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Research Paper

Measurement of public acceptance of TDM policies using combination of public policy acceptance (PPA) and value belief norm (VBN) approach

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ABSTRACT

One strategy to overcome the problem of imbalance between the demand and supply of road transportation that causes congestion is to apply transport demand management (TDM). TDM is a series of transportation policies aimed at achieving sustainable transportation by reducing the use of private vehicles and prioritizing public transport and/or non-motorized vehicles. The level of public acceptance of TDM largely determines the success of TDM implementation. Through the Value Belief Norm Theory approach, it can be seen that public acceptance of TDM policies will be influenced by how high the norm of community partiality towards the environment. The level of public acceptance of a TDM regulation can also be measured by the Public Policy Acceptance (PPA) Model. The results of the study proved that acceptance of TDM strategy implementation was quite significantly influenced by the pro-environment attitude of the community. The PPA model result showed that people tend to be skeptical of the implementation of TDM policies.

1. Introduction

Discussing sustainable transportation always joggles aboutcitizen's behaviour issues. Extensive car use with nonrenewable fuels is the main problem of road transportation as the imbalance in demand growth (movement using private vehicles) with supply growth (road transportation network infrastructure) (Kresnanto, 2019; Thomas et al., 2020) rapidly increases environmental problems (e.g. congestion and air pollution) (Zhang and Batterman, 2013; Jereb, Kumperščak and Bratina, 2018; Li et al., 2020; Rocha Filho et al., 2020; Gunawan, 2021). Concern about environmental issues brings more initiatives about pro-environmental behaviour in transportation (Mikiki and Papaioannou, 2012), which addresses sustainable transportation. Travel behaviour set with boundaries is believed to be a strategic way to make behaviour change movement (Eriksson, Garvill and Nordlund, 2006). Transport Demand Management (TDM) is one of the public policies in transportation embedded in the comprehending way to trigger citizen's changing behaviour. Through various schemes (e.g. tax vehicle, fuel tax, cordon pricing, road pricing, parking management, working hours setting), TDM offers alternative strategies to reduce transportation problems (Eriksson, Garvill and Nordlund, 2006; Bao et al., 2020; Kresnanto and Putri, 2023).

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Meanwhile, the prior research highlights the acceptability of TDM measures as a hierarchical set of beliefs (Eriksson, Garvill and Nordlund, 2006). As an early model for the acceptability of TDM measures, this research depicted fundamental beliefs that develop the Public Policies Acceptance (PPA) approach can work and measure (Loukopoulos, 2005). In urban mobility, public policies and individual concern about the environment and sustainability play essential roles in developing pro-environmental behaviour in transportation (Steg and Vlek, 1997; Steg, 2007). In framing the interrelation between changing behaviour in urban transportation, Erikkson proposed the models which joined the value belief norm (VBN) theory (Stern et al., 1999) and public policies acceptance approach (Oxley, 2010; Zvěřinová, Ščasný and Kyselá, 2013), which specified willingness to reduce car use (Eriksson, Garvill and Nordlund, 2006; Gärling and Schuitema, 2007).

According to Eriksson's model, they discussed how personal norms represent personal value as the principal factor influencing the willingness to reduce cars. Erricson also stated that problem awareness directly influences personal norms in the context of pro-environmental behaviour. Addressing the acceptability of TDM, Eriksson connects the VBN theory with the PPA approach, which consists of freedom, own reduction, effectiveness, and fairness as an antecedence to influence TDM acceptability as the product of public policies.Eriksson's model is a valuable conceptual background that enlarges the idea of comprehending the pro-environmental behaviour model, specifically to propose the relationship between VBN and TDM (as the product of the PPA approach), but not sufficient to explain how the result of TDM measurement impacted on intention or switching to the actual behaviour. One of the well-known behavioral theories in environmental psychology (Abrahamse, 2019) is the Theory of Planned Behavioral (Ajzen, 1991). The TPB stated that the behaviour is directly determined by behavioural intention as personal motivation, attitudes towards the behaviour, subjective norms and perceived behavioural control (Ajzen, 1991). TPB is the best framework to clarify the sustained behaviour change as a significant challenge (Zavareh et al., 2020), which has to be solved with the comprehending approach depicted from VBN theory as a personal norm and acceptance of TDM as a public policies product and behavioural theory, which can explain how each of concept is interrelated. The study examines the relationship between factors in personal norms to influence the acceptability of TDM measures, intention and behaviour. This study expands Erikkson's model by including the intention and (actual) behaviour.

2. Literature review

2.1. Transport demand management (TDM) as public policy for transportation problem solution

Behavioural changes of individual car users are believed to be a vital strategy for conducting sustainable transportation (Eriksson, Garvill and Nordlund, 2006; Steg, 2007). The willingness to reduce car use has been a factor in the VBN model to measure TDM acceptance and reflects the public policy approach in transportation (Loukopoulos, 2005; Eriksson, Garvill and Nordlund, 2006). TDM strategy is divided into two policy strategies: push and pull (Steg, 2007; Kresnanto and Putri, 2023). Pull policies encourage using non-car modes by making them attractive to car users. These policies include transit-oriented development, road reclamation, and rapid bus transit development. In contrast, a push policy discourages car use by making it less attractive, including toll roads, parking fees and guard fees (Habibian and Kermanshah, 2011). Another prior research divided TDM strategies into noncoercive (pull) and coercive (push), but in political or public policy perspectives, coercive and noncoercive have to be combined (Gärling and Schuitema, 2007) for the best result.

Then, the two major groups of strategies are divided into implementing strategies, as shown in Table 1.

The success of TDM can be measured by single occupant vehicle (SOV) trips reduced and vehicle mile travelled (VMT) reduced as key measured and fuel saved, emissions reduced, cost per vehicle trip reduced, and cost per VMT reduced as supporting measured (Thompson and Suter, 2012). Moreover, the success story of implementing TDM occurred in several cities; for example, Bellevue, Washington, managed to reduce SOV from 74.3% to 61.8% during the period 1993–2014 with the Commute Trip Reduction (CTR) program (Bellevue Transportation Commission, 2015); London applies SOV Pricing, which is by charging a fee on vehicles that only have one passenger (driver only) if entering the city. This strategy can increase public transport use and reduce accidents and pollution (Nelson, 2008); in Milan in 2015, an area pricing strategy reduced traffic by 31.1% on area pricing and 0.4% across the city in a year. This strategy can also reduce CO2 contamination by up to 35% (Beria, 2016). Furthermore, with 30 years of road pricing experience, Singapore can reduce traffic volume by 10–30% with the Electronic Road Pricing (ERP) scheme (Chin, 2005). ERP in Singapore can increase the use of public transport from 58% in 2008 to 63% in 2012. In addition, ERP can reduced CO2 pollution by up to 103 kilotons over the last ten years (The Case for Electronic Road Pricing | Development Asia, 2016), and in Jordan (Amman) was implementing Simulation using Synchro Transportation Modeling of 19 TDM strategies coupled with implementing Transportation System Management (TSM) can reduce delays at intersections and reduce fuel consumption significantly (Jrew, Msallam and Momani, 2019).

Furthermore, the results of an inventory of the success of TDM in several cities in the world, based on the type and type of strategy, can be seen in Table 2.

2.2. Value belief norm (VBN)

VPN was first developed by Stern et al. (Stern et al., 1999), who explained the influence of human values and behaviour on pro-environmental orientation. The VBN theory of environmentalism postulates that values influence pro-environmental

Table 1
TDM strategy based on literature review.

Policy Strategy	General Strategy		Operational Strategy
Push Strategy	Controlling motorized ownership	Vehicle ownership tax scheme	Progressive vehicle tax Vehicle sales tax
		Vehicle ownership restrictions	Vehicle ownership permit
	Controlling Motorized Vehicle Use	Taxes related to vehicle use	Fuel tax
		Transport infrastructure taxes and access restrictions (access management)	**Road pricing** Cordon/Area pricing Congestion pricing **Plat based restriction** Parking management Car-free day **Working hours setting**
		Subsidies for public transport/transit	Transit operational subsidies Fare subsidies
Pull Strategy	Encouraging non-motorized use	Pedestrian infrastructure improvement (walking)	Sidewalk/crosswalk Pedestrian area
		Cycling infrastructure improvement (cycling)	Bicycle lanes Bicycle parking area Bicycle service points
	Encouraging public transport use	Transit services improvement	Integrated transit services (schedule, fare) Rapid transit development (e.g. bus lanes, bus priority at the junction)Improve public transport facilities (station, bus stop, etc)

Sources:(Kresnanto and Putri, 2023).

behaviour via pro-environmental beliefs and personal norms (Hiratsuka, Perlaviciute and Steg, 2018). VBN is a framework for carrying out a normative investigation of a person and whether his attitudes and behaviour are pro-environmental. VBN theory of pro-environmental behaviour posited that pro-environmental behaviours are the result of the activation of the personal moral norms in which activated by beliefs about awareness of consequences, ascribed responsibility to act, and environmental concern about oneself (egoistic), others (social altruism) and non-human organism (biospheric) (Aziz and Ajuhari, 2014).

In implementing TDM policy, one's VBN to the environment will significantly affect the acceptance of the TDM strategy that the government will carry out. Personal awareness and personal norms on environmental conditions due to congestion will encourage public interest and participation in the success of sustainable transportation (i.e., TDM) programs. One measure that a person is interested in and desires to participate in sustainable transportation is his willingness to reduce the use of private vehicles (Jakobsson, Fujii and Gärling, 2000; Nordlund and Garvill, 2003). TDM-VBN model can be described in Fig. 1. If the community has good personal awareness (PA) and personal norm (PN) towards the environment, it will be pro to TDM policy by trying to reduce the use of private vehicles (WR).

2.3. Public policy acceptance (PPA)

In the application of regulations or policies, especially public policy, the most crucial reason that society will accept or reject is related to social-psychological factors and policy-specific beliefs about fairness (FR) and infringement on freedom (IF) (Oxley, 2010; Zvěřinová, Ščasný and Kyselá, 2013). So it can be said that public acceptance of a public policy depends very much on its views on policy, whether it will provide justice and freedom.

If TDM is seen as a form of public policy, then the framework for measuring public acceptance of TDM can be approached with PPA (Fig. 2). Measurement of TDM success in Indonesia seen from the outcome, in general, has never been done, but descriptive measurement of the level of public acceptance of how many TDM strategies have been carried out in Jakarta. This research revealed that the majority of road users are willing to participate in TDM (Rachmat and Pitaloka, 2010). Road pricing policy in some countries is considered a policy that has received much public opposition for two reasons, namely (1) it is considered unfavourable to low-income people and tourists, and (2) it is an unpopular policy related to politics because it is considered a new type of tax (Qin et al., 2022).

3. Materials and methods

3.1. Proposed SEM-based TDM acceptance framework

The analysis used the structural equation model (SEM) method. SEM allows direct analysis among several dependent (exogenous) and independent (endogenous) variables (Hair et al., 2010).

Table 2
Experience in TDM Implementation Effectiveness from Various World Cities.

Case Study	Type of Policy TDM Strategy	TDM Operational Strategy	Effectiveness Measurement	Source
Southern California	Pull Strategy	Telecommuting	Vehicle Miles Traveler (VMT) reduction (91.1%), trips reduction (1.0%), CO2 emission reduction (1.0%) (Cameron, 1991; Harvey and Deakin, 1991)	(Kusumantoro, Martha and Kipuw, 2009)
Lloyd District, Portland	Pull Strategy	Transit, bicycling, car sharing, walking and ridesharing	SOV dropped by 40% and dropped by 4.3 million peak-hour vehicle miles travelled in the last ten years	(Transportation Demand Management Case Study - EcoDistricts, no date)
Bellevue Washington	Push Strategy	Commute Trip Reduction	Reduced SOV from 74.3% to 61.8% during the period 1993–2014	(Bellevue Transportation Commission, 2015)
Milan	Push Strategy	Area pricing	Reduced traffic by 31.1% in area pricing and 0.4% citywide in a year. This strategy can also reduce CO2 contamination by up to 35%	(Beria, 2016)
Singapore	Push Strategy	Electronic Road pricing (ERP)	Reduce traffic volume by 10–30%	(Chin, 2005)
USA	Pull and Push Strategy	Combination of Monetary Incentive, public transport, transportation service	Can increase Vehicle Travel Reduction (VTR) 10–50% depending on the type of combination of wisdom	(United States. Department of Transportation, 2020)
Auckland	Push Strategy	Parking Management	Reduce vehicle trips by 8–18% and reduce the level of drive-alone by around 2–5% (Auckland Regional Council, 2000)	(Kusumantoro, Martha and Kipuw, 2009)
Amsterdam	Pull Strategy	Cycling, public transport, and enacting parking policies	63% of Amsterdam residents use their bikes daily and an estimated 61% of trips are undertaken by walking or cycling	(Thomas et al., 2020)
London	Pull Strategy	Improving public transport	Reduced private vehicle usage from 49% to 36% in 20 years	(Thomas et al., 2020)
Seattle	Pull and Push Strategy	Interventions based on integrated transport and land use planning, commute trip reduction policies, and investment in public transport	Drive-alone rates dropped from 35% to 25% (2010–2017)	(Thomas et al., 2020)

Fig. 3(a) shows the structural model framework with SEM on the proposed Public Acceptance of TDM Policies Model. This model is a combination of three theoretical approaches. The first theory is VBN, which assumes that TDM Acceptance will be influenced by one's partiality to the environment (pro-environment) because TDM is a pro-environment policy (sustainable transportation). A person's partiality to the environment is shown by the endogenous variable willingness to reduce car use (WR), which is influenced by two exogenous variants (PN and PA).

The second theory, PPA theory, views that people's partiality towards a public policy (TDM endogenous variable, the acceptance of TDM strategy (AC)) will be influenced by exogenous variables of fairness (FR) norms and belief in the absence of infringement on freedom (IF). The third theory, The Theory of Planned Behaviour (Ajzen, 1991), is to complete how this

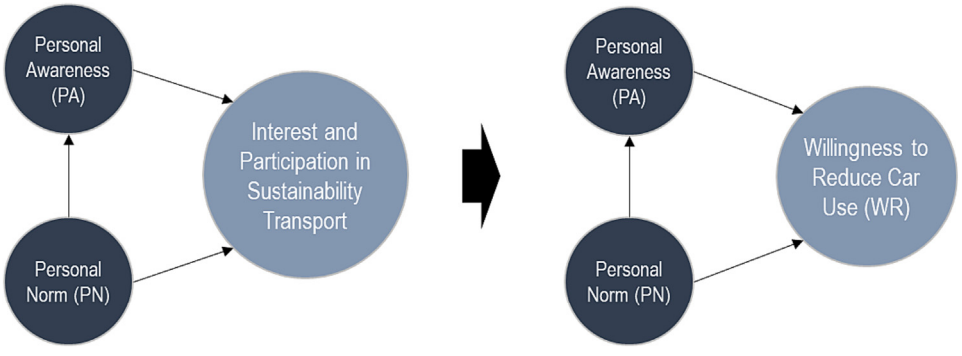


Fig. 1. Value Belief Norm Model for Sustainable Transportation (TDM Policy).

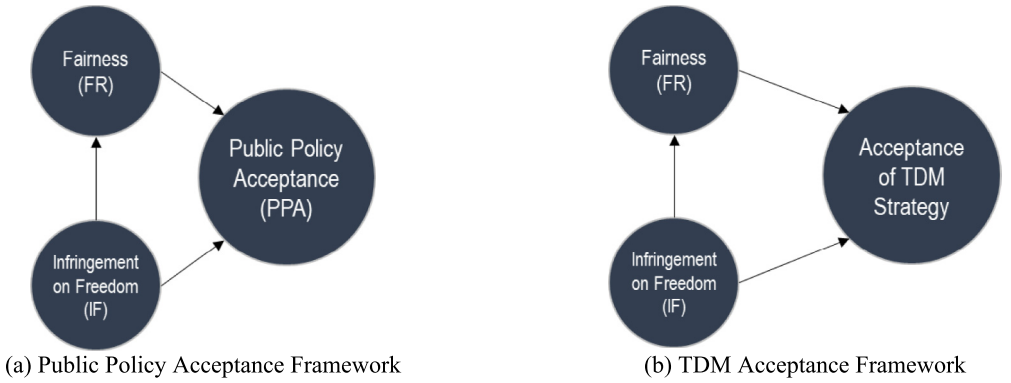


Fig. 2. Public Policy Acceptance vs TDM Acceptance Framework.

process in the VBN and PPA theory becomes an intention and realize (actual) behaviour. So, accepting a public policy, TDM will affect intentions (IN), leading to actual behaviour (BE) towards TDM. In this paper, the TDM strategy chosen to build a structural model was a TDM strategy that has been widely implemented, (1) road pricing (Chin, 2005), (2) plate license restriction (Supriana et al., 2020), and (3) working hour setting (Giuliano and Golob, 1990).

Based on the research objectives, this proposed model extends and modifies Erikkson's model. The comparison between Eriksson's and proposed models is shown in Fig. 3. Erikkson's model is connected to the willingness to reduce with all the acceptability of the TDM measure's antecedent. So, the relationship between willingness to reduce and acceptability of TDM is measured through variables such as freedom, own reduction, effectiveness, and fairness (see Fig. 3(a)). Meanwhile, the proposed model does not connect the willingness to reduce car use through the variables of freedom and fairness but directly to the TDM strategy's acceptability and interrelation with intention and behaviour (see Fig. 3(b)).

3.2. Study location, procedure, and respondents

This research was conducted by a survey to measure the indicators of the TDM Acceptance Model on respondents in the Special Region of Yogyakarta (DIY). DIY was chosen as a research location considering the fairly high growth of private vehicles, which is more than 10% per year (Kresnanto, 2019). The questionnaire was distributed randomly in July 2023 in the DIY Province region, with the respondent residential dispersion depicted in Fig. 4.

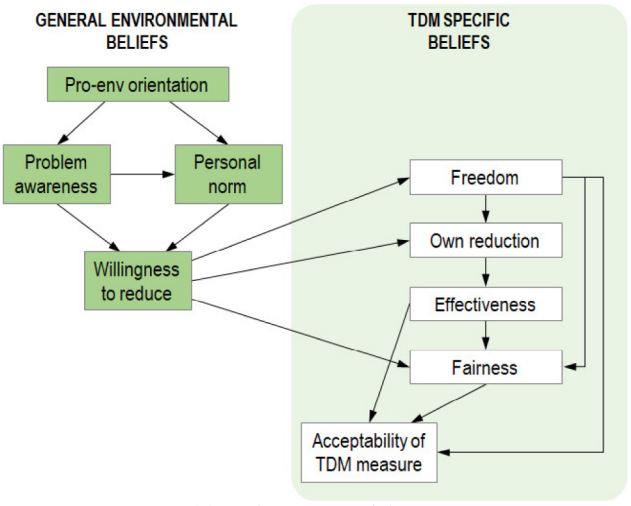
Respondents were people who travelled every day to the Yogyakarta City area. With a DIY population of 4,021,816 people, the minimum sample size based on the Slovin Formula (Ellen, 2020) with a margin of error of 5% is ≈ 400 respondents. The number of respondents obtained during the survey was 451, with the characteristics in Table 3.

3.3. Questionnaire

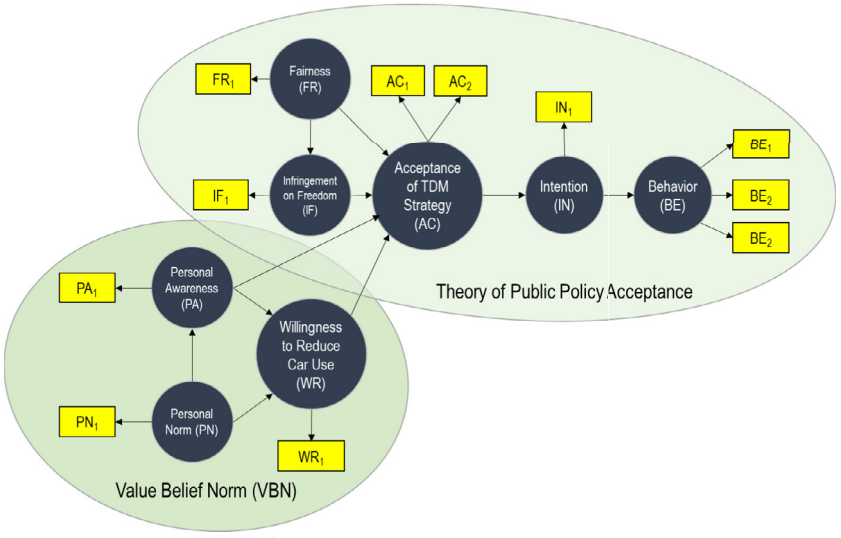
A questionnaire was designed on the TDM Acceptance Structural Model (acceptance of road pricing model, acceptance of plate-based restriction model, acceptance of working hour setting model) with the PPA and VBN combination approach as in Table 4. All question items were modified from previous research (Eriksson, Garvill and Nordlund, 2006; Jou et al., 2010; Gibson and Carnovale, 2015; Hsieh, 2022). Measurement of answers to the questionnaire used the Likert Scale 1–7 levels (1 = strongly disagree, 2 = more disagree, 3 = disagree, 4 = undecided, 5 = agree, 6 = more agree, 7 = strongly agree). These 7 Likert scales provided a much broader picture of respondent's opinions (Bernstein, 2005). Moreover, the Likert 7 scale was chosen to get responses with great accuracy. The rating scales that yielded the least reliable scores turned out to be those with the fewest response categories on several indices of reliability, validity, and discriminating power, the two-point, three-point, and four-point scales performed relatively poorly, and indices were significantly higher for scales with more response categories, up to about 7 (Preston and Colman, 2000). 7-point scales strongly correlated with t-test results (Lewis, 1993). A 7-point Likert item is more likely to reflect a respondent's proper subjective evaluation of a usability questionnaire than a 5-point item scale (Finstad, 2010).

4. Result and discussions

The three models built can be considered suitable or appropriate judging from the threshold value of Standardized Root Mean Residual (SRMR) of < 0.10 or less (Henseler et al., 2014), and the value of acceptance score Normal Fit Index (NFI) is > 0.80 (Reinard, 2006). Based on the Table 5, the value of estimated model on plate license restriction is 0.075 < 0.10 and the value of estimated model on working hour setting is 0.081 < 0.10, it means that both model indices an appropriate



(a) Eriksson's model



(b) Proposed Public Acceptance of TDM Policies Model

Fig. 3. Proposed TDM Acceptance Structural Model.

model fit. However, the model that was considered the best is the Acceptance of Working Hour Setting Model with better SRMR and NFI values compared to other models.

4.1. Descriptive analysis (VBN and PPA)

Table 6 shows the average results and standard deviations of assessment by respondents against VBN and PPA variables. In VBN, problem awareness (PA) respondents showed a good response (mean > 5) related to awareness about the bad consequences of motor vehicle pollution. Likewise with the personal norm (PN), with a mean close to 5. However, a good enough PA and PN did not guarantee that respondents will have an interest and will participate in sustainable transportation, as evidenced by the mean in WR smaller than PA and PN.

Meanwhile, the other variables had almost the same average and are at a sufficient level.

Fig. 5 depicts the respondents' response trends' results due to hierarchical beliefs from problem awareness, personal norms, and willingness to reduce car use. It shows that the bottom of the bar chart (PA) is dominated by strongly agree (green area), but shifts up above to PN, the green area gets narrower, and the top chart (WR) shows that the green area is increasingly narrow. It means that problem awareness is not necessarily followed by increasing personal norms and willingness to reduce car use but instead decreases. Based on the data, it can be seen that problem awareness in the community should be increased extensively to result better trend in pro-environmental behaviour.

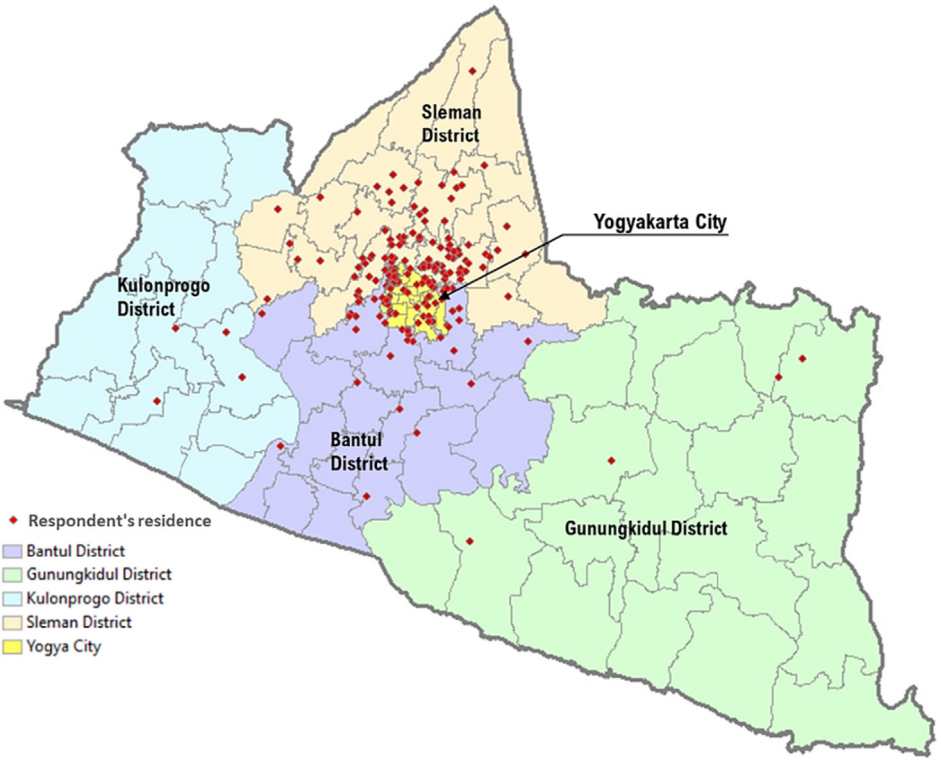


Fig. 4. Spatial distribution of respondent's residence.

Table 3
Characteristics of respondents.

Characteristics	Num of Respondents	Percent (N = 419)
Age		–
15–20	59	14.08%–
21–30	245	58.47%–
31–40	55	13.13%–
41–50	48	11.46%–
51–60	8	1.91%
> 60	4	0.95%
Gender		
Male	251	59.90%
Female	168	40.10%
Education Level		
Elementary school	3	0.72%
Junior high school	19	4.53%
Senior High School	251	59.90%
Diploma	17	4.06%
Bachelor's Degree	115	27.45%
Master's Degree	11	2.63%
Doctoral	3	0.72%
Income per Month (Rupiah – Rp)		
< Rp2.500.000	277	66.11%
Rp2.600–000 - Rp5.000.000	85	20.29%
Rp5.100–000 - Rp7.500.000	26	6.21%
Rp7.600–000 - Rp10.000.000	15	3.58%
Rp10.100–000 - Rp12.500.000	7	1.67%
Rp15.100–000 - Rp20.000.000	5	1.19%
> Rp20.000.000	4	0.95%
Main Transport Mean		
Walking	14	3. 34%
Cycling	6	1. 43%

(*continued on next page*)

Table 3 (*continued*)

Characteristics	Num of Respondents	Percent (N = 419)
Motorbike	348	83. 05%
Car	43	10. 26%
Transit	8	1. 91%
Purpose of Daily Travel		
Working	259	61. 81%
Shopping	2	0. 48%
Studying for Bac'elor's Degree	49	11. 69%
Studying in Junior/Senior High School	66	15. 75%
Other	43	10. 26%

Table 4
Questionnaire for Indicator Measurement.

THOERY	LATENT VARIABLES	OBSERVED INDICATORS		THE NATURE OF THE QUESTION
VALUE BELIEF NORM (VBN) Pro Environment Orientation	**The Problem of Awareness (PA.)**	(PA_1) I believe that pollution from motor vehicles is very bad for people and the environment? (Eriksson, Garvill and Nordlund, 2006)		Positive
	Personal Norm PN)	(PN_1) I feel morally responsible to reduce the use of private vehicles in order to reduce the negative impact of pollution and fuel wastage? (Eriksson, Garvill and Nordlund, 2006)		Positive
	Willingness Reduce Car Use (WR.)	(WR_1) I Agree / willing to reduce the use of private vehicles in order to reduce the negative impact of pollution and fuel waste? (Eriksson, Garvill and Nordlund, 2006)		Positive
PUBLIC POLICY ACCEPTANCE (PPA)	**Fairness (FR.)**	(FR_1) In my opinion, the TDM (*road pricing/plate number restriction/working hour setting*) policy is unfair to me and other drivers (Jou et al., 2010)		Negative
	Infringement On Freedom (IF)	(IF_1) In my opinion, The implementation of TDM (such as: *road pricing/plate number restriction/working hour setting*) is a violation of freedom in choosing routes due to the increase in travel costs (Jou et al., 2010)		Negative
	Acceptance (AC.)	(AC_1) In my opinion, TDM policies (such as: *road pricing/plate number restriction/working hour setting*) are positive policies to overcome congestion (Jou et al., 2010)		Positive
		(AC_2) If you vote in a referendum, it is likely will I receive a TDM policy? (Jou et al., 2010)		Positive
	Intention (IN)	(IN_1) I agree with the implementation of TDM (*road pricing/plate number restriction/working hour setting*) policy to reduce congestion (Hsieh, 2022)		Positive
	Behavior (BE.)	Acceptance of road pricing model	(BRP_1) I will still go through the road with the application *road pricing* and not looking for alternatives (Gibson and Carnovale, 2015)	Positive
			(BRP_2) I will find an alternative way to avoid *road pricing* (Gibson and Carnovale, 2015)	Negative
			(BRP_1) I will change the travel time so as not to be subject to the road pricing policy (Hsieh, 2022)	Negative
		Acceptance of plate license restriction model	(BPL_1) I will use public transportation if my vehicle plate is subject to the odd–even policy	Positive
			(BPL_2) I will use another vehicle whose license plate number matches odd/even	Negative
		Acceptance of working hour setting model	(BWS_1) I will go to work/school according to the set hours	Positive

Table 5
Model Fit.

	Acceptance of Road Pricing Model		**Acceptance of Plate License Restriction Model**		**Acceptance of Working Hour Setting Model**	
	Saturated Model	Estimated Model	Saturated Model	Estimated Model	Saturated Model	Estimated Model
SRMR	0.092	0.122	**0.056**	**0.075**	**0.030**	**0.081**
NFI	0.706	0.657	0.789	0.760	**0.891**	**0.843**

Table 6
Mean and Standard Deviation (SD) for VBN and PPA Variables.

		Acceptance of Road Pricing Model		Acceptance of Plate License Restriction Model		Acceptance of Working Hour Setting Model	
		Mean	SD.	Mean	SD.	Mean	SD.
Value Belief Norm (VBN)	Problem Awareness (PA)	5.304	1.356	5.457	1.226	5.401	1.293
	Personal Norm (PN)	4.922	1.337	4.889	1.203	4.878	1.221
	Willingness to Reduce Car Use (WR.)	4.698	1.264	4.654	1.226	4.685	1.236
Public Policy Acceptance (PPA)	Fairness (FR.)	4.149	1.183	4.326	1.261	4.126	1.112
	Infringement On Freedom (IF)	4.432	1.212	4.308	1.116	4.215	1.055
	AC1	4.621	1.272	4.472	1.188	4.494	1.095
	AC2	4.412	1.282	4.237	1.138	4.397	1.068
	Intention (INT)	4.647	1.427	4.375	1.253	4.497	1.162
	BRP1	4.304	1.384				
	BRP2	4.297	1.375				
	BRP3	4.601	1.397				
	BPL1			4.408	1.214		
	BPL2			4.169	1.207		
	BWS1					4.641	1.142

Scales 1–7 (1 = strongly disagree, 2 = more disagree, 3 = disagree, 4 = undecided, 5 = agree, 6 = more agree, 7 = strongly agree).

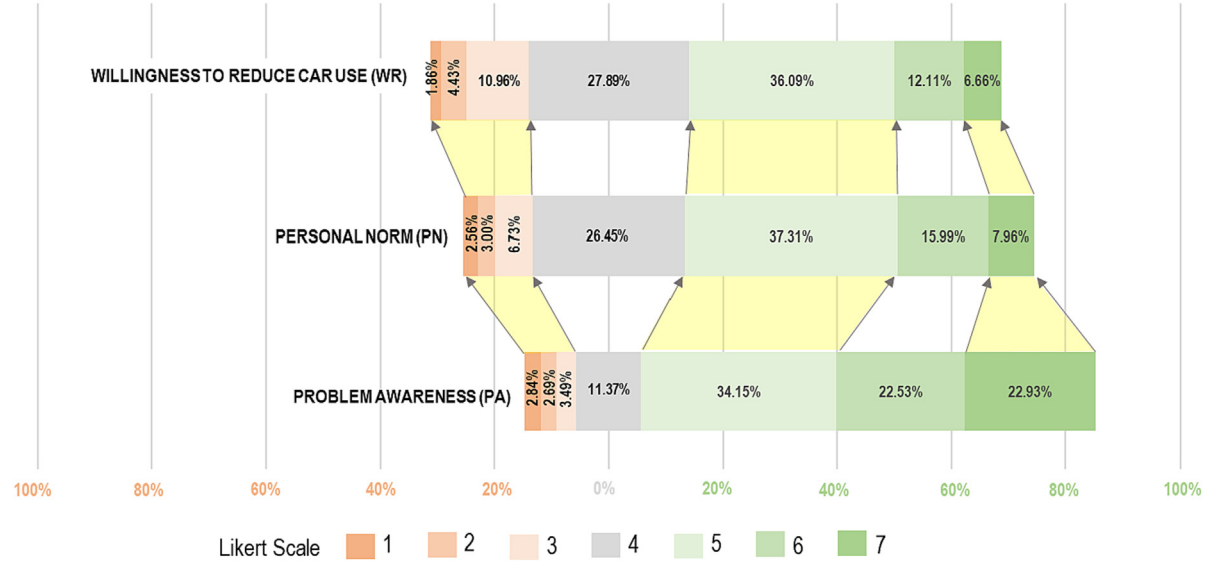
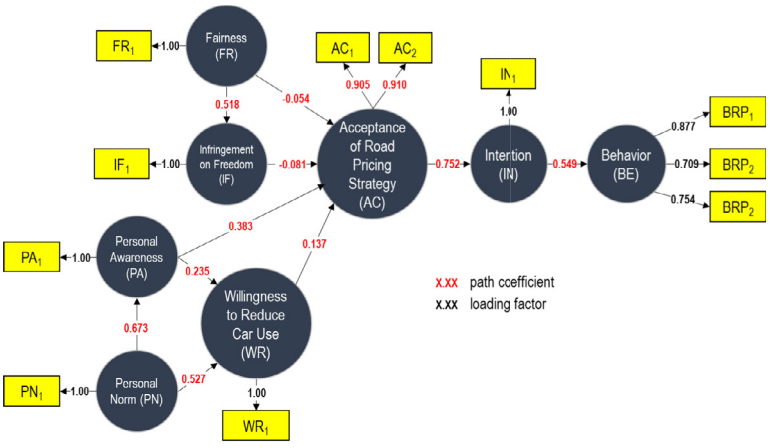


Fig. 5. Hierarchical beliefs from problem awareness, personal norms, and willingness to reduce car use.

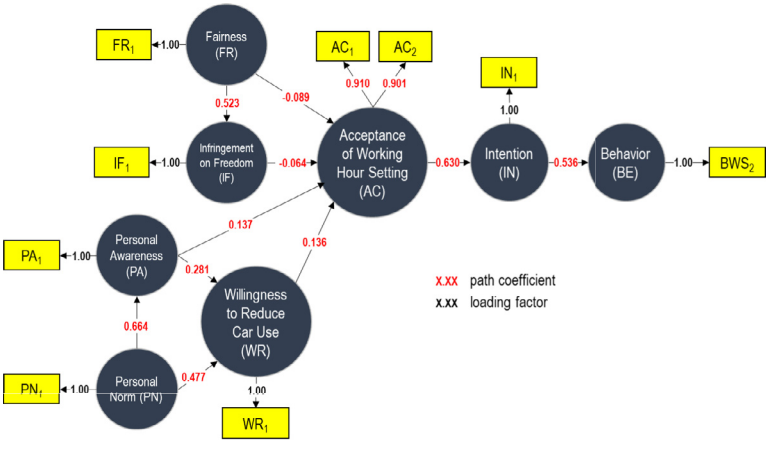
4.2. Path analysis

Path coefficients are a helpful value in showing the direction of the relationship between variables in SEM, which ranges from − 1 to 1. The closer to 1, the stronger the positive relationship, and vice versa; the closer to − 1, the two variables have a negative relationship (opposite). Otherwise, a value close to 0 means that the two variables have no relationship (Ayer et al., 2017). The results of the SEM path analysis on three TDM strategies (Fig. 6) show that most endogenous variables positively affected the exogenous variables, except for PPA. In the case of implementing TDM policy, it turned out that FR and IF considerations can be ruled out, while PA and PN communities are the key to the success of implementing TDM policy. Acceptance attitudes towards pro-environment policies are further strongly influenced by gender, socioeconomic and education levels (Karpudewan, 2019), and especially knowledge (Liobikienė and Poškus, 2019).

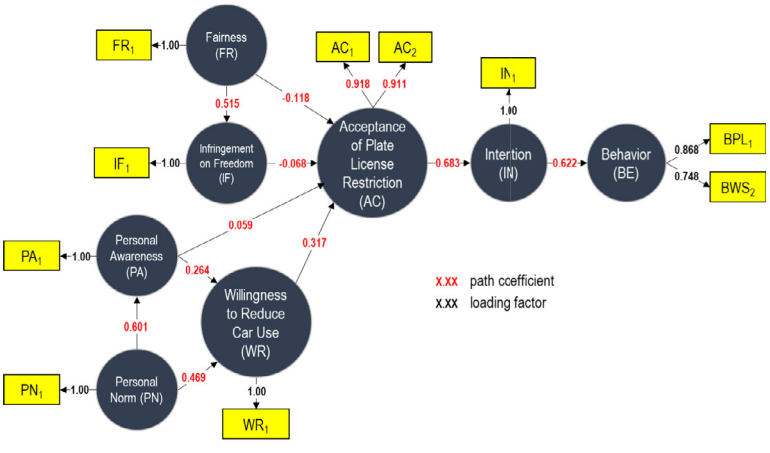
In VBN, the correlation of endogenous variables to exogenous is very varied; this is in line with research conducted by Ghazali et al. (2019) that the socioeconomic conditions of the community strongly influence the influence of PA and PN on WR. Nevertheless, PN significantly influenced PA in all TDM strategy implementations.



(a) Loading factor and path coefficient road pricing acceptance



(b) Loading factor and path coefficient working hour setting acceptance



(c) Loading factor and path coefficient of plate license restriction acceptance

Fig. 6. Loading Factor and Path Coefficient from VBN and PPA Transport Demand Management.

The path coefficient in PPA (in all models) showed that perceptions of fairness and infringement on freedom did not significantly affect AC or had a very small/near-zero negative influence (Fig. 6). This result was also supported by the results of bootstrapping analysis on the structural model which shows that there is no correlation between the variables PPA (Fairness

Table 7
Bootstrapping Analysis Results.

	Road Pricing		Plate License Restriction		Working Hour Setting	
	T-Sta	P-Values	T-Sta	P-Values	T-Sta	P-Values
Acceptance of TDM Strategy -> INTENTION	26.445	0	17.774	0	13.846	0
Fairness -> Acceptance of TDM Strategy	**0.925**	**0.355**	**1.859**	**0.064**	**1.202**	**0.229**
Fairness -> Infringement on Freedom	11.642	0	8.993	0	9.818	0
INTENTION -> BEHAVIOR	14.868	0	14.371	0	9.214	0
Infringement on Freedom -> Acceptance of TDM Strategy	**1.414**	**0.158**	**1.025**	**0.306**	**0.788**	**0.431**
Personal Norm -> Problem Awareness	19.638	0	11.694	0	17.409	0
Personal Norm -> Willingness to Reduce Car Use	7.695	0	6.993	0	8.304	0
Problem Awareness -> Acceptance of TDM Strategy	6.69	0	**1.02**	**0.308**	2.039	0.042
Problem Awareness -> Willingness to Reduce Car Use	3.975	0	4.146	0	4.919	0
Willingness To Reduce Car Use -> Acceptance of TDM Strategy	2.284	0.023	5.653	0	2.307	0.021

and infringement on freedom) and AC (Acceptance of TDM Strategy), indicated by p values > 0.05 and t-stat > 1.96. This condition can be considered as a condition that the community has a skeptical attitude toward a policy that will be implemented.

The plate license restriction model also found that a variable that did not significantly affect AC was problem awareness (PA), with a p-value of < 0.05.

The results showed that perceptions of fairness and infringement of freedom did not affect public policy acceptance (Table 7). This finding might occur due to the public's scepticism or indifference towards applying public policy. In the other hand, based on VBN theory, p-value score in all paths on model working hour setting and road pricing model are statistically significant to shaping (actual) behaviour.

5. Conclusions

The results showed that public acceptance of the TDM strategy (road pricing, license plate restriction, working hour setting) was influenced by pro-environment attitudes (willingness to reduce car use). This pro-environment attitude was an accumulation of the influence of personal norms and personal awareness of the community in responding to environmental conditions due to road transportation problems. However, based on PPA modelling, the DIY community still tends to be sceptical of implementing TDM policies. This was indicated by the path coefficient value between policy social-psychological factors (FR and IF) to AC, which is close to zero. The highlighted relationship between VBN and PPA enriches the research in TDM and enables another scholar to examine the phenomena in contextual ways.

TDM strategy can be effective if it does not only implement one strategy but must be a combination of several strategies. Thus, as a follow up research, it is necessary to measure the acceptance of combination TDM strategies, especially the combination of push and pull that is applied together.

CRediT authorship contribution statement

Nindyo Cahyo Kresnanto: Conceptualization, Funding acquisition, Data curation, Writing – original draft, Writing – review & editing, Visualization, Formal analysis, Methodology.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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