e-ISSN: 2550-1895

Available online at
https://mar.uitm.edu.my/index.php

Management And Accounting Review (25) 2026, 156-174

Management And Accounting Review

Factors Influencing Young Malaysians to Adopt Sustainable Mobility Modes

Nor Farizal Mohammed[1*], María-Elena Sánchez-del-Río-Vázquez[2], Carlos Rodríguez-Rad[3] and María-Ángeles Revilla-Camacho[4]

[1] *Universiti Teknologi MARA, Puncak Alam, Malaysia*
[2,3,4] *Universidad de Sevilla, Seville, Spain*

ARTICLE INFO

Article history:
Received 20 October 2025
Accepted 24 February 2026
Published 1 April 2026

Keywords:
Sustainability
Mobility
Adoption Forces
Diffusion
Market-Based Management

DOI:

10.24191/MAR.V25i01-10

ABSTRACT

The advancement of sustainable transport modes is a central challenge highlighted by the United Nations 2030 Agenda's Sustainable Development Goal 11: Sustainable Cities and Communities. While governments increasingly invest in sustainable mobility infrastructure, the effectiveness of such initiatives depends on user adoption, raising concerns regarding public sector accountability. Accordingly, this study aimed to fill the gap in the literature regarding how to accelerate the diffusion of sustainable mobility modes, particularly in developing countries in the East. Therefore, this study aimed to examine how perceived impacts of the mobility modes on city sustainability, customer forces, and product forces influence the intention to adopt sustainable transport modes among young Malaysians in Puncak Alam. An empirical study was conducted using the partial least squares (PLS) method. The findings revealed that perceived impacts had a significant influence on young people's intention to use sustainable mobility modes. Consequently, to enhance the likelihood of success, public and private organisations should focus on strengthening customer-related factors and effectively communicate the positive impacts of these transport modes at the local level. This study extends the sustainability performance measurement literature by positioning user adoption intention as a leading non-financial indicator of SDG effectiveness.

[2*]Corresponding author. *E-mail address*:norfa783@uitm.edu.my

1. INTRODUCTION

Sustainable mobility encompasses transportation modes that are economically sustainable, socially inclusive, and environmentally responsible. Transportation strategies based on this concept aim to meet the needs of present generations while ensuring that future generations are not disadvantaged. On this foundation, sustainable mobility not only addresses environmental issues but also fosters social and economic progress by offering comprehensive solutions within the transport sector (Singh et al., 2020). Achieving sustainable mobility involves adopting eco-friendly practices such as walking, cycling, increased use of public transportation, and reducing reliance on private vehicles, which helps to lower emissions and minimize environmental impact. Additionally, sustainable mobility prioritizes the affordability of transportation options. In practical terms, this includes promoting public transit, encouraging carpooling and ride-sharing, and supporting vehicles powered by renewable energy sources (Naaman et al., 2024). These efforts align with SDG 11 of the United Nations, which advocates for sustainable, inclusive, safe, and resilient cities and communities.

Like many other nations, Malaysia has prioritized green transportation within its urban transit systems, as detailed in the National Transport Policy 2019-2030 (Ministry of Transport Malaysia [MOTM], 2020). This policy identifies the development of public transportation as a central objective in urbanized areas (MOTM, 2020). Furthermore, a review of Act 333 is underway to encourage the adoption of energy-efficient vehicles and to introduce green indexes, marking an initial step toward creating a low-carbon environment (MOTM, 2020). The Klang Valley stands as a prime example of a rapidly growing urban region in Malaysia (Khoo & Ong, 2015), making significant progress toward a more sustainable, efficient, and safe transportation system through the expansion and integration of various public transit modes (MOTM, n.d.). The Klang Valley Integrated Transit System includes services such as the Kuala Lumpur International Airport (KLIA) Ekspres, KLIA Transit, Mass Rapid Transit (MRT), Light Rapid Transit (LRT), Kereta Api Tanah Melayu (KTM) Komuter, and the Kuala Lumpur (KL) Monorail, all of which contribute to sustainable mobility. This network features ten fully operational rail lines: two commuter lines, five rapid transit lines, and three airport links connecting to KLIA and Subang Airport (MOTM, n.d.). Additionally, the MOTM has introduced a demand-responsive transit van service in the Klang Valley, funded by RM50 million from Budget 2024, to improve first- and last-mile connectivity (MOTM, n.d.).

In contrast, Puncak Alam, a suburban area that has experienced significant development in recent years (Ahmad et al., 2023), remains heavily dependent on private vehicles, leading to notable environmental impacts (Sundram et al., 2022). The UiTM Puncak Alam campus has also contributed to the area's growth (Ahmad et al., 2023). Despite these challenges, Puncak Alam holds considerable potential for sustainable mobility. As a rapidly expanding area near Kuala Lumpur, Malaysia’s capital, Puncak Alam is well-positioned to pursue sustainable mobility initiatives.

Sustainable mobility systems have emerged as a rapidly evolving field in recent years, marked by advancements in micro-mobility, Mobility as a Service (MaaS), and shared mobility (Naaman et al., 2024; Kriswardhana & Esztergár-Kiss, 2024). Given the technological progress in this domain and its implications for urban sustainability, scholars have emphasized the urgent need for deeper research to accelerate the adoption of sustainable transport modes—a subject that remains underexplored (Rodríguez et al., 2023). Notably, there is a scarcity of studies focusing on sustainable mobility in developing nations,

https://doi.org/10.24191/MAR.V25i01-10

particularly in the Far East regions (Ho & Tirachini, 2024). Investigating these areas could significantly enrich the global understanding of sustainable transport challenges and potential solutions.

Youth populations are especially critical to this discourse, as they represent a strategic demographic for driving behavioural shifts toward sustainable mobility practices (Kriswardhana & Esztergár-Kiss, 2024). Their adoption of eco-friendly transport habits could catalyse broader societal change, making them a focal group for policy and innovation efforts.

The primary aim of this study was to examine the factors that either facilitated or hindered the adoption of various sustainable mobility modes among young Malaysians. To address the research objectives, data were collected from students at Universiti Teknologi MARA (UiTM), Puncak Alam. This township, situated in the Kuala Selangor District within Malaysia's Klang Valley, the country's most populous and developed region, is well-connected to both Kuala Lumpur, the capital, and Shah Alam, the capital of Selangor. Despite having access to basic public transportation, students in Puncak Alam continue to rely heavily on private vehicles, posing a challenge to advancing sustainable mobility goals (Sundram et al., 2022).

This study thus provides insights from the perspective of a developing country, offering actionable strategies that can contribute to achieving SDG 11. In doing so, it responds to academic calls to address the research gap and accelerate the adoption of sustainable mobility modes. As previously noted, Ho & Tirachini (2024) emphasized that this research gap is particularly pronounced in developing countries, especially in the eastern part of the world. Additionally, by comparing the factors influencing user intentions across different sustainable mobility modes, this study offers important implications to support policy formulation, resource allocation, and non-financial sustainability reporting by public institutions and transport authorities. From the above, the study reframes mobility adoption intention as a behavioural outcome with direct implications for sustainability performance measurement and public decision-making.

2. LITERATURE REVIEW

Externalities in the transportation systems, such as traffic congestion, air pollution, greenhouse gas emissions, noise pollution and social inequities, have made sustainable urban mobility increasingly critical. Mobility plays a crucial role in urban economic activity and quality of life, resulting in global concerns about how traffic noise and commuter travel time affect daily living (Bebber et al., 2021). As such, smart mobility projects are often seen as a first step to establishing Smart Cities, with new urban mobility solutions leading to more sustainable, quieter, and less polluted cities (Rodríguez et al., 2023).

Furthermore, the integration of information and communication technologies in urban mobility facilitates more sustainable and efficient transport, opening the possibility for more interconnected services for cars, bike-sharing, ride-sharing, buses, and trains in real-time, and contributing to multimodality (Naaman et al., 2024). This trend is exemplified by the rise of Mobility as a Service (MaaS), as noted in Kriswardhana and Esztergár-Kiss (2024). MaaS consolidates multimodal travel into one integrated service, accessed through digital channels, allowing users to easily combine public transit, bike-sharing, and ride-sharing services. Kriswardhana and Esztergár-Kiss (2024) highlight the potential use of mobile apps for planning and payment of transport services.

https://doi.org/10.24191/MAR.V25i01-10

Moreover, sustainable urban mobility transformation towards a low-carbon circular economy and cutting emissions more broadly can be aided by public policy and measures to synchronize these concepts with urban mobility in the future (Ho & Tirachini, 2024). In Santiago, Chile, communities prefer Metro, bikes, and shared scooters to private cars and ridesourcing, suggesting the decarbonization potential of these multimodal solutions (Ho & Tirachini, 2024). Nevertheless, sustainable mobility in developing countries faces challenges due to limited data-sharing practices, lack of investment in digital infrastructure, and financial constraints (Ho & Tirachini, 2024). Public transport frequently depends on informal networks, limiting the scalability of MaaS to regions with formal systems such as rail and bus rapid transit. This creates issues of limited coverage and social inequality. The government must actively regulate and provide financial support in order to implement MaaS effectively.

2.1 Evolution of prior studies on sustainable urban mobility

As the field of sustainable mobility has garnered significant researchers' attention due to concerns about environmental degradation and climate change, a literature review was performed. The current state of research on sustainable mobility strategies was synthesized, and gaps in the literature were identified.

Scheffer et al. (2019) address SDG 11: Sustainable Cities and Communities by examining sustainable mobility in university settings. Traffic congestion, pollution, and inadequate infrastructure on university campuses prompted the need for sustainable planning. Scheffer et al. (2019) suggested that prioritization of vehicles in campus planning requires immediate intervention. They demonstrated that universities played a crucial role in promoting sustainable mobility, both as influencers and as implementers of sustainable practices. Implementing sustainable mobility plans at universities could lead to broader adoption of sustainable practices in urban mobility planning, improving quality of life and reducing environmental impact. Chirieleison et al. (2019) explored the relationship between event sustainability and sustainable transportation, while Aloui et al. (2021) focused on collaborative sustainable transportation.

By performing 40 extensive narrative literature reviews of scholarly articles published between 1959 and 2020, Dehghanmongabadi and Hoskara (2020) discussed various strategies for promoting sustainable mobility, including land use planning, clean energy, mode shifting, and the use of education and information technology such as Internet of Things and smartphone applications. Investment in infrastructure, accessibility and community engagement were key to fostering active modes of transportation as part of sustainable urban development. Zhao et al. (2020) highlight travel behaviour and transport strategic planning as among the hot issues investigated regarding sustainable mobility. They suggested that future research should explore public awareness of sustainable development, travel behaviour, and mode choice. Jeyaseelan et al. (2022) provided a comprehensive review of current trends, challenges, and future prospects for sustainable mobility.

The growing number of literature on sustainable urban mobility reflects the importance of the subject. University students play a critical role in shaping future societal norms and influencing policymakers to develop green transportation systems. De Angelis et al. (2021) explored the factors influencing the mobility behaviours of Italian university students and staff, highlighting the role of commuting distance in shaping their choices. They proposed that universities enhanced shared mobility services for medium-range commutes and encourage behaviour change through incentives like subsidised public transport passes, supporting alternative mobility habits such as biking, and target individuals in life transitions. Another related study by Pazhuhan et al. (2022) examined environmentally friendly behaviours and commuting

https://doi.org/10.24191/MAR.V25i01-10

patterns among university students, focusing on the University of Tehran, Iran. Pazhuhan et al. (2022) found that students relied heavily on public transportation but exhibited low environmentally friendly behaviours, suggesting improved transit and bike-sharing programmes to reduce private vehicle use. They urged integrating environmental education and sustainable practices within university programmes to cultivate a culture of environmentally friendly behaviours.

Addressing a shift towards more sustainable practices is not only about adopting public transit or cycling infrastructure but also about identifying the underlying factors that enabled effective and lasting transformation (Bebber et al., 2021). Naaman et al. (2024) investigated the factors influencing transportation choices and how policies can shift commuters toward sustainable practices. Using survey data from the University of Isfahan, Iran, the study found that improving public transport access and quality significantly reduces private vehicle use. Advancing active modes while allowing work-from-home and online classes makes the campus environment more sustainable. Parking difficulty promoted walking, and the campus shuttles affect travel behaviour. Naaman et al. (2024) suggested the need for targeted policies at universities that promote sustainable travel behaviours, which can yield significant environmental benefits.

Moreover, the evolution of sustainable urban mobility has been significantly influenced by technological advancements and changing societal needs. Wang et al. (2022) sought to understand the factors influencing preferences for shared mobility options and the implications for improving transportation equity and accessibility. The study recommended subsidies, digital inclusion initiatives, or service expansions to improve shared mobility. It provided insights for transportation providers on tailoring services to meet the unique needs of low-income communities, as preferences vary depending on factors such as income, age, employment status, and familiarity with technology. By examining consumer perceptions of factors influencing the adoption of sustainable transportation modes, Rodríguez et al. (2023) offered a novel perspective that enhances our understanding of effective adoption. Using data from the city of Seville, their findings revealed that user-perceived impacts on sustainability and customer dynamics affected citizens' adoption of a transportation mode, whereas product dynamics appeared to have little impact on this adoption.

A recent study by Kriswardhana and Esztergár-Kiss (2024) examined the factors influencing students at the Budapest University of Technology and Economics in their decision to adopt MaaS. They investigated students due to their socio-economic characteristics, the significant amount of daily travel to and from universities, and their younger demographic, which can influence future travel patterns. The findings highlighted the importance of individual attitudes and technological familiarity in shaping the adoption of MaaS among young and urban populations.

Consequently, this study built upon foundational research previously conducted in Seville, Spain. Empirical research there examined students' intentions to adopt sustainable mobility modes at the University of Seville (Rodríguez et al., 2023). The progress Seville had made in integrating electric scooters, bicycles, ride-hailing services, and public transportation within a unified regulatory framework, as documented by Rodríguez et al. (2023), offered valuable insights that can inform Malaysia's approach to sustainable mobility.

Despite the Malaysian government's initiatives to encourage sustainable mobility, Sundram et al. (2022) highlighted that many students at UiTM Puncak Alam continue to rely on personal cars,

https://doi.org/10.24191/MAR.V25i01-10

motorcycles, or ride-hailing services for commuting, primarily due to insufficient public transport coverage. For travel within the campus, however, some students living in university accommodation opted to walk, cycle, or use the university's public bus service. The authors also pointed out that the lack of reliable and affordable transportation options was frequently cited by students as a significant obstacle to adopting more sustainable travel practices. Nevertheless, Sundram et al. (2022) observed that recent improvements, such as the expansion of bus routes and increased service frequency, suggested a growing recognition of the need for enhanced public transport.

Accordingly, as outlined in the Introduction, this study investigated the factors influencing the adoption of sustainable transport among young Malaysians. It considered key aspects such as the ecological, social, and economic impacts of sustainable mobility, acknowledging their importance in shaping urban travel behaviours (Bąk et al., 2022).

2.2 Innovation diffusion theory

Numerous previous studies have employed Rogers' (1995) Innovation Diffusion Theory (IDT) to elucidate the factors that affect the adoption of innovations. For instance, Min et al. (2019) utilised IDT, the Technology Acceptance Model (TAM), and Consumer Behaviour Analysis to clarify the relationship between innovation characteristics, user perceptions, and technology adoption in the context of the Uber mobile application. Similarly, Ahn and Park (2022) combined IDT and TAM to investigate the determinants of sustainable transportation acceptance. Rogers (1995) identified key factors such as relative advantage, compatibility, complexity, trialability, and observability. However, Rodríguez et al. (2023) argued that these characteristics do not fully capture the diverse perspectives present in current innovations.

Building on Rogers' IDT, Best (2013) and Hawkins and Mothersbaugh (2010) highlighted the importance of customer forces (such as perceived risk, felt need, and observability) and product forces (including affordability, simplicity, and availability). Customer forces refer to user-related characteristics that influenced innovation adoption, while product forces pertained to essential aspects of product positioning that impacted market growth rates (Rodríguez et al., 2023).

To strengthen the explanatory power of the framework, Rodríguez et al. (2023) applied this extended model to analyse adoption factors and diffusion processes among students in Seville, Spain. Differentiating between customer forces and product forces allowed for a more comprehensive understanding of the elements that shaped adoption rates, as the model considered both innovation attributes and the perceptions of potential adopters. Furthermore, Rodríguez et al. (2023) incorporated users' perceived impacts of urban mobility on city sustainability—encompassing ecological, economic, and social dimensions. By integrating these aspects into IDT, the model offered a more robust structure for interpreting and predicting the adoption of sustainable mobility solutions, particularly in contexts where ecological and social considerations strongly influenced user preferences.

2.3 Model and Hypotheses

This study extended the research conducted by Rodríguez et al. (2023) and adopted the same theoretical framework. Consequently, our proposed model incorporated the six customer forces (ease of purchase, trialability, observability, references, risk avoidance, and felt need) and six product forces (affordability, simplicity of use, availability, services, product advantage, and risk of non-compliance) outlined by

https://doi.org/10.24191/MAR.V25i01-10

Rodríguez et al. (2023). Additionally, it included customer-perceived impacts on urban sustainability, as defined in their model. The following hypotheses and structural relationships were proposed:

H1: Product forces are positively related to user intention.

H2: Customer forces are positively related to user intention.

H3: Perceived impacts are positively related to user intention.

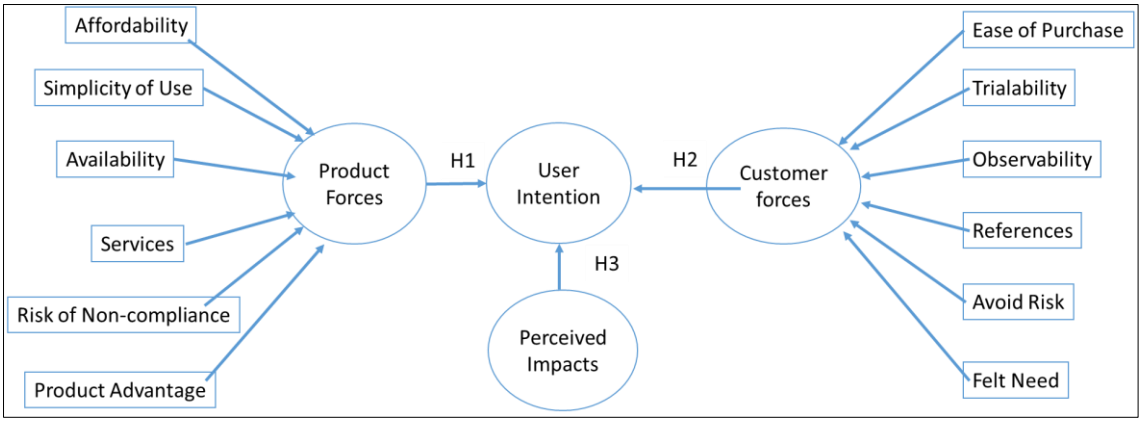

Figure 1. Proposed model

In this way, this study strove to fill the gap in the literature regarding how to accelerate the diffusion of sustainable mobility modes, especially in oriental developing countries, and more specifically in an area of great potential for sustainable mobility such as Puncak Alam.

In other words, our research question became even more concrete: How do perceived impacts, customer forces, and product forces influence the intention to adopt sustainable transport modes among young Malaysians in Puncak Alam?

3. METHODOLOGY

All constructs in this study were assessed using 5-point Likert scales, where a score of five represented the most favourable scenario. The items for each scale were derived from indicators identified in the literature review. To capture the multidimensionality of the construct "Product Forces", a nineteen-item scale was developed, drawing on the frameworks proposed by Best and Hawkins & Mothersbaugh, and tailored to fit the context of this research. These 19 items comprised the following six independent dimensions: affordability, ease of use, availability, product advantages, service, and risk of non-compliance. In the second-order model (explained in the section 'Data analysis and results'), this 'Product Forces' construct was conceptualised as consisting of these six dimensions. These dimensions were considered to function independently, meaning they didnot necessarily correlate with one another, supporting the classification of the construct "Product Forces" as formative. Similarly, based on the studies of Best and Hawkins & Mothersbaugh, the construct 'Customer Forces' was measured using a nineteen-item scale comprising six dimensions. These dimensions were adapted for this study and were as follows: ease of purchase,

https://doi.org/10.24191/MAR.V25i01-10

trialability, observability, references, risk avoidance, and felt need. As with Product Forces, these dimensions operated independently rather than co-varying, which aligned with the formative nature of the construct "Customer Forces". The construct "Perceived Impacts" was assessed using a four-item scale that captured perceptions of the environmental, economic, social, and overall impacts of sustainable mobility modes on the city's future development. Essentially, this scale reflected how different transport modes were believed to influence the city's sustainability. Finally, the construct "User Intention" was measured using a four-item scale adapted from Ray and Sahney, and assessed both the intention to use sustainable transport modes and the intention to recommend them to others. The recommendation aspect was particularly important, as word-of-mouth was recognised as one of the most effective methods for attracting new users. All constructs in this research collectively addressed the research question of how perceived impacts, customer forces, and product forces shaped adoption intentions.

4. DATA ANALYSIS AND RESULTS

To analyse the proposed framework, a second-order hierarchical model was developed. This approach allowed for a nuanced examination of the relationships between the higher-order constructs (customer and product forces) and their underlying dimensions.

In the first-order model: Customer Forces (CF) and Product Forces (PF) were modelled as first-order reflexive constructs (Mode A).

In the second-order model: FC and VET were reconfigured as higher order formative constructs (Mode B), where their dimensions were independent drivers that collectively defined the construct. This recognized that changes in individual dimensions (e.g., increased affordability) directly shaped the overall construct without the need for internal coherence.

The analysis followed a two-stage process. The first stage was the measurement model, which represented the relationship between observable variables (indicators) and latent variables (constructs). The second stage was the structural model, which described the relationships between the latent variables. This hierarchical approach ensured a robust analysis of both the measurement quality and the theoretical relationships in the context of sustainable mobility adoption.

4.1 First-Order Model; Measurement Model

The analysis began with the evaluation of the measurement model, following the two-step PLS-SEM approach recommended by Hair et al. (2022). Since the first-order constructs were modeled reflectively (Mode A), reliability, convergent validity, and discriminant validity were assessed using established thresholds.

All item loadings met or were close to the recommended threshold of 0.7 (Table 1). Items slightly below this value were retained only if their removal did not enhance construct validity. Internal consistency was confirmed through Cronbach's Alpha and Composite Reliability (CR) values exceeding 0.7, while convergent validity was supported by Average Variance Extracted (AVE) scores above 0.5 (Table 1).

Discriminant validity was evaluated using the Heterotrait-Monotrait (HTMT) ratio, with all constructs demonstrating values below the conservative threshold of 0.85, ensuring a clear distinction between latent

https://doi.org/10.24191/MAR.V25i01-10

variables (Franke & Sarstedt, 2019). These results confirmed the robustness of the model, with all constructs meeting rigorous psychometric standards.

Table 3. Measurement model; loadings, construct reliability and convergent validity

Construct/ Dimension/ Indicator	**Dimensions**	**Cronbach's Alpha**	**Composite Reliability**	**Average Variance Extracted (AVE)**	**Loading**
Affordability (AFF)		0.919	0.949	0.860	
AFF1	Affordability of the initial price (for purchase or registration)				0.925
AFF2	Affordability of the periodic cost (maintenance or recharge)				0.913
AFF3	Affordability of the total cost of use				0.945
Simplicity of Use (SIM)		0.651	0.713	0.806	
SIM1	Easy to use				0.934
SIM2	Easy to park				0.763
SIM3	Does not require a vehicle license for its use *				
Availability (AVA)		0.804	0.881	0.712	
AVA1	That there are enough vehicles available				0.943
AVA2	That it is accessible (easy to dispose of)				0.954
AVA3	That it allows me to move when I need it				0.963
Product Advantage (ADV)		0.791	0.904	0.825	
ADV1	That it is fast				0.884
ADV2	That it is comfortable				0.931

https://doi.org/10.24191/MAR.V25i01-10

Construct/ Dimension/ Indicator	Dimensions	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	Loading
ADV3	That it allows me to avoid traffic jams *				
Risk of Non Compliance (RIN)		0.855	0.912	0.775	
RIN1	That it allows me to move around any area *				
RIN2	That it allows me to move around without timetable restrictions				0.879
RIN3	That allows me to get to my destination on time				0.895
RIN4	That it fulfills what was promised in the advertisement				0.868
Services (SER)		0.801	0.880	0.714	
SER1	Include extras such as water, air conditioning, helmet, etc.				0.682
SER2	That I have access to customer service				0.927
SER3	That it has an app to manage the service				0.904
Ease of Purchase (PUR)		0.838	0.902	0.755	
PUR1	That it is easy to buy				0.844
PUR2	That I don't have to consult with others about my purchase decision				0.881
PUR3	That it doesn't require a lot of paperwork to use it				0.881
Trialiability (TRI)		0.859	0.913	0.777	
TRI1	That you can try it beforehand				0.868
TRI2	That you are allowed to try it for free				0.851

https://doi.org/10.24191/MAR.V25i01-10

Construct/ Dimension/ Indicator	Dimensions	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	Loading
TRI3	That there are demonstrations of its use				0.924
Observability (OBS)		0.929	0.955	0.875	
OBS1	That other people around me use it				0.938
OBS2	That I have seen other people using it				0.944
OBS3	That it is a widely used mode of transport				0.925
References (REF)		0.903	0.939	0.836	
REF1	That there are positive reviews in my networks				0.938
REF2	That other people talk positively about its use				0.942
REF3	That the institutions promote its use				0.862
Avoid Risk (AVO)		0.902	0.931	0.772	
AVO1	That I avoid the risk of causing an accident				0.889
AVO2	That it avoids me the risk of having an accident				0.877
AVO3	That it allows me to control my expenses				0.849
AVO4	That my family and friends consider a good idea to use it				0.899
Felt Need (NEE)		0.950	0.968	0.910	
NEE1	That it fits my mobility needs				0.851
NEE2	That it fits my schedule				0.796
NEE3	That it fits my frequent destinations				0.883
Perceived Impacts (PI)		0.940	0.957	0.848	

https://doi.org/10.24191/MAR.V25i01-10

Construct/ Dimension/ Indicator	Dimensions	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	Loading
PI1	The use of this mode of transport is good for the environment				0.915
PI2	The use of this mode of transport is positive for the economy of the city				0.918
PI3	The use of this mode of transport helps to reduce social inequalities				0.909
PI4	In general, the use of this mode of transport is positive for the city				0.941
User Intention (UI)		0.945	0.960	0.857	
UI1	I will use this mode of transport in the future				0.926
UI2	I will use this mode of transport in the near future				0.930
UI3	I have positive things to say about this mode of transport				0.928
UI4	I will recommend this mode of transport to other people				0.920

Note: * Items eliminated by recommendation of the methodology

4.2 Second Order Model: Measurement Model

In the second-order model, perceived impacts and user intention were specified as reflective constructs (Mode A), while customer forces and product forces were modeled as formative constructs (Mode B). For these formative constructs, the analysis utilised the calculated factor scores from the six dimensions defining both customer forces and product forces, following established hierarchical component modelling methodologies (Hair et al., 2024). This method ensured that each dimension's unique contribution is accurately represented within the overall construct.

All formative dimensions demonstrated meaningful contributions to their respective constructs, confirming convergent validity. To assess potential multicollinearity, Variance Inflation Factor (VIF) values were calculated, with none exceeding the threshold of 5 (Hair et al., 2022), indicating no collinearity issues. Furthermore, after performing 5,000 bootstrap iterations, all formative weights and reflective loadings were statistically significant ($p < 0.05$), and thus no indicators were removed from the model, as each retained its relevance in explaining the constructs.

https://doi.org/10.24191/MAR.V25i01-10

4.3 Second Order Model: Structural Model

This second part of the PLS-SEM modelling sought to analyse the relationships between the constructs. Bootstrapping with 5000 samples was performed (Becker et al., 2023), providing both t-values and confidence intervals to assess the statistical significance of the proposed relationships.

The results are presented in Table 2.

Table 2. Results of the structural model

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Impacts -> User Intention	0.691	0.679	0.057	12.079	0.000
Product Forces-> User Intention	0.061	0.070	0.035	1.731	0.084
Customer Forces-> User Intention	0.185	0.195	0.050	3.729	0.000

Empirical evidence from this study demonstrated a significant relationship between perceived impacts and user intention, as well as between customer forces and user intention. Consequently, both hypothesis H1 and hypothesis H2 were supported. In contrast, no significant relationship was found between product forces and user intention, leading to the rejection of hypothesis H3. These findings highlighted the importance of perceived impacts and customer-related factors in influencing young Malaysians' willingness to adopt sustainable mobility modes, suggesting that product-related attributes alone were insufficient to drive user intention.

Table 3. Strength and significance of the dimensions

	Sample Mean (M)	T Statistics (|O/STDEV|)	P Values
Product Advantages -> Product Forces	0.378	2.767	0.006
Availability -> Product Forces	0.105	0.651	0.515
Affordability -> Product Forces	0.267	2.304	0.021
Risk Of Non Compliance -> Product Forces	-0.084	0.551	0.582
Services -> Product Forces	0.126	1.129	0.259
Simplicity Use -> Product Forces	0.413	3.342	0.001
Avoid Risk -> Customer Forces	0.416	3.454	0.001
Observability -> Customer Forces	0.256	2.098	0.036

https://doi.org/10.24191/MAR.V25i01-10

	Sample Mean (M)	T Statistics (|O/STDEV|)	P Values
Ease Of Purchase -> Customer Forces	0.025	0.272	0.786
References -> Customer Forces	-0.018	0.148	0.882
Felf Need -> Customer Forces	0.513	4.099	0
Trialability -> Customer Forces	-0.152	1.835	0.067

Table 3 displays the results regarding the strength and significance of the dimensions comprising the formative constructs of product forces and customer forces. Among the product forces, simplicity of use (0.413), perceived advantages (0.378), and affordability (0.267) demonstrated the highest explanatory power and were statistically significant. In contrast, perceived risk of non-compliance (0.08), availability (0.105), and services (0.126) were not significant and contributed less to the overall explanation of product forces.

For customer forces, suitability (0.513), risk avoidance (0.416), and observability (0.256) demonstrated strong explanatory power and were all statistically significant. On the other hand, trialability (0.152), ease of purchase (0.025), and references (-0.018) showed a lower degree of explanation and were not statistically significant.

To assess the predictive power of the constructs in our model, we examined the coefficient of determination (R^2), as recommended by Sarstedt et al. (2021). This value reflects the proportion of variance in a construct explained by its predictor variables (Chin, 2010). In our model, the explanatory constructs accounted for a substantial portion of the variance in user intention ($R^2 = 0.749$). Specifically, perceived impacts explained 58.75% of the variance in user intention, while consumer factors accounted for 12.82%.

Analysing the effect size (f^2) of these relationships, we found that the impact of perceived impacts on user intention was large (0.950), whereas the effect of consumer forces on user intention was small (0.064), in line with Schuberth et al. (2023).

Lastly, the overall fit of the model was confirmed by the SRMR fit index of 0.043, well below the recommended maximum value of 0.08 (Benitez et al., 2020), indicating a good model fit.

5. DISCUSSION OF RESULTS

The study examined the factors influencing the adoption of sustainable mobility modes among young Malaysians, specifically analysing the effects of perceived impacts, consumer factors, and product factors on user intention. The results indicated that both consumer factors and perceived impacts had a significant positive effect on user intention, while product factors did not show a significant influence. Perceived impacts were found to explain 58.75% of the variance in user intention (Hypothesis H1), suggesting that efforts to raise awareness among young people about the social, economic, and environmental benefits of sustainable transport can greatly facilitate their willingness to adopt these modes. It is crucial to develop

policies that informed users about the benefits of sustainable mobility, including its contribution to cleaner cities, improved quality of life, and environmental protection, thereby increasing their willingness to adopt sustainable mobility practices.

Consumer forces, including ease of purchase, trialability, observability, references, risk avoidance, and felt need, also positively influenced user intention (Hypothesis H2), accounting for 12.82% of its variance. To enhance the adoption of new sustainable mobility modes, it is essential for public policy to support innovation. As observed in Seville, Spain (Rodríguez et al., 2023), the findings supported the recommendation that Malaysian public and educational authorities should develop strategies linking sustainable transport use to social well-being and urban environmental improvement. For example, universities may incorporate students' intention to adopt sustainable transport as a key performance indicator within campus sustainability dashboards. Additionally, municipalities and transport authorities may integrate perception-based measures into their non-financial sustainability reporting disclosures to monitor SDG alignment initiatives.

However, product forces, including affordability, simplicity of use, availability, services, product advantage, and risk of non-compliance, did not have a significant effect on user intention, leading to the rejection of Hypothesis H3. This suggests that focusing solely on product features, without simultaneously strengthening consumer factors, is unlikely to increase user intention. The finding also implied that overemphasis on product forces expansion without addressing behavioural and perceptual factors may lead to suboptimal allocation of public resources. While prior studies on sustainable transport adoption predominantly emphasized individual attitudes and technological attributes, this study implied that perceived societal impacts and consumer-related forces played a more decisive role than product forces in shaping adoption intention.

6. CONCLUSIONS

This research advances both academic understanding and practical policymaking by offering valuable insights for designing targeted interventions in Malaysia, thereby supporting the global agenda to reduce greenhouse gas emissions and promote urban sustainability. By comparing different sustainable mobility modes, the study provided a comprehensive perspective on how various urban transport options can facilitate the shift toward sustainable mobility. It also highlights the crucial role of youth as agents of change in this transition and emphasises that universities can be decisive actors if they integrate the promotion of sustainable mobility into their institutional goals (Scheffer et al., 2019).

In line with Dehghanmongabadi and Hoskara (2020) and Ho and Tirachini (2024), this study concluded that successful adoption in Malaysia depended not only on perceptions of impact or consumer influences but also on comprehensive strategies that supported a modern, intermodal transport system. To promote the adoption of sustainable mobility among young Malaysians, it is essential to ensure that consumer forces are viewed in a positive light. In particular, addressing the felt need, that is, to ensure the innovation meets a recognised and pressing demand. It is also crucial to communicate that there is minimal risk associated with trying and using the new mobility mode, considering physical, social, and economic aspects. Making the use and benefits of these modes easily observable is another key factor.

https://doi.org/10.24191/MAR.V25i01-10

While allowing young people to try the transport mode before adoption is beneficial, it is not essential. Interestingly, peer references do not appear to be significant for this demographic, suggesting that resources allocated to social media marketing might be better invested elsewhere. This contrasts with findings from Europe (Kriswardhana & Esztergár-Kiss, 2024), where technological familiarity and social acceptance were major factors in adopting services like Mobility as a Service (MaaS). Such cultural differences suggested that communication strategies in Malaysia should be tailored to local contexts, with a greater emphasis on education and direct experience to foster a felt need and mitigate perceived risks, rather than relying solely on social campaigns.

Although product forces did not directly affect user intention, some aspects still deserve attention. Sustainable transport should be easy to use and compatible with users' daily routines and lifestyles. The advantages over less environmentally friendly alternatives must be clearly communicated, and both the price and operating costs should be reasonable. However, investing in additional supporting services may not be necessary, as potential adopters do not perceive these as adding significant value.

This study contributes to the sustainability and mobility literature by applying existing behavioural adoption models to the domain of public sector accountability and non-financial sustainability performance assessment. The findings of this study offer a theoretical understanding by placing adoption intention as an indicator that reflects the perceived public value of sustainability initiatives rather than merely individual preference. As in the European context (Rodríguez et al., 2023), this study recommends that Malaysian public and educational authorities develop strategies that connect the use of sustainable transport modes with broader goals of social well-being and urban environmental enhancement.

This study has certain limitations that should be acknowledged. First, the research focused on a geographically limited scope within Malaysia, which may affect the generalisability of the findings. Second, the cross-sectional design restricted our ability to analyse behavioural changes over time, although the theoretical framework provides robust support for the hypothesized causal relationships. For future research, we recommend expanding this work through cross-cultural comparative analyses to explore how cultural differences influenced perceptions of the impacts of sustainable mobility. Additionally, adopting a longitudinal approach could reveal temporal dynamics in adoption patterns, complementing the current snapshot with insights into long-term behavioural shifts.

7. ACKNOWLEDGEMENTS

The authors would like to thank the Faculty of Accountancy, Universiti Teknologi MARA, for providing the necessary financial assistance for this study.

8. CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders. data availability/supplementary materials

9. ETHICS STATEMENT

This study involved human participants and utilised a questionnaire from the University of Seville, administered to university students. The study adhered to established ethical standards for social science research; participation was voluntary, informed consent was obtained, and responses were anonymous and treated confidentially. Formal ethics approval was not sought at the time the study was conducted, as the study posed minimal risk to participants and involved no collection of personally identifiable information.

10. REFERENCES

Ahmad, R., Zakaria, M. A., Anuar, M. I. N. M., Ab Rahman, Z., & Abdullah, J. (2023). Green cover trend: Towards a sustainable city-campus relationship between Puncak Alam and its vicinity. *Planning Malaysia, 21*.

Ahn, H., & Park, E. (2022). For sustainable development in the transportation sector: Determinants of acceptance of sustainable transportation using the innovation diffusion theory and technology acceptance model. *Sustainable Development, 30*(5), 1169–1183.

Aloui, A., Hamani, N., Derrouiche, R., & Delahoche, L. (2021). Systematic literature review on collaborative sustainable transportation: Overview, analysis and perspectives. *Transportation Research Interdisciplinary Perspectives, 9*, 100291.

Bąk, A., Nawrocka, E., Jaremen, D.E. (2022). "Sustainability" as a motive for choosing shared-mobility services: The case of Polish consumers of Uber services. *Sustainability, 14*(10), 6352.

Bebber, S., Libardi, B., Moschen, S. D. A., Silva, M. B. C. D., Fachinelli, A. C., & Nogueira, M. L. (2021). Sustainable mobility scale: A contribution for sustainability assessment systems in urban mobility. *Cleaner Engineering and Technology, 5*, 100271. https://doi.org/10.1016/j.clet.2021.100271

Becker, J.-M., Cheah, J. H., Gholamzade, R., Ringle, C. M., Sarstedt, M. (2023): PLS-SEM's Most Wanted Guidance, *International Journal of Contemporary Hospitality Management, 35*(1), 321-346.

Benitez, J., Henseler, J., Castillo, A., & Schuberth, F. (2020). How to perform and report an impactful analysis using partial least squares: Guidelines for confirmatory and explanatory IS research. *Information & management, 57*(2), 103168.

Best, R.J. (2007). Marketing Estratégico. Pearson Educación.

Best, R.J. (2013). Market-Based Management: Strategies for growing customer value and profitability. Pearson.

Chin, W. W. (2009). How to write up and report PLS analyses. In Handbook of partial least squares: Concepts, methods and applications (pp. 655-690). Berlin, Heidelberg: Springer Berlin Heidelberg.

Chirieleison, C., Montrone, A., & Scrucca, L. (2019). Event sustainability and sustainable transportation: A positive reciprocal influence. *Journal of Sustainable Tourism, 28*(2), 240-262.

Ciavolino, E., Ferrante, L., Sternativo, G. A., Cheah, J.-H., Rollo, S., Marinaci, T., & Venuleo, C. (2022). A Confirmatory Composite Analysis for the Italian Validation of the Interactions Anxiousness Scale: A Higher-order Version. *Behaviormetrika, 49*(1), 23-46

Dehghanmongabadi, A., & Hoşkara, Ş. (2020). Determinative variables toward promoting use of active modes of transportation: Enhancing level of sustainable mobility in communities. *Sage Open, 10*(3), 2158244020961118.

De Angelis, M., Prati, G., Tusl, M., Battistini, R., & Pietrantoni, L. (2021). Mobility behaviors of Italian university

students and staff: Exploring the moderating role of commuting distances. *International Journal of Sustainable Transportation, 15*(8), 581-591.

Franke, G. R., & Sarstedt, M. (2019). Heuristics Versus Statistics in Discriminant Validity Testing: A Comparison of Four Procedures, *Internet Research, 29*(3): 430-447.

Hair, J. F., Hult, G. T. M., Ringle, C. M., and Sarstedt, M. (2022). A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)., 3rd Ed., Thousand Oakes, CA: Sage.

Hair, J. F., Sarstedt, M., Ringle, C. M., and Gudergan S. P. (2024). Advanced Issues in Partial Least Squares Structural Equation Modeling (PLS-SEM), 2nd Ed., Sage: Thousand Oaks.

Hasselwander, M., Bigotte, J. F., Antunes, A. P., & Sigua, R. G. (2022). Towards sustainable transport in developing countries: Preliminary findings on the demand for mobility-as-a-service (MaaS) in metro Manila. *Transportation Research Part A: Policy and Practice*, 155, 501-518. https://doi.org/10.1016/j.tra.2021.11.024

Hawkins, D. I., Mothersbaugh, D. L. (2010). *Consumer behaviour: Building marketing strategies*. McGraw-Hill.

Ho, C., & Tirachini, A. (2024). Mobility-as-a-Service and the role of multimodality in the sustainability of urban mobility in developing and developed countries. *Transport Policy, 145*, 161-176. https://doi.org/10.1016/j.tranpol.2023.10.013

Jayaseelan, T., Porpatham, E., Subramanian, J., & Shamim, T. (2022). A comprehensive review on the current trends, challenges and future prospects for sustainable mobility. *Renewable and Sustainable Energy Reviews, 157*, 112073.

Khoo, H. L., & Ong, G. P. (2015). Understanding sustainable transport acceptance behavior: A case study of Klang Valley, Malaysia. *International Journal of Sustainable Transportation, 9*(3), 227-239.

Kriswardhana, W., & Esztergár-Kiss, D. (2024). University students' adoption of mobility as a service with respect to user preferences and group differences. *Journal of Public Transportation, 26*,100079.

Ministry of Transport Malaysia (MOTM). (n.d.). *Current rail services*. https://www.mot.gov.my/en/land/infrastructure/current-rail-services

Ministry of Transport Malaysia (MOTM). (2020). National Transport Policy 2030: *Connecting the future of transportation*. https://dpn.mot.gov.my/portal/Slide_NTP2030.pdf

Min S., So, K. F., & Jeong M. (2019). Consumer adoption of the Uber mobile application: Insights from Diffusion of Innovation Theory and Technology Acceptance Model.

Min, S., So, K.K.F., & Jeong, M. (2021). Consumer adoption of the Uber mobile application: Insights from diffusion of innovation theory and technology acceptance model. *Future of Tourism Marketing*, 2-15. Routledge.

Munkácsy, A.; Monzón, A. (2018). Diffusion of bike sharing as an innovation vector in the city: The case of BiciMAD (Madrid). *Journal of Urban Technology, 25*(3), 1–26.

Naaman, A., Shiran, G., Haghshenas, H., & Alavi, M. (2024). Application of sustainable transport at the university campus level in the face of the COVID-19 pandemic. *Case Studies on Transport Policy, 15*, 101133. https://doi.org/10.1016/j.cstp.2023.101133

Pazhuhan, M., Soltani, A., Ghadami, M., Shahraki, S. Z., & Salvati, L. (2022). Environmentally friendly behaviors and commuting patterns among tertiary students: the case of University of Tehran, Iran. Environment, *Development and Sustainability, 24*(5), 7435-7454.

Ringle, C. M., Wende, S., & Becker, J.-M. (2024). SmartPLS 4. Bönningstedt: SmartPLS. Retrieved from

https://www.smartpls.com

Rodríguez-Rad, C. J., Revilla-Camacho, Sánchez-del-Río-Vázquez, M. E. (2023). Exploring the intention to adopt sustainable mobility modes of transport among young university students. *International Journal of Environmental Research and Public Health, 20*(4), 3196. https://doi.org/10.3390/ijerph20043196

Rogers, E. M. (1995). Lessons for guidelines from the diffusion of innovations. *The Joint Commission Journal on Quality Improvement, 21*(7), 324-328.

Sarstedt, M., Ringle, C. M., & Hair, J. F. (2021). Partial Least Squares Structural Equation Modeling. In C. Homburg, M. Klarmann, & A. E. Vomberg (Eds.), Handbook of Market Research (pp. 1–47). Springer: Cham

Scheffer, A. P., Cechetti, V. P., Lauermann, L. P., Porto, E. R., & Rosa, F. D. (2019). Study to promote the sustainable mobility in university. *International Journal of Sustainability in Higher Education, 20*(5), 871-886.

Schuberth, F., Rademaker, M. E., & Henseler, J. (2023). Assessing the Overall Fit of Composite Models Estimated by Partial Least Squares Path Modeling. *European Journal of Marketing, 57*(6), 1678-1702.

Singh, A., Gurtu, A., & Singh, R. K. (2020). Selection of sustainable transport system: A case study. *Management of Environmental Quality: An International Journal, 32*(1), 100-113.

Sundram, V. P. K., Hashim, N., Shariff, S. H., Pujiati, A., & Ardiansari, A. (2021). Sustainable transportation on university campus: A case at UiTM Selangor, Puncak Alam Campus, Malaysia and Universitas Negeri Semarang, Indonesia. *Asian Journal of University Education, 17*(2), 262-272.

Sundram, V. P. K., Shariff, S. H., Daud, A., Muhamed, A. A., Pyeman, J., & Ghapar, F. (2022). Sustainable transport practices in an urban university. A case study approach. *Journal of Positive School Psychology*, 9767-9791.

Wang, X., Yan, X., Zhao, X., & Cao, Z. (2022). Identifying latent shared mobility preference segments in low-income communities: Ride-hailing, fixed-route bus, and mobility-on-demand transit. *Travel Behaviour and Society, 26*, 134-142.

Zhao, X., Ke, Y., Zuo, J., Xiong, W., & Wu, P. (2020). Evaluation of sustainable transport research in 2000–2019. *Journal of Cleaner Production, 256*, 120404.