

Public acceptance intention toward autonomous rapid transit in Malaysia using an extended technology acceptance model

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Abstract

Autonomous rapid transit (ART) is being considered as an emerging urban public-transport option in Malaysia, but its benefits depend in part on public willingness to use and trust the technology. This study evaluates public acceptance of ART in Iskandar Malaysia, Johor, using an enhanced Technology Acceptance Model (TAM) that incorporates demographic characteristics and perceived safety and security alongside perceived usefulness, perceived ease of use, perceived environmental friendliness, and intention to use. An online questionnaire yielded 426 responses. Descriptive and chi-square cross-tabulation analyses were used to examine acceptance patterns, while covariance-based structural equation modelling (CB-SEM) was used to assess the proposed measurement and structural relationships. Acceptance was significantly associated with respondents' location ($\chi^2 = 142.857$, $df = 12$, $p < 0.001$), profession ($\chi^2 = 235.823$, $df = 16$, $p < 0.001$), and current transport mode ($\chi^2 = 470.788$, $df = 16$, $p < 0.001$). Overall, 75.8% of respondents indicated that they were likely or very likely to accept ART. Students and private-sector employees showed comparatively strong acceptance, while private-car users constituted the largest respondent group. The SEM demonstrated satisfactory overall fit (CFI = 0.983, TLI = 0.982, RMSEA = 0.033, SRMR = 0.069). Demography had a positive association with Acceptance (estimate = 0.131, $p < 0.001$), whereas Safety and Security had a negative association with Acceptance (estimate = - 0.428, $p < 0.001$). Demography was also significantly associated with Safety and Security (estimate = - 0.160, $p < 0.001$). Perceived cyber-security risk was not a significant indicator of Safety and Security (estimate = - 0.079, $p = 0.367$). The findings suggest that ART implementation should combine technology-oriented communication with visible onboard safety measures, accessible first- and last-mile connections, and user-centred service design.

1 Introduction

Advances in vehicle automation, sensing, communications, and intelligent transportation systems have expanded interest in automated public transport [1, 2]. Early pilot deployments, such as the City Automated Transport System in Europe, illustrate that driverless transit concepts have been under active development and public trial for some time [8]. Autonomous and automated transit services are expected to offer potential benefits including improved operational safety, accessibility, travel-time reliability, and reduced dependence on private vehicles [9, 10]. However, these potential benefits cannot be assumed to translate directly into adoption: passengers must perceive the service as useful, easy to use, safe, secure, and compatible with their travel needs [11, 12].

In Malaysia, the emergence of Autonomous Rapid Transit (ART) in Iskandar Malaysia provides an important context for examining acceptance of automated public transport. ART is particularly relevant to urban mobility because its successful implementation requires not only technical and infrastructure readiness but also public confidence in the service [13]. The present study therefore focuses on public acceptance in Johor and examines how demographic characteristics, perceived safety and security, and TAM-related perceptions are associated with acceptance.

1.1 Problem statement and research gap

Existing acceptance studies have examined autonomous cars, automated shuttles, and automated buses using TAM, UTAUT, the Theory of Interpersonal Behaviour, and other behavioural frameworks [14, 15, 16, 17, 18]. Evidence indicates that perceived usefulness, ease of use, trust, safety, security, social influence, and individual characteristics can shape acceptance [8, 19, 20, 21, 22]. Nevertheless, the evidence base remains context dependent, and comparatively less empirical work has examined ART acceptance in Malaysia [13, 23].

A further gap concerns the joint consideration of conventional TAM variables with demographic characteristics and safety/security perceptions in an urban public-transport context. This gap is notable given that most Malaysian public-transport acceptance research to date has concentrated on conventional bus, rail, and light-rail services rather than automated systems [24, 25]. This study addresses that gap by testing an enhanced TAM-based model using survey data from Iskandar Malaysia. The contribution is empirical rather than a claim of universal causality: the study identifies associations among observed demographic variables, safety/security perceptions, and ART acceptance within the sampled population.

1.2 Research objectives and questions

The study has two objectives: (1) to evaluate public acceptance of ART in Iskandar Malaysia, Johor; and (2) to evaluate an enhanced TAM-based model incorporating demographic characteristics and safety/security perceptions as additional explanatory constructs.

RQ1. What is the level of public acceptance of ART among respondents in Iskandar Malaysia? RQ2. Is ART acceptance statistically associated with respondents' location, profession, and current transport mode? RQ3. How are demographic characteristics and safety/security perceptions related to ART acceptance in the proposed SEM?

The findings are relevant to transport authorities, urban planners, ART operators, technology developers, and researchers concerned with technology-enabled public transport, providing evidence on user segments and perceived barriers that can inform communication, service design, safety provision, and first- and last-mile integration.

1.3 Literature review and conceptual framework

The Technology Acceptance Model (TAM) proposes that perceived usefulness and perceived ease of use are central determinants of technology acceptance [3]. Subsequent TAM research has supported extensions in which contextual, social, trust, and risk-related variables are incorporated to reflect the characteristics of specific technologies and use environments [4, 18, 26]. For automated public transport, this extension is particularly relevant because acceptance involves both conventional technology-use perceptions and concerns about safety, security, reliability, and the absence of a human driver [12, 20].

Previous studies of automated buses and shuttles report that perceived safety, trust, system characteristics, usefulness, ease of use, and passenger experience can affect willingness to use automated services [15, 16, 27, 28, 29, 30]. International studies also indicate that attitudes vary with individual characteristics and travel context [11, 31]. These findings support the need to examine ART as a public-transport service rather than treating it as equivalent to a privately owned autonomous vehicle [2, 13].

Safety and security are salient acceptance considerations for automated public transport [10, 21]. Perceived safety risk may reflect concerns about technical failures or operational hazards, whereas onboard security may encompass concerns such as harassment, theft, and emergency response [21, 22]. Cybersecurity and privacy concerns are also plausible barriers because automated services depend on software, communications, and connected systems [19, 20]. The empirical results of the present study, however, show that the perceived cyber-security-risk indicator was not statistically significant in the final measurement model; therefore, cybersecurity should not be described as a significant predictor on the basis of these data.

Perceived environmental friendliness and usefulness extend the conventional TAM logic to the public-transport setting [9, 32]. Respondents may evaluate ART not only according to direct usability but also according to whether the service contributes to more sustainable mobility and offers practical benefits such as accessibility, time savings, and reduced dependence on private transport.

The tested model treats age, profession, and highest educational level as indicators of a Demography construct; perceived safety risk, perceived onboard safety, and perceived cyber-security risk as indicators of Safety and Security; and perceived environmental friendliness, intention to use, perceived ease of use, and perceived usefulness as indicators of Acceptance. Age, profession, and education have been shown to moderate technology-acceptance relationships in other contexts, which supports treating demographic characteristics as a distinct construct in the present model [17, 18]. Because some demographic categories were coded directionally, the signs of demographic loadings should be interpreted in relation to the coding scheme rather than as substantive positive or negative effects. This structural logic is consistent with behavioural frameworks in which background factors are modelled as antecedents of belief-based constructs rather than as direct predictors of intention [14].

The structural component evaluates three relationships: Demography → Acceptance; Safety and Security → Acceptance; and Demography → Safety and Security, represented as:

$$\text{Acceptance} = \gamma_1(\text{Demography}) + \gamma_2(\text{Safety and Security}) + \zeta_1$$

$$\text{Safety and Security} = \gamma_3(\text{Demography}) + \zeta_2$$

The principal structural hypotheses are: H1: Demography is significantly associated with Acceptance. H2: Safety and Security is significantly associated with Acceptance. H3: Demography is significantly associated with Safety and Security.

2 Methods

2.1 Research design and study context

A quantitative cross-sectional survey design was used. The study focused on the ART context in Iskandar Malaysia, Johor, including the Phase 1 areas identified in the source manuscript: Tebrau, Skudai, Iskandar Puteri, and Pantai Lido. The study examined prospective public acceptance rather than claiming that acceptance guarantees subsequent real-world ridership.

2.2 Questionnaire development

The questionnaire comprised four broad components covering respondent characteristics; safety and security perceptions; technology-related perceptions and initial trust/reliability considerations; and intention to use/acceptance. Five-point Likert-type response scales were used for perception items, consistent with established TAM- and UTAUT-based survey instruments [3, 17]. The questionnaire was administered through Google Forms.

2.3 Pilot reliability assessment

A pilot survey was conducted among volunteer respondents in the proposed study area. Internal consistency was evaluated using Cronbach's alpha [33] and McDonald's omega, the latter being recommended as a less assumption-dependent alternative to alpha [34]. The reported posterior mean values were 0.784 for Cronbach's alpha and 0.774 for McDonald's omega, with 95% credible intervals indicating acceptable internal consistency. Reliability is reported here as internal consistency reliability; it is not treated as evidence of construct validity by itself [35].

Table 1 Pilot internal-consistency reliability statistics

Statistic	Posterior mean	95% CI lower	95% CI upper
Cronbach's α [33]	0.784	0.756	0.812
McDonald's ω [34]	0.774	0.746	0.807

2.4 Sampling and data collection

The survey was distributed online through social-media channels including WhatsApp, Instagram, and Facebook over a three-month period. Because participation was voluntary and recruitment occurred through online channels, the sampling procedure is best characterised as non-probability volunteer/convenience sampling rather than probability random sampling [36]. A total of 426 valid responses were obtained.

2.5 Data analysis

Descriptive statistics were used to summarise respondent characteristics and current transport modes. Pearson chi-square cross-tabulations were then used to examine associations between ART acceptance and location, profession, and current transport mode. Statistical significance was evaluated at $\alpha = 0.05$. Reported software output values of 0.000 are presented as $p < 0.001$.

Covariance-based structural equation modelling was conducted in JASP using the lavaan framework in R [6]. The analysis comprised measurement-model evaluation and structural-model estimation. Model fit was assessed using χ^2 , CFI, TLI, RMSEA, SRMR, GFI and related indices, following established cutoff guidance [5, 7]. The χ^2 statistic was not treated as a stand-alone indicator of practical model fit because exact-fit χ^2 is sensitive to sample size [5, 7].

2.6 Ethics approval and consent to participate

This study was reviewed and approved by the relevant research ethics committee of Universiti Teknologi MARA (UiTM) and by the appropriate state/local approval authority governing research conducted within Iskandar Malaysia, Johor, prior to data collection. Participation was voluntary and anonymous, and respondents were informed of the purpose of the study before completing the questionnaire. Because the sample included respondents aged 14 to 19 years, parental/guardian consent and participant assent procedures consistent with the approved protocol were applied for this age group.

3 Results

3.1 Respondent profile

The dataset comprised 426 respondents. Men represented 59.4% and women 40.6% of the sample. The largest age group was 14–19 years (50.7%), followed by 26–34 years (22.1%). Students represented 54.0% of respondents and private-sector employees 22.1%. Respondents with a bachelor's degree or diploma represented 58.7%, while 28.9% had secondary-school education. By location, Skudai accounted for 33.6% of respondents, followed by Iskandar Puteri (30.3%), with smaller shares from Tebrau and Pantai Lido.

3.2 Current transport mode

Table 2 Current transport mode of respondents

Current mode	Frequency	Percent
Personal car	334	78.4
E-hailing	50	11.7
Taxi	3	0.7
Public bus	35	8.2
Walking and cycling	4	0.9
Total	426	100.0

3.3 Acceptance of ART by location

ART acceptance was significantly associated with respondents' location, Pearson $\chi^2(12) = 142.857$, $p < 0.001$. The results indicate comparatively stronger acceptance among respondents from Skudai and Iskandar Puteri, followed by Tebrau, while Pantai Lido showed comparatively lower acceptance. Because the analysis is cross-sectional and non-probability based, these results indicate association within the sample and should not be interpreted as causal or population-representative effects [36].

Table 3 Chi-square test statistics: acceptance by location

Test	Value	df	p
Pearson χ^2	142.857	12	<0.001
Likelihood ratio	151.595	12	<0.001
Linear-by-linear association	41.112	1	<0.001
Valid cases	426		

3.4 Acceptance of ART by profession

Profession was significantly associated with ART acceptance, Pearson $\chi^2(16) = 235.823$, $p < 0.001$. Students and private-sector employees showed comparatively higher acceptance, whereas self-employed, government-employed, and unemployed groups showed lower acceptance in the observed sample. The linear-by-linear association was not significant ($p = 0.099$), so the finding should be interpreted as a categorical association rather than an ordinal trend.

Table 4 Chi-square test statistics: acceptance by profession

Test	Value	df	p
Pearson χ^2	235.823	16	<0.001
Likelihood ratio	169.035	16	<0.001
Linear-by-linear association	2.714	1	0.099
Valid cases	426		

3.5 Acceptance of ART by current transport mode

Current transport mode was significantly associated with ART acceptance, Pearson $\chi^2(16) = 470.788$, $p < 0.001$. Private-car users formed the largest group and showed substantial willingness to accept ART. E-hailing and public-bus users also showed willingness to accept the service, whereas the very small walking/cycling subgroup showed low acceptance. The linear-by-linear association was not significant ($p = 0.489$), again indicating that the result should be interpreted as a nominal association.

Table 5 Chi-square test statistics: acceptance by current transport mode

Test	Value	df	p
Pearson χ^2	470.788	16	<0.001
Likelihood ratio	101.306	16	<0.001
Linear-by-linear association	0.478	1	0.489
Valid cases	426		

3.6 Overall acceptance

Across the acceptance responses, 75.8% of respondents were classified in the likely or very likely categories. This indicates a generally favourable stated acceptance of ART in the sampled population, while the cross-tabulation results show meaningful differences across location, profession, and current transport mode.

3.7 SEM model fit

The model produced $\chi^2(32) = 197.641$, $p < 0.001$. The exact-fit χ^2 was statistically significant, but the remaining fit indices indicated satisfactory approximate and comparative fit: CFI = 0.983, TLI = 0.982, NNFI = 0.982, NFI = 0.939, PNFI = 0.881, RFI = 0.953, IFI = 0.983, RNI = 0.983, RMSEA = 0.033 (90% CI: 0.005–0.066), and SRMR = 0.069. GFI and MFI were 0.978 and 0.961, respectively. These indices

collectively support an acceptable-to-good fit of the specified model, consistent with commonly applied cutoff criteria [5, 7].

Table 6 Structural equation model fit indices

Fit index	Value
χ^2	197.641
df	32
p	<0.001
CFI	0.983
TLI	0.982
RMSEA	0.033
RMSEA 90% CI	0.005–0.066
SRMR	0.069
GFI	0.978
MFI	0.961
NFI	0.939
PNFI	0.881

3.8 Measurement model

The supplied SEM output reports unstandardized factor loadings. Because one indicator per latent construct is fixed to 1.000 for identification, these unstandardized loadings should not be compared with a universal 0.80 loading threshold [35, 36]. The key finding is statistical significance of the estimated loadings and the nonsignificance of perceived cyber-security risk.

Table 7 Measurement model: unstandardized factor loadings

Latent construct	Indicator	Estimate	SE	z	p
Acceptance	Perceived environmentally friendly	1.000	0.000	12.782	<0.001
Acceptance	Intention to use	1.005	0.077	13.107	<0.001
Acceptance	Perceived ease of use	1.277	0.098	12.983	<0.001
Acceptance	Perceived usefulness	1.132	0.085	13.327	<0.001
Demography	Age range	1.000	0.000	12.782	<0.001
Demography	Profession	-0.918	0.111	-8.296	<0.001
Demography	Highest educational level	-0.620	0.070	-8.849	<0.001
Safety and Security	Perceived safety risk	1.000	0.000	13.782	<0.001
Safety and Security	Perceived onboard safety	1.550	0.210	7.380	<0.001
Safety and Security	Perceived cyber-security risk	-0.079	0.088	-0.902	0.367

Perceived cyber-security risk was not a statistically significant indicator of Safety and Security (estimate = -0.079, $p = 0.367$) [19, 20]. Accordingly, the original claim that perceived cybersecurity positively influenced acceptance has been removed.

3.9 Structural model

The structural estimates indicate significant relationships among the latent constructs. Demography was positively associated with Acceptance (estimate = 0.131, SE = 0.029, $z = 4.577$, $p < 0.001$). Safety and Security was negatively associated with Acceptance (estimate = -0.428, SE = 0.064, $z = -6.667$, $p < 0.001$). Demography was also negatively associated with Safety and Security (estimate = -0.160, SE = 0.029, $z = -5.543$, $p < 0.001$). The signs should be interpreted in conjunction with the coding direction of the underlying indicators, particularly because higher values of some safety/security items represent greater perceived risk.

Table 8 Structural model path estimates

Path	Estimate	SE	z	p	95% CI
Demography → Acceptance	0.131	0.029	4.577	<0.001	-0.001 to 0.236
Safety and Security → Acceptance	-0.428	0.064	-6.667	<0.001	-0.630 to -0.213
Demography → Safety and Security	-0.160	0.029	-5.543	<0.001	-0.250 to -0.062

3.10 Explained variance

The reported R^2 for Acceptance was 0.679, indicating that approximately 67.9% of the variance in the Acceptance construct was explained by the structural predictors included in the model. The R^2 for Safety and Security was 0.690. The remaining indicator-level R^2 values reported by the software are reproduced below for transparency.

Table 9 Explained variance (R^2) for model parameters

Parameter	R^2
Age range	0.781
Profession	0.755
Highest educational level	0.798
Perceived safety risk	0.697
Perceived onboard safety	0.751
Perceived cyber-security risk	0.696
Perceived environmentally friendly	0.779
Intention to use	0.681
Perceived ease of use	0.896
Perceived usefulness	0.849
Safety and Security	0.690
Acceptance	0.679

4 Discussion

The observed 75.8% likely/very-likely acceptance suggests a favourable initial attitude toward ART among the surveyed participants, comparable in magnitude to acceptance levels reported for other automated bus and shuttle deployments [16, 27, 30]. However, the composition of the sample matters: young respondents, students, private-sector employees, and private-car users form substantial portions of the dataset. The findings therefore support targeted rather than universal conclusions about acceptance.

The three chi-square analyses demonstrate statistically significant associations between acceptance and location, profession, and current transport mode. These results are useful for market segmentation and stakeholder engagement because acceptance is not distributed uniformly across the sampled

groups, echoing evidence that behavioural intention toward public transport varies systematically across traveller segments in the Malaysian context [24, 25]. The nonsignificant linear-by-linear statistics for profession and transport mode also show why the Pearson chi-square results should not be described as monotonic trends.

Safety and Security was significantly related to Acceptance. Because the construct includes perceived risk-oriented items, the negative structural coefficient is substantively consistent with the interpretation that greater perceived safety/security risk is associated with lower acceptance, in line with findings from automated-shuttle trials elsewhere [21, 22]. Onboard safety was a significant measurement indicator, highlighting the importance of visible passenger protection, emergency response, and personal security in automated transit environments [10, 21].

Contrary to the original manuscript's interpretation, perceived cyber-security risk did not significantly load on the Safety and Security construct in the final model. This does not establish that cybersecurity is irrelevant to ART users in general; rather, it indicates that the present dataset did not provide statistically significant evidence for its role within the specified measurement model. Future research should therefore measure cybersecurity and privacy using multiple validated items and, where possible, distinguish cyber risk from physical safety and data privacy, as recommended in prior technology-acceptance and automated-driving research [19, 20].

Perceived usefulness, perceived ease of use, intention to use, and perceived environmental friendliness were statistically significant indicators of the Acceptance construct in the supplied model. This supports the value of extending TAM to reflect the public-transport context [3, 4, 12, 17, 18]. Nevertheless, the model should be understood as an adapted TAM-based specification rather than the canonical TAM, because the four indicators were modelled jointly as indicators of an Acceptance construct.

The study contributes a context-specific empirical extension of TAM for automated public transport by incorporating demographic and safety/security dimensions. Its principal contribution is the joint empirical examination of these dimensions in the Malaysian ART context. This mirrors similar extensions of established behavioural theories, such as the theory of planned behaviour, to novel transport modes and contexts [14, 37]. The results also demonstrate the importance of distinguishing significant structural associations from nonsignificant measurement indicators, particularly for cybersecurity.

For transport authorities and ART operators, implementation should prioritise visible onboard safety, reliable emergency procedures, clear passenger information, and effective first- and last-mile connectivity. Engagement should also be tailored to groups with lower observed acceptance rather than relying on a single general communication strategy. Private-car users constitute the largest sampled group, suggesting that ART promotion should emphasise credible travel-time, convenience, reliability, and accessibility benefits that can motivate modal shift, consistent with determinants identified for shifting private motor-vehicle users toward rail-based transport in Kuala Lumpur [25]. Infrastructure design should minimise conflicts between ART operations and mixed traffic where applicable, but any

specific lane/barrier recommendation should be validated against the final engineering and operating design. For technology developers, the findings support user-centred design and transparent communication about system capabilities and limitations, consistent with recommendations from behavioural-intention research on public transport in Malaysia [24, 37]. For policymakers, acceptance monitoring should continue after deployment through stated-preference and revealed-preference studies, enabling comparison between intention to use and actual ridership.

5 Conclusions

online survey responses and an enhanced TAM-based SEM framework. Overall, 75.8% of respondents reported that they were likely or very likely to accept ART. Acceptance was significantly associated with location, profession, and current transport mode. The SEM showed satisfactory comparative and approximate fit, with CFI = 0.983, TLI = 0.982, RMSEA = 0.033, and SRMR = 0.069 [5, 7]. Demography was significantly associated with Acceptance and with Safety and Security, while Safety and Security was significantly associated with Acceptance.

A key correction to the original manuscript is that perceived cyber-security risk was not a significant indicator of Safety and Security ($p = 0.367$). Therefore, the data do not support the earlier statement that cybersecurity positively influenced acceptance. The results instead emphasise the broader role of safety/security perceptions and user-oriented acceptance factors.

The study recommends: (1) strengthening onboard safety and emergency-management measures; (2) improving first- and last-mile accessibility and service usability; (3) tailoring public communication to different demographic and travel-mode groups; (4) continuing cybersecurity/privacy research using validated multi-item measures; and (5) conducting post-deployment longitudinal studies to compare stated acceptance with actual ART use.

5.1 Limitations and future research

Several limitations should be recognised. First, the online volunteer/convenience sample limits statistical generalisability to the wider Malaysian population [36]. Second, the sample contains a large proportion of young respondents, including respondents in the 14–19 age range, which requires explicit verification of consent and assent procedures. Third, the study is cross-sectional and measures stated acceptance rather than revealed behaviour. Fourth, the study focuses on the Johor context, so acceptance may differ in other Malaysian cities. Fifth, the SEM specification groups heterogeneous constructs and uses some categorical demographic variables as indicators; future studies should consider alternative measurement specifications, measurement invariance, and theoretically explicit mediation/moderation models, drawing on established guidance for reporting reliability and validity in SEM [35, 36]. Finally, future work should incorporate actual passenger experience, service reliability, perceived value, trust, privacy, and post-deployment behavioural data.

Declarations

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Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

This study was reviewed and approved by the relevant research ethics committee of Universiti Teknologi MARA (UiTM) and by the appropriate state/local approval authority governing research conducted within Iskandar Malaysia, Johor, prior to data collection. Informed consent to participate was obtained from all respondents; for respondents aged 14 to 19 years, parental/guardian consent together with participant assent was obtained in accordance with the approved protocol. Participation was voluntary and anonymous throughout. All methods were carried out in accordance with the relevant guidelines and regulations applicable to human-subjects research in Malaysia.

Consent for publication

Not applicable. This manuscript presents only aggregate survey results, and contains no personally identifiable data, images, or case details relating to an individual.

Data availability

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request, subject to applicable ethical and data-protection requirements.

Materials availability

Not applicable; no unique physical materials was in this study.

Code availability

The structural equation model was estimated in JASP using the open-source lavaan package for R [6]. No custom code was developed for this study.

Author contributions

Conceptualization: L.G.D.-A., N.M.R., A.K.A. Methodology: L.G.D.-A., N.M.R. Literature review: L.G.D.-A., R.M.-T. Questionnaire design: L.G.D.-A., N.M.R., E.S. Investigation (data collection): L.G.D.-A., R.M.-T. Data curation: L.G.D.-A., R.M.-T. Formal analysis (descriptive, chi-square and SEM): L.G.D.-A., N.M.R. Validation of statistical results: N.M.R., E.S. Writing – original draft: L.G.D.-A. Writing – review and editing: N.M.R.,

R.M.-T., E.S., A.K.A. Visualization: L.G.D.-A. Supervision: N.M.R., E.S., A.K.A. Project administration: A.K.A. All authors read and approved the final manuscript.

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Figures

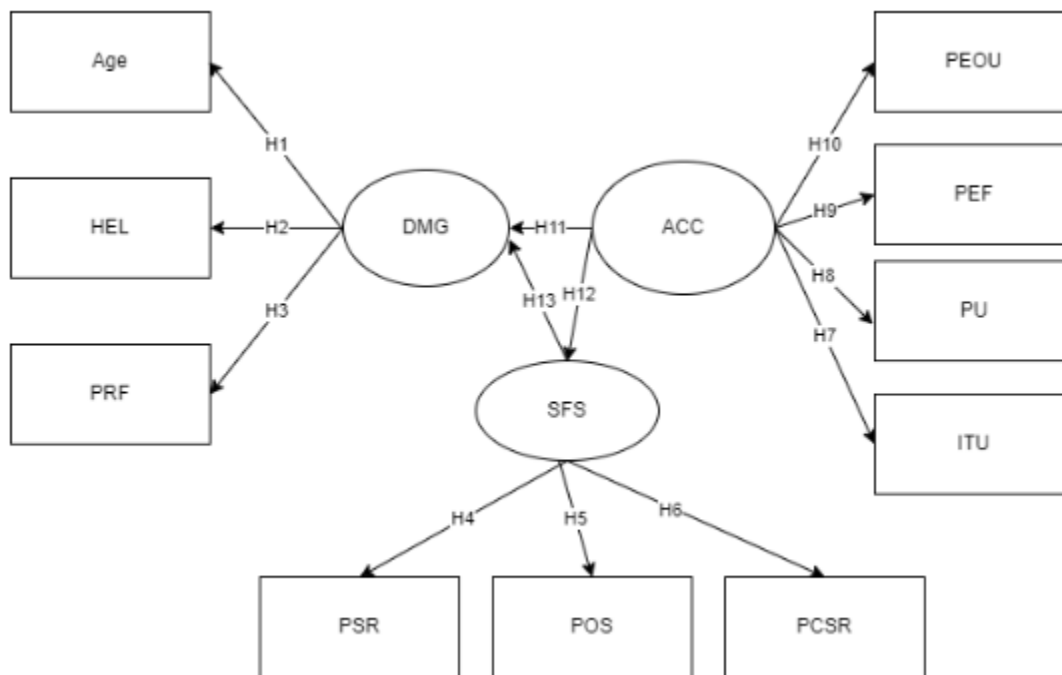


Figure 1
Enhanced TAM-based conceptual model used in the study

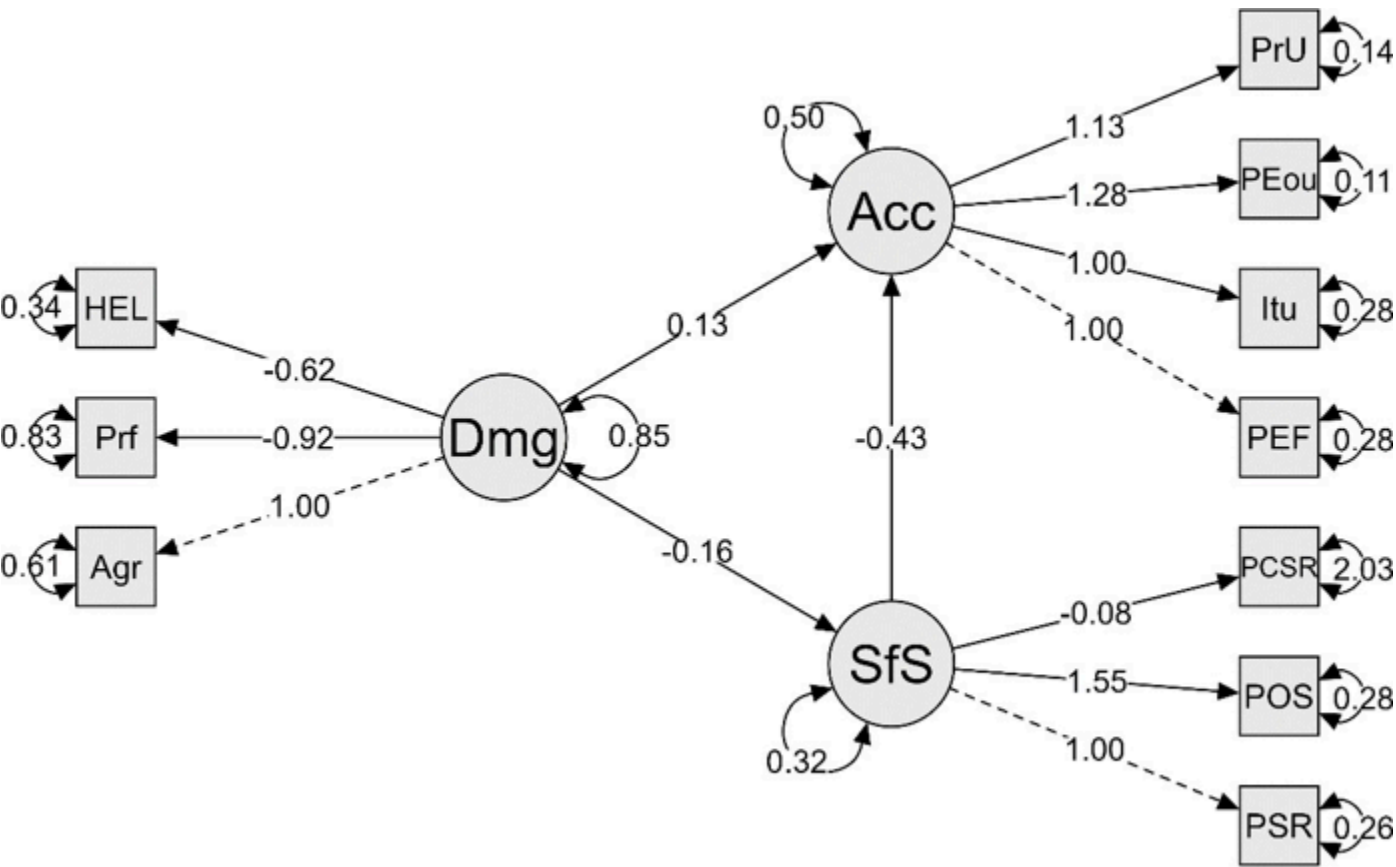


Figure 2
Structural/path diagram of the estimated model



Figure 3

ART study context/route coverage