CO2), with road transport accounting for over 70% of these emissions (Sudjoko et al., 2021).

From the whole of road transportation, from the daily traffic activity we can conclude that logistics or distribution vehicles are one of the parts of road transportations. This fact is a reminder that a solution is needed to minimize green gas emission production from road mode transportation. Therefore, substituting conventional vehicles into electric vehicles is one of the alternative solutions that can be implemented. Compared to conventional cars that operate on fossil fuels, electric vehicles produce fewer emissions. Electric vehicles can use energy to operate three to five times more efficiently than traditional vehicles (Sudjoko et al., 2021).

In the other hand, the adoption of electric vehicles (EVs) in Indonesia is still far below expectations, highlighting significant challenges in the country’s efforts to transition to the concept of green logistics, as cited by Sasongko et al. (2024). Despite having ambitious targets, the growth of 4-wheeled EVs has been slow, with total market penetration in 2022 reaching only 14,437 units, or around 1.47%. This figure represents a substantial shortfall from the target of 10% for 2022, as well as the government’s goal of achieving 400,000 EV units by 2025 across all sectors.

With these conditions, through this study, further exploration will be carried out regarding the purchase intention of electrical logistics vehicle by logistics distribution actors in Indonesia. The challenge variable (X1) and the perception of the electrical vehicle (X2) act as independent variables, in other words, the indicators of the two variables will be further analysed to determine the level of influence of these variables on the dependent variable (Y), namely the purchase intention of EVs.

Literature Review

This section provides an overview of the literature that includes the discussion of the research, the information presented is based on previous studies as well as the basis of the methodology used for this research.

Distribution Logistics

Logistics of distribution involves all the steps and tasks needed to prepare and carry out distribution. How a company uses distribution logistics depends on several factors, like its manufacturing plan, where its production sites are located, the demand in major cities, the setup of distribution centers, the available transportation (vehicles and transport network quality), and the timing of distribution activities (Straka, 2017). Distribution logistics is a part of logistics that focuses on storing, packaging, transporting, and managing products, services, and information. It represents the major components and involves the coordination of all these elements to ensure smooth movement and delivery (Straka, 2019).

Transportation

Transportation networks are central to the supply chain and form the backbone of a nation's economy. However, the transportation sector is also a major source of both greenhouse gases (GHG) and pollutants (Yee Van Fan, 2018). Transportation was managed by the management that planning of all system of goods movement in order to minimize cost and maximize service to the customers that constitutes the concept of business logistics. In

order to satisfy customer demands, efficient transportation systems make sure that goods are delivered at the appropriate time and location. Road transports are crucial for extending delivery services in air and maritime logistics, as they play a vital role in connecting airports and seaports to the final destinations in global distribution through first and last-mile transportation (Patil et al., 2023). On the other hand, the extensive use of road transport contributes to environmental issues such as pollution and carbon emissions. Previously reliant on fossil fuel vehicles, road transport is now transitioning to electric vehicles to mitigate these issues.

Electric Vehicle (EV) in logistics

In response to the global and Indonesian challenges of carbon emissions, the logistics industry, closely tied to transportation, has evolved with the concept of green logistics. This approach involves transitioning from oil-fuelled vehicles to electric vehicles. The use of two-wheeled and four-wheeled electric vehicles as a mode of land transportation is an alternative to reduce the impact of the energy crisis and air pollution (Siahaan et al., 2021).

EV Challenges

The obstacles experienced in the adoption of Electrical Vehicles prevent widespread application even with environmentally friendly benefits. The difficulties faced include the scope of infrastructure, economy, and technology. In this section, it will be described more specifically regarding the challenges of EV adoption according to previous studies.

High Initial Purchase Cost

The first challenge is related to the considerable initial cost. According to a source from The International Council on Clean Transportation, there is a data that describes the comparison of component costs which includes powertrain, direct component cost, and indirect component cost between gasoline base transportation and electric base transportation in 2017 and 2025. Broadly speaking, the cost of gasoline base transportation components has a total of $23,500; Electric Base Transportation in 2017 had a total cost of $38,133; and electric base transportation prediction in 2025, which is approximately $26,129 (Berckmans et al., 2017). Then as conveyed by Yang et al. (2022), manufacturers of equipment are responsible for 60–80% of a vehicle's manufacturing cost, so it can be concluded that the cost of components will affect the final cost of the vehicle. From these two statements, we can predict that later the final price of Electrical vehicles will be more expensive compared to conventional vehicles even though the cost of components has decreased in 2025 compared to 2017. Besides, according to the study by Brückmann et al. (2021), it concludes that resale anxiety is a significant obstacle to electric vehicle adoption, but targeted policies such as guaranteed buyback prices or depreciation insurance can help alleviate this concern and promote EV uptake. Therefore, this issue is one of the things that must be identified in the application of electrical vehicles in the realm of logistics.

Charging Infrastructure

Not only to the initial purchase cost of vehicles, adopting an electric vehicle means also considering charging infrastructure or battery replacement costs. In other words, to be able to install electric vehicle infrastructure requires additional costs. In a study, it was stated that EV users are probably going to favour mode-2 charging technology due to its standardised vehicle-to-charger connection and shorter charging time compared to mode-1. Mode-2 technology installation for residential infrastructure is estimated to cost between $2,150 and $2,300 USD (Savari et al., 2023).

Limited Range

The distance that can be travelled by electric vehicles is one of the issues because of its shorter reachability compared to conventional vehicles. For example, in a study, it is said that the mileage of an electric compact car type vehicle reaches 160 km in a fully charged condition (Shrestha et al., 2022). When compared to conventional compact cars, the mileage of vehicles in full tank gasoline conditions is 360 miles or equivalent to approximately 579 km (Madman, 2023). This of course needs to be explored further, especially in the realm of logistics vehicles.

Lack of Knowledge

Either the current amount of public infrastructure was sufficient, or that public charging was not necessary and was instead a type of mental barrier due to lack of knowledge or experience (Smart & Salisbury, 2015). In a study conducted by Alanazi (2023), this is called "business strategy" which is the way of group of business that provides goods or services. The study categorizes lack of knowledge or business strategy as one of the challenges in implementing electrical vehicles.

Perception of EVs

In this study, perception is the variable that affects purchase intention. Perception itself has a broad meaning, but it can be concluded that perception is the process of individuals in selecting, organizing, and translating captured information to form a structured and meaningful understanding of a situation (Viora, 2020). As cited in the journal by (Zhang Wenliang et al., 2022), providing consumers with information about the benefits of adopting and utilizing electric vehicles (EVs), including details on energy efficiency and performance, can enhance their understanding and perception of EVs, ultimately leading to a higher willingness to adopt them. Therefore, the indicators used to measure perception in this study consist of ease of use, additional distinguishing characteristics, reliability of goods, and popularity of the product brand (Viora, 2020)

Purchase Intention of EVs

Purchase intention for electric vehicles (EVs) is significantly influenced by environmental factors, and studies suggest that effectively conveying the long-term benefits, reliability of EVs, and enhancing public charging infrastructure can reduce perceived risks and positively impact consumer attitudes towards purchasing (Han et al., 2024). Based on study conducted by Hanjani & Widodo (2019), it is said that the purchase intention indicator according to Ferdinand (2006) consists of transactional interest, namely when consumers intend to buy a product; referential interest, namely the tendency of consumers to give a recommendation of a product to other consumers; preferential interest, that is, when the consumer has a definite reference to a product as his first choice; and lastly exploratory interest, or when consumers intend to find out more information related to the product to be purchased.

Conceptual Framework

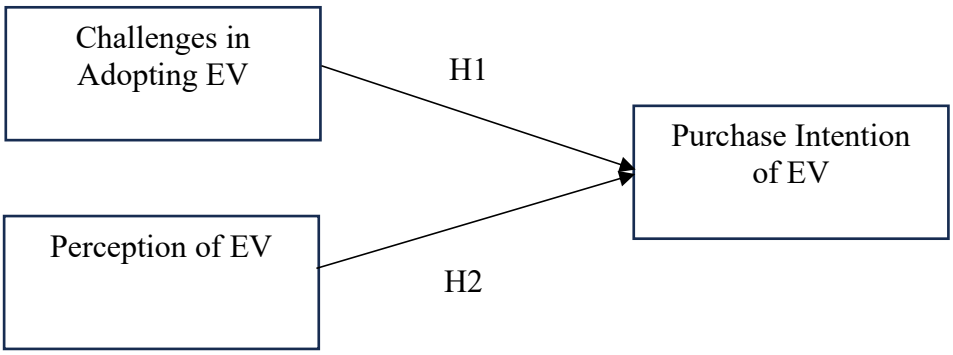

Figure 1. Research Framework

The hypothesis is arranged based on the theory and theoretical framework previously described, so from the theory and framework above, several hypotheses can be formulated as follows:

H1: Challenges in adopting EV has a positive and significant effect on purchase intention of EV

H2: Perception of EV has a positive and significant effect on purchase intention of EV

METHOD

This research utilizes a secondary sampling method. The details concerning the respondents will be discussed in the subsequent subsection on data. The initial step involves assessing the validity and reliability of the data. According to Bajpai & Bajpai (2014) validity is a test of how well an instrument that is developed measures the particular concept it is intended to measure. On the other hand, reliability assesses how well the indicators represent the variables. Reliability can be more easily understood by identifying the testing methods for stability and consistency (Mohamad et al., 2015). In this statistical evaluation, the Spearman coefficient correlation was used to determine specific reliability. Additionally, the reliability of the variables was analysed using Cronbach's alpha, and we employed the data with the partial least squares structural equation modelling (PLS-SEM) technique.

The measurement of the variables used in this study included the independent variables, namely challenges in adopting EV and perception of EV, and the dependent variable, that is purchase intention of EV. According to Lee & Paek (2014), the research discovered that 2- and 3-point response scales had less favourable psychometric properties compared to those with four or more points. However, they found no significant differences in the standard measures of validity and reliability for scales with more than four response options. The instruments in this study were measured using a Likert scale consisting of 4 points, which are (1) Strongly Disagree, (2) Disagree, (3) Agree, and (4) Strongly Agree.

Table 1 Measurements of Variable

Variable	Definition	Indicator	Source
Challenges	Difficulties and obstacles that impede the widespread adoption and effective use of EVs.	1. Initial purchase cost 2. Charging infrastructure 3. Limited range 4. Lack of knowledge	(Alanazi, 2023; Preedakorn et al., 2023)
Perception	Perception is how individuals understand and interpret information from their	1. Ease of use 2. Additional distinguishing characteristics	(Viora, 2020)

	surroundings, which ultimately influence their choices, including purchase decisions.	3. Reliability of goods 4. Product brand popularity	
Purchase Intention	Form of behaviour from consumers who wish to buy or choose a product based on experience, its use and desire for a product.	1. Transactional interest: Consumers intend to make a purchase on a product. 2. Referral interest: Consumers tend to want to provide a reference or recommend a product to other consumers. 3. Preferential interest: Consumers intend to make a product their first choice in shopping. 4. Exploratory interest: Consumers intend to find out more about a product to buy.	(Hanjani & Widodo, 2019)

RESULT AND DISCUSSION

Profile Respondent

The population size for this study could not be precisely estimated. The survey method was employed, and online questionnaires were distributed individual via a Google Form link shared through email, WhatsApp, and LinkedIn. Referring to the journal written by Shaqina Nuruly (2023), these questionnaires were specifically targeted at individuals currently working as employees or interns in Indonesian logistics companies such as logistics coordinator, distribution manager, fleet manager, driver, and other profession that relevant to logistics distribution activity to ensure relevant responses.

A final sample of 100 completed questionnaires was retained for analysis. In this study, it can be seen that the largest number of respondents come from Logistics Staff experience for 43%. The demographic category shows that 45% of respondents working in Jakarta, 30% of respondents working in West Java, and other province of Indonesia for the rests.

Of this usable sample, 68% were from respondents working in logistics companies that already have electric vehicles (EVs), while 32% were from those employed in logistics companies without EVs. Among the 100 respondents categorized by the size of their company's fleet, 40% worked in companies with 1-10 vehicles, 42% in companies with 11-50 vehicles, 6% in companies with 51-100 vehicles, and 12% in companies with more than 100 vehicles.

Regarding the number of EVs in their companies, among the 68% of respondents whose companies have EVs, 62% reported having 1-5 EVs, 9% reported 6-10 EVs, 9% reported 11-20 EVs, and 21% reported more than 20 EVs. Additionally, concerning the duration of EV usage, 29% of respondents had been using EVs for 1-2 years, 25% for 3-4 years, 34% for less than 1 year, and 12% for more than 4 years.

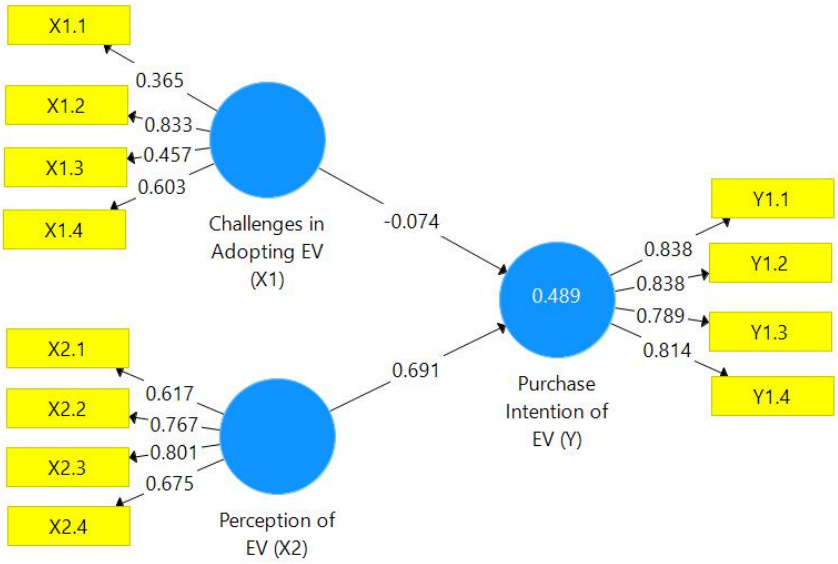

Figure 2. PLS Algorithm

The result in figure 2 shows that 12 indicators of statement for challenges in adopting EV, perception of EV, and purchase intention are not all indicators already have a value greater than > 0.70. There are still some indicators with outer loading values < 0.7. Some indicators for Challenges in Adopting EV's variable are still in the range of 0.5-0.6 is deemed adequate to fulfill convergent validity criteria (Ghozali Imam & Latan Hengky, 2015). According to the outer loading values, it indicates that the convergence validity requirement has been met, other techniques can also ensure convergent and discriminatory validity values. One way to approach this is by testing the Average Variance Extracted (AVE) for each indicator, where a value greater than 0.50 indicates a strong model (Setiawan & Eko Prasetyo Utomo, 2024).

Table 2 Outer Loading Table

Variable	Challenges in Adopting EV (X1)	Perception of EV (X2)	Purchase Intention (Y)	Result
X1.	0.365			Not Valid
X1.2	0.833			Valid
X1.3	0.457			Not Valid
X1.4	0.603			Valid
X2.1		0.617		Valid
X2.2		0.767		Valid
X2.3		0.801		Valid
X2.4		0.675		Valid
Y1.1			0.838	Valid
Y1.2			0.838	Valid
Y1.3			0.789	Valid
Y1.4			0.814	Valid

Discriminant Validity

The objectivity of discriminant validity is to ascertain whether each concept associated with a specific latent variable is distinct from those related to other variables.

Tabel 3. Discriminant Validity – HTMT

	Challenges in Adopting EV (X1)	Perception of EV (X2)	Purchase Intention (Y)
Challenges in Adopting EV (X1)	0.592		
Perception of EV (X2)	-0.064	0.719	
Purchase Intention (Y)	-0.118	0.695	0.820

According to Ramayah et al. (2017), as cited in (Fauzan Tribowo et al., 2023), if the HTMT value is below 0.85, it indicates that there are no issues with discriminant validity. In other words, it suggests that the model can effectively differentiate between categories. Referring to Table 3 above, the discriminant validity test shows that the HTMT value is less than 0.85, confirming that there is no problem with discriminant validity.

Reliability Test

The reliability test is carried out to test whether the variables in a research questionnaire are reliable.

Table 4. Construct Validity and Reliability Table

	Crobach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)	Result
Challenges in Adopting EV (X1)	0.412	0.373	0.662	0.350	Not Reliable
Perception of EV (X2)	0.685	0.703	0.809	0.517	Reliable
Purchase Intention (Y)	0.837	0.838	0.891	0.672	Reliable

Based on the validity and reliability test results, two indicators used in this study are valid and reliable, with a load factor result > 0.5 (Herniyanti et al., 2023).

R-Square

Table 5. R-Square

Variable	R square	R square adjusted	Result
Purchase Intention	0.489	0.479	Moderate

As cited in Herniyanti et al. (2023), Herfiyanto (2018) classifies R-square values as follows: 0.67 or higher indicates a strong relationship, 0.33 and higher indicates a moderate relationship, and under 0,33 indicates a weak relationship. In Table 5, the bootstrapping method reveals that the R-square value for consumer purchasing decisions is 0.489, or 48.9%. This implies that 51.1% of the variability is not explained within the context of this research.

F-Square

The R-squared value obtained from the previous calculation is 0.489 (48.9%), with 2 independent variables (k) (Challenges in Adopting EV and Perception of EV). The total sample size (n) used was 100, and the significance level (α) applied was 5%. The F-value was then calculated using the following formula:

$$F = \frac{R^2(n-k-1)}{k(1-R^2)}$$

$$F = \frac{0{,}489^2(100-2-1)}{2(1-0{,}489^2)}$$
$$F = \frac{23{,}19}{1{,}52}$$
$$F = 15{,}24$$

Then the F table value is obtained through the F table with a significance value of 5%, as follows:

$$Ftabel = F\alpha(k, n-k-1)$$
$$Ftabel = F0{,}05\ (2{,}100-2-1)$$
$$Ftabel = F0{,}05\ (2{,}97)$$
$$Ftabel = 3{,}09$$

Based on the calculation of the F test above, it is obtained showing the value of Fstatistics > Ftable with the results of Fstatistics 15,24 > Ftable 3,09 indicating that the variables Challenges in Adopting EV (X1) and Perception of EV (X2) affect the Purchase Intention (Y) by 48.9% (R-Square).

Q-Square

As mentioned by Wijaya et al. (2021), according to Ghozali & Latan (2015), research models with a Q-square score above 0 (zero) are considered to have good predictive relevance; on the other hand, models with a value below 0 (zero) are considered to have insufficient predictive relevance. Since 0.308 Q-square value is greater than zero, it can be said that the research model already possesses predictive relevance, which indicates that it is applicable to this study and has the ability to forecast the relationship between the variables under investigation.

Table 6. Q-Square

	SSO	SSE	Q^2 (=1-SSE/SSO)
Challenges in Adopting EV (X1)	400.000	400.000	
Perception of EV (X2)	400.000	400.000	
Purchase Intention (Y)	400.000	276.611	0.308

Model Fit

Model fit is a metric that indicates how closely the proposed model aligns with the empirical data being analysed. if it is greater than 0, the model is considered to have a good fit, while a value below 0 suggests the model does not adequately represent the data (Peterson et al., 2020) (Perry et al., 2015). The model fit table below shows a value of 0.090, which indicates that the model has an acceptable but not perfect fit.

Table 7. Q-Square

	Saturated Model	Estimated Model
SRMR	0.090	0.090

Hypotheses Test

Table 8. Path Coefficient & T-Statistic (Bootstrapping)

Path Coefficients	Original Sample	Sample Mean	Standard Deviation	T statistics	P values	Result
Challenges in Adopting	-0.074	-0.093	0.086	0.868	0.386	Rejected

EV -> Purchase Intention of EV						
Perception of EV -> Purchase Intention of EV	0.691	0.693	0.058	11.809	0.000	Accepted

Impact of Challenges in Adopting EV on Purchase Intention of EV

Results of statistical tests on the estimated value of the negative impact of challenges in adopting EV on purchase intention of EV, there are T-statistic values (0.868) < T-table (1,985) and p-value (0,386) > 0,05. Based on these results, it can be concluded that H1 is not accepted because the challenges in adopting EV have a negative and have no significant influence on purchase intention of EV. In other words, high initial purchase of cost, charging infrastructure, limited range, and lack of knowledges do not affect the level of purchase intention of logistics distribution actors

Impact of Perception of EV on Purchase Intention of EV

Results of statistical tests on the estimated value of the positive impact of perception of EV on purchase intention of EV, there are T-statistic values (11.809) > T-table (1,985) and p-value (0,000) < 0,05. Based on these results, it can be concluded that H2 is accepted because perception of EV has a positive and significant influence on purchase intention of EV. It can be concluded that the perception of distributors about EVs by considering ease of use, additional distinguishing characteristics, reliability of goods, and product popularity have an effect on the purchase intention of EVs. The findings of this research are consistent with those of a previous study conducted by (Hanjani & Widodo, 2019), which found that perception variable is significantly affects purchase intention.

CONCLUSION

After conducting research on the challenges of adopting electric vehicles (EVs) and the perception of EVs in influencing purchase intention among logistics distribution actors, the researcher concluded that the challenge in adopting EV has no significant effect on purchase intention of EV. Factors such as high initial costs, charging infrastructure, limited driving range, and lack of knowledge do not deter logistics distribution company from purchasing EVs. In contrast, the second hypothesis demonstrates that factors like ease of use, unique features, reliability, and product popularity positively influence logistics distribution actors' interest in purchasing EVs. The R-Square value of 0.489 in Figure 2 indicates that 48.9% of the variation in purchase intention is explained by the perception of EVs.

Implications

The findings of this study have significant implications for the adoption of electric vehicles (EVs) in the logistics sector in Indonesia. Despite initial concerns regarding high purchase costs, charging infrastructure, range limitations, and lack of knowledges, these challenges do not seem to deter distributors from purchasing intent. In contrast, the decision to adopt EVs is largely driven by perceptions of electric vehicles, such as ease of use, unique characteristics, reliability, and market popularity. This suggests that efforts to promote EV adoption should focus on increasing these positive perceptions, as they have a considerable influence on purchase intent. In addition, the study showed that almost half of the decision-making process was influenced by other factors not explored in this study, highlighting the need for further investigation into these variables. Stakeholders and policymakers aiming to increase EV adoption in logistics should consider strategies that reinforce favourable perceptions of EVs while addressing unidentified factors that can influence decision-making. This approach will not only support efforts to reduce greenhouse gas emissions, but also the transition to sustainable logistics.

Research Limitation

The results taken from this study cannot be separated from limitations such the scope of the respondents' companies is mostly from West Java and Jakarta with 100 as the amount of respondent, therefore it is necessary to further identify challenges from other regions outside West Java and Jakarta. This study also uses two dependent variables with a possible influence on the independent variable of 48.9%, other variables that may have an influence on purchase intention among logistics distribution actors need to be further researched.

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