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Multi-Generational Analysis on Behavioral Intention to Use Public Transportation using Structural Equation Modeling: Evidence from Indonesia

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Abstract. Air pollution and traffic congestion are significant challenges in Indonesia, particularly Jakarta. These challenges arise mainly from the rapid increase in private vehicles in recent years, leading to congested roads, environmental issues, and health risks due to emissions. Therefore, this study examines the factors influencing the inclination of Behavioral Intention (BI) of Generations X and Y to use public transportation. It focuses on Generation X and Y (Millennials) who use public transit and private vehicles in Jakarta City. The study adopted a model that combines the Theory of Planned Behavior (TPB), the Technology Acceptance Model (TAM), Environmental Concern (EC), and demographic factors. The conceptual model was validated through expert interviews. The gathered data were then analyzed using Structural Equation Modeling (SEM), and program recommendations were derived from the interviews. The result shows that only EC influences the BI of Generation X. Meanwhile, the BI of Generation Y is controlled by Perceived Ease of Use (PE), Perceived Usefulness (PU), Subjective Norm (SN), and EC. The recommended programs are introducing eco-friendly public transportation options, enhancing inclusivity and accessibility for passengers, integrating public transportation modes, and improving electronic payment systems.

Keywords: Multi-Generational Analysis; Public transportation; Structural Equation Modeling (SEM); Theory of Planned Behavior (TPB); Technology Acceptance Model (TAM)

1. Introduction

Environmental pollution is a significant problem faced by the world and encountered by both developed and developing nations, including Indonesia. It ranked as the fourth leading cause of death in the world, with 4.9 million deaths per year (IHME, 2018). In addition, 123.753 people die due to environmental pollution per year in Indonesia, making it 5th leading cause of death after obesity (IHME, 2018). Based on the World Air Quality Report 2022, Jakarta, the capital of Indonesia, is globally ranks 20th as a regional capital city with an Air Quality Index (AQI) of 36.2 µg/m^3 using parameters of pollutant particles, with a diameter of less than 2.5 micrometers (PM2.5) (IQAir, 2021). These facts require policymakers to pay more attention to minimizing these negative impacts for the greater good of society.

Previous studies showed that the transportation sector was the largest contributor of CO as a contaminant in Jakarta, with a percentage of 99.94% (Darmanto and Sofyan, 2012).

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The sector is also a major cause of traffic congestion in the busiest hours, such as morning and evening. Promoting people to use public transportation could reduce these problems (Black and Black, 2009). The use of Bus Rapid Transit (BRT) TransJakarta and Commuter Line (KRL) has increased from 2015 to 2022, as well as Mass Rapid Transit (MRT) (BPS, 2018). However, the increase is still directly proportional to the use of private vehicles. This is evident in the data from Biro Pusat Statistik, indicating an increased growth per year between 2015 and 2021 of 5.30% and 6.48% for motorcycles and cars, respectively (BPS, 2018).

Understanding people's behavior is essential to encourage the use of public transportation (Le-Klähn, Gerike, and Hall, 2014). Furthermore, understanding generational differences might provide valuable insights into distinct behaviors, preferences, and attitude (ATT) toward various aspects of life, including transportation choices. The generational views changes can also be used to inform long-term transportation planning for policymakers and transportation planners. This understanding also enables designing strategies to address each generation's needs and preferences. From a business perspective, analyzing generational differences increases customer satisfaction and loyalty, contributing to a more sustainable transportation system.

The theory of Planned Behavior (TPB) has been widely used in predicting and explaining the behavior of an individual across a variety of disciplines to understand future behavior (Bae and Chang, 2021; Ajzen, 1985). Travelers could perceive public transportation, such as BRT, MRT, and Light Rail Transit (LRT) as a new technology. Therefore, previous studies used the Theory of Technology Acceptance Model (TAM) to understand the behavior of acceptance in the context of information technology. Many individuals, irrespective of age, have accepted public transportation, leading to distinct generational segments among users, including Generations X and Y (Millennials). The differences in the generation of users could affect the behavior in the choice of transportation mode (Chen and Chao, 2011).

Only a few studies specifically addressed the views of Generations X and Y in public transportation usage using TPB and TAM methods. Hence, this study aims to determine the factors that could promote the behavior intention of Generations X and Y in using public transportation daily. These factors might help policymakers develop programs to attract both generations to use public transit.

2. Literature Review

2.1. Public Transportation in Jakarta

Public transportation significantly reduces traffic congestion and air pollution in many countries (Teodorovic and Janic, 2016). In Jakarta, BRT have attracted so many commuters for their daily activities and it consists of adequate facilities and infrastructure, such as a computerized ticketing system (Wahyuni, 2012). Other transportation modes in Jakarta include Angkutan Kota or Angkot; some of them have utilized technology-based payments. Moreover, MRT in Jakarta was built because the TransJakarta lane could not reduce congestion due to the overlaps of the bus lane and existing road (Anwar *et al.,* 2015). LRT development will connect Jakarta with surrounding cities, such as Bekasi, Depok, and Bogor. In addition, the Commuter Line (KRL) in Indonesia is currently the most utilized transportation mode by those who live in urban areas, providing daily transportation mode for workers living in the periphery of Jakarta.

2.2. Generation Gap

Strauss and Howe (1991) divided generations based on the same birth period and the similarity of historical events characterizing their formative years. Other studies also divided the generations with different labels, such as Newbold and Scott (2017), which assume Generation Y was born between 1980 and 2000. Strauss and Howe (1991) also believe that Generation Y was born between 1982 and 2003.

Accurately determining the exact endpoints of each generational group presents a challenge, yet the defined periods provide shared points of reference. Generation X, born between 1960 and 1980, experienced a transformative period marked by significant cultural and economic changes. Meanwhile, Generation Y, born between 1980 and 1995, came of age during an era characterized by rapid technological innovation and the emergence of the digital age (Bencsik, Horváth-Csikós, and Juhász, 2016). Based on previous studies, each generation has different characteristics and attitudes toward technology, work, philosophy, and mobility. For example, in the context of mobility, Generation X might use private vehicles routinely, while Generation Y is more open-minded about using public transportation. However, the selection still depends on the facilities and features the service providers offer (Szmelter, 2019; Newbold and Scott, 2017).

2.3. Theory of Planned Behavior (TPB)

Ajzen developed TPB to predict and explain human behavior in specific disciplines (Fishbein and Ajzen, 1975). It is a psychological model that considers three aspects of human behavior, namely Attitude (ATT), Subjective Norm (SN), and Perceived Behavioral Control (PBC). These aspects are interrelated and affect one another, shaping a specific behavior and mediating its relationship with the actual behavior (Sharma *et al*., 2023; Ajzen, 1991).

ATT reflects the extent to which a person has a positive or negative evaluation of specific behavior. Lippa (1990) states that ATT is an evaluative response to a particular object. SN originates from an individual perception of the inclination of essential people in life regarding a particular behavior (Ajzen, 1991). PBC reflects the extent to which a person perceives one specific behavior to be under control. According to Chen and Chao (2011), ATT, SN, and PBC positively and significantly affect switching intention toward public transportation.

2.4. Technology Acceptance Model (TAM)

TAM is a theory commonly used in the context of technology adoption to examine acceptance by individuals (Candra, Nuruttarwiyah, and Hapsari, 2020; Davis, 1989). It includes Perceived Usefulness (PU) and Perceived Ease of Use (PE) as the predecessors of ATT in the technology adoption context (Hong, 2018). Previous works suggested integrating TAM with other theories that had a variable associated with human or social factors to increase the prediction strength and clarity (Venkatesh and Davis, 2000). Candra, Nuruttarwiyah, and Hapsari (2020) utilized TAM by incorporating e-trust variables to provide insight into the determinants of consumer interest. PE is the extent to which an individual believes that using particular systems would significantly reduce effort. Meanwhile, PU is the extent to which an individual believes using particular systems would increase performance (Davis, 1989).

2.5. Structural Equation Modeling (SEM) and Partial Least Square (PLS)

SEM is a multivariate analysis technique used to test the relationship between recursive and non-recursive complex variables to obtain an overall picture of the model (Hair *et al.,* 2021). The component of the SEM model consists of latent and observable variables, as well as structural and measurement models (Mustakim *et al*., 2023). It also

could explain the presence or absence of relationships between variables. Moreover, PLS-SEM can avoid two problems CB-SEM faced: inadmissible solutions and factor indeterminacy (Ghazali *et al*., 2023; Fornell and Bookstein, 1982).

In PLS-SEM, there are two validity measurements, namely convergent and discriminant validity. Convergent validity measures the correlation between different indicators in the same construct, while discriminant measures the correlations between the build and those in the study model. The test is successful in convergent validity when the Average Variance Extracted (AVE) value is greater than 0.5. A high AVE value shows that the latent variables could explain more than half of the indicator variants in the average (Hair *et al.,* 2014).

2.6. Multigroup Analysis (MGA) and Measurement Invariance of Composite Models (MICOM)

PLS multigroup analysis was used to determine the significant differences between groups in the PLS model. Before carrying out MGA testing, the Measurement Invariance of Composite Models (MICOM) procedure must be performed to determine whether the measurements of the outer models between groups are the same. The lack of measurement invariance shows that the same construct significantly differs in groups (Henseler, Ringle, and Sarstedt 2016). In PLS-MGA testing, the difference between the path coefficients for different groups is significant when $p < 0.05$. MGA testing is carried out when there is measurement invariance. Furthermore, the MICOM procedure is a three-step process including configural invariance, compositional invariance, and scalar invariance analysis.

3. Methodology

This study began by determining the theories of TPB and TAM that could influence the behavior in using public transportation. Figure 1 shows the conceptual model previously developed by Widjaya and Ardi (2020).

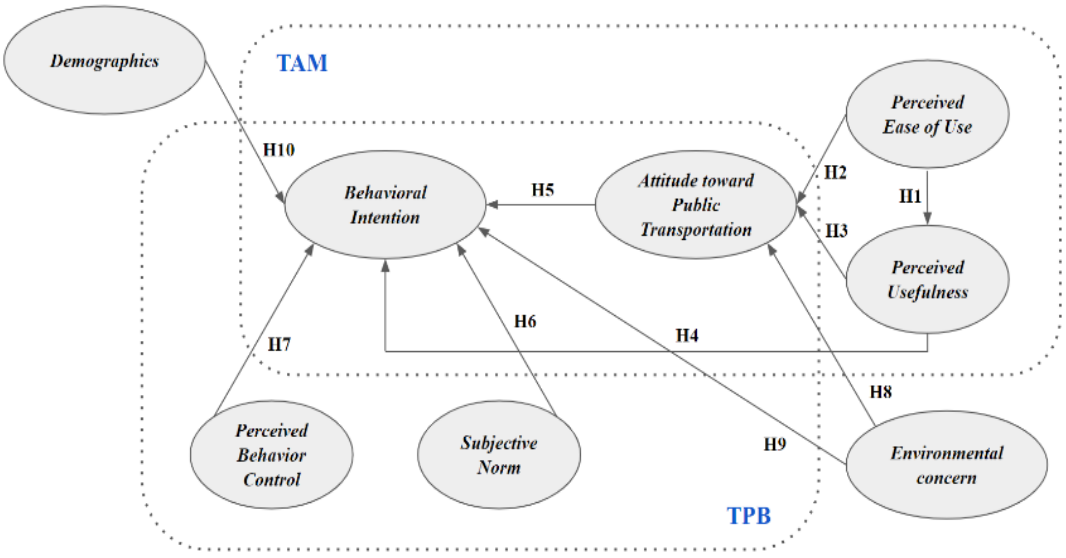

Figure 1 Conceptual Model

Experts from academia and non-governmental organizations assisted in developing the conceptual model in Figure 1. Experts were selected based on proficiency in academic or study fields, decision-making roles, and practitioner experience (Baker, Lovell, and Harris, 2006). After the model and hypotheses were developed, the questionnaire for the primary survey was designed and tested using pilot testing.

Table 1 represents the hypotheses formulated to understand the cause-and-effect relationship of the researched problem.

Table 1 Hypothesis

	Hypothesis	Sources
H1	Perceived ease of use (EU) has a positive effect on perceived usefulness (PU)	Chen and Chao (2011)
H2	Perceived usefulness (PU) has a positive effect on attitude (ATT) toward public transportation	Chen and Chao (2011)
H3	Perceived ease of use (EU) has a positive effect on attitude (ATT) toward public transportation	Chen and Chao (2011)
H4	Perceived usefulness (PE) has a positive effect on behavioral intention (BI))to use public transportation	Chen and Chao (2011)
H5	Attitude (ATT) toward public transportation has a positive effect on behavioral intention (BI) to use public transportation	Chen and Chao (2011)
H6	Subjective norm (SN) has a positive effect on behavioral intention (BI) to use public transportation	Chen and Chao (2011)
H7	Perceived behavioral control (PBC) has a positive effect on behavioral intention (BI) to use public transportation	Chen and Chao (2011)
H8	Environmental concern (EC) has a positive effect on attitude (ATT)	Borhan *et al.* (2014)
H9	Environmental concern (EC) has a positive effect on behavioral intention (BI) to use public transportation	Borhan *et al.* (2014)
H10	Demographics have a positive effect on behavioral intention (BI) to use public transportation	Anwar *et al.* (2017)

This study employed a questionnaire and then tested it in a pilot analysis. The target respondents were individuals from Generations X and Y, aged 19 to 55, who engage in daily activities in DKI Jakarta and use public or private transportation at least three times a week. This study then utilized 138 and 151 respondents for Generation X and 151, respectively. The sample size was appropriate and proportional as it exceeded the minimum requirement. This rule suggested that the minimum sample size should be at least ten times the largest number of structural paths directed at a particular latent variable (Wang *et al.*, 2023; Barclay, Thompson, and Higgins, 1995). Since the largest number of paths in this study is six arrows, at least 60 samples were required for each of Generations X and Y.

The pilot testing was used to determine the reliability (Cronbach $\alpha \geq 0.70$) and validity (AVE ≥ 0.50) of the questionnaire and distributed in Jakarta when the requirements were met (Irtema, 2018). In PLS-SEM, the tests include validity, reliability, R2, Q2, goodness of fit, hypotheses, and MICOM. These tests were carried out to determine the relative weights and significance of the criteria and sub-criteria. PLS-SEM was used in this study because this method does not have a limit on the number of variables (Hu *et al.,* 2016).

4. Results and Discussion

4.1. Total Effect Results

Figure 2 shows that Environmental Concern (EC) had the highest effect on Behavioral Intention (BI) to use public transportation. Therefore, Behavior Intention (BI) to use public transportation increases along with an increase in EC. Here, BI increased with the increase of PE, PU, SN, and PB in all three models: X generation, Y generation, and combined model. However, in the PBC of the Generation Y model, BI increases along with the decrease in PBC. The significant factors on behavior intention in the whole sample model are EC, PE, PU, and SN, while for Generation X, it is EC, and for Y, it is EC, PU, PE, and SN. PBC does not have a significant effect on BI in all three models. This showed that PBC had no influence on the use or not of public transportation.

EC has the highest value of total effect in all three models, showing the most significant impact. This could be caused because knowledge about the environment and ATT are

closely related. Therefore, pro-environment respondents understand the impact of using private vehicles and tend to use public transportation (Flamm, 2009). In the Generation X model, only EC significantly affects BI. Several factors do not influence Generation X's decision to use public transportation. These factors include cost savings, time and effort, ease of use, increased efficiency and convenience, freedom to use public transportation, and the influence of the surrounding environment, such as family, friends, and neighbours.

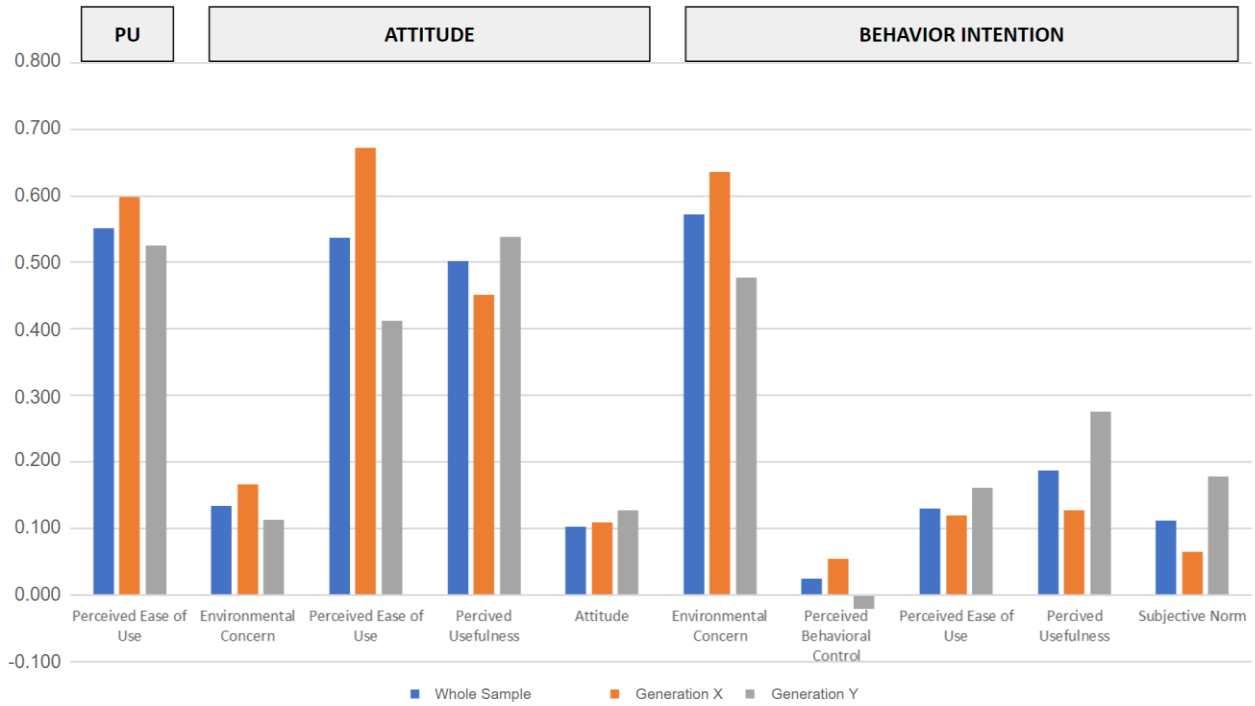

Figure 2 Total Effect Influence on the Whole Sample, Generation X, and Y Models

4.2. Hypothesized Test Result for Whole Sample Model, Generations X and Y (Millennials)

The acceptance or rejection of the hypothesis depends on the path coefficient (β), t-value, and p-value. The path coefficient value is obtained through SmartPLS bootstrapping results. The result showed several similarities in behavior for Generations X and Y, such as rejecting the hypothesis for both H5 and H7. The result of H5 showed that the positive or negative evaluation of public transport service attributes perceived by Generations X and Y did not affect the decision to use public transportation. The result differs from a previous study where ATT influenced the switching intention from private vehicles to public transportation (Chen and Chao, 2011). However, the result is consistent with the report of another previous study that an individual ATT toward public transit does not directly affect behavior (Fu and Juan, 2017). The result showed that the comfort of travel, public transportation, security, and specific experiences felt in using public transportation are not very important for Generations X and Y. Table 2 shows the results of the hypothesis comparison of each variable.

In the case of H7, the use of public transportation is seemingly more complex than private vehicles for Generations X and Y. The result was consistent with a previous study conducted by Chen where PBC had no significant effect on switching intention to public transportation (Chen and Chao, 2011). This study further showed that users felt more inconvenience or difficulty in using public transportation than using a car. Another study supported the result that PBC has no significant positive effect on intention (Shi, Wang, and Zhao, 2017).

Table 2 Hypotheses Comparison Results

Code	Variable	Hypothesis	Whole Sample	Generation X	Generation Y (Millennials)
H1	Perceived Ease of Use	Perceived Ease of Use has a positive effect on Perceived Usefulness	Accepted	Accepted	Accepted
H2		Perceived Ease of Use has a positive effect on attitude toward public transportation	Accepted	Accepted	Rejected
H3	Perceived Usefulness	Perceived Usefulness has a positive effect on attitude toward public transportation	Accepted	Accepted	Accepted
H4		Perceived Usefulness has a positive effect on behavioral intention	Accepted	Rejected	Accepted
H5	Attitude	Attitude toward public transportation has a positive effect on behavioral intention	Rejected	Rejected	Rejected
H6	Subjective Norm	Subjective norm has a positive effect on behavioral intention	Accepted	Rejected	Accepted
H7	Perceived Behavioral Control	Perceived Behavioral Control has a positive effect on behavioral intention	Rejected	Rejected	Rejected
H8	Environmental Concern	Environmental Concern is positively related to the behavioral intention towards public transportation use mediated by attitude	Accepted	Accepted	Rejected
H9		Environmental Concern is positively related to the behavioral intention to use public transportation	Accepted	Accepted	Accepted

This is due to the large number of respondents using private vehicles. Consequently, the use of public transportation might become more complicated than private vehicles in the context of "ease of use" and "convenience" (Shi, Wang, and Zhao, 2017).

H2, stating that PE positively influences ATT, was accepted in the Generation X model and rejected in Y. The hypothesized result for the Generation X model is consistent with a previous study (Chen and Chao, 2011), where PE has a significant positive effect on ATT toward public transportation. Generation Y model showed that PE of using new technology or public transit did not influence in terms of evaluating the choice to use public transport. This is because Generation Y has more experience in using modern technology in their daily lives and adapts more quickly (Gures *et al.,* 2018). Therefore, PE's effect on an individual with more experience in using a particular technology or transportation might be less critical in adopting a specific transportation system (Cheng and Huang, 2013).

4.3. Multigroup Analysis Results

Table 3 shows the differences in significance between Generations X and Y regarding the direct impact on the use of public transportation. The result showed that only PE variable towards ATT had a significant difference in Generations X and Y models. Meanwhile, other variables did not have substantial differences. This showed that the relationship of ATT, EC, PBC, PU, and SN towards BI was almost the same in both generations.

Table 3 Multigroup Comparison Test Results

Path Relationship	Path Coefficients Original (Generation X)	Path Coefficients Original (Generation Y)	Path Coefficients Diff.	P-Value	Evaluation Significance
ATT → BI	0.109	0.127	-0.019	0.916	No
EC → ATT	0.167	0.114	0.053	0.504	No
EC → BI	0.617	0.463	0.155	0.110	No
PBC → BI	0.054	-0.021	0.076	0.555	No
PE → ATT	0.402	0.129	0.273	0.020	Yes
PE → PU	0.598	0.525	0.073	0.426	No
PU → ATT	0.451	0.538	-0.087	0.399	No
PU → BI	0.079	0.207	-0.128	0.368	No
SN → BI	0.065	0.179	-0.114	0.237	No

4.4. Recommendation of Programs

Based on the analysis above, the factors influencing the decision of Generations X and Y to use public transportation are EC, PE, PU, and SN. These factors could be used as a basis for creating programs to increase users of public transportation, such as introducing more eco-friendly public transportation options, enhancing inclusivity and accessibility, incorporating Near Field Communication (NFC) or a technology used for payment systems (Liébana-Cabanillas, Molinillo, and Ruiz-Montañez, 2019), integrating modes of public transportation, as well as leveraging influencers and public figures to promote public transportation usage and transparent information dissemination.

For instance, promoting eco-friendly growth through public transportation and sustainable commuting can increase the number of public transport users by creating a more attractive and convenient transportation option (Jing *et al.,* 2022). Furthermore, other studies have identified increasing the accessibility of public transport as one of the strategic programs (Gutman, Vorontsova, and Seredin, 2021).

5. Conclusions

In conclusion, environmental concerns positively and significantly influenced the intention to use public transportation in Generation X. In Generation Y, the factors included PE, PU, EC, and SN. No valid indicators were found in demographic characteristics, showing that these factors did not affect behavior intention in using public transportation and should be eliminated. EC was the most influential factor in Generations X and Y in behavior intention. This study excluded other important latent variables, such as service quality, satisfaction, and habit, to comprehend individuals' responses to the quality of services provided by public transportation.

Interestingly, our study found no significant differences in the determinant of behaviors to use public transport between the two generations. It might show that generational membership has limited influence on behavior intention in this regard, and the differences appear merely because they face different stages of life. This study has limitations that might offer improvements for future studies. Firstly, this study omits the data from Generation Z, whose characteristics and behaviors might differ from the X and Y generations. Secondly, this study limits the scope of the work by incorporating the samples merely from the city of Jakarta. Future work might include a larger sample size from other urban areas, especially cities in the Jakarta Greater Are.

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