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Article

Factors Influencing Telematics System Acceptance Among Logistics Companies in Malaysia: The Moderating Role of User Attitude

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Abstract: The logistics industry is increasingly adopting telematics systems to enhance efficiency and safety. This research examines the factors influencing the acceptance of telematics systems among Malaysian logistics companies using a hybrid model of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) from TAM. Social Influence (SI) and Facilitating Condition from UTAUT. One new variable added to the model which is Perceived Trust (PT). Data was collected from 382 logistics personnel via stratified random sampling across Malaysia's central, northern, and southern hubs. This study focus on third party logistics (3PL) companies. The data had analysed through Partial Least Squares Structural Equation Modelling (PLS-SEM), the study reveals that Perceived Ease of Use (PEOU), Facilitating Conditions (FC), and Perceived Trust (PT) are significant direct drivers of acceptance, in a sector where systems monitor driver behaviour and real-time positioning, employees must trust that data will be used for safety rather than "punitive surveillance, while User Attitude (UA) serves as a critical moderator for social and environmental factors. It acted as a catalyst for external enablers, strengthening the impact of Social Influence and Facilitating Conditions on actual acceptance. Notably, Perceived Trust emerged as the single largest structural driver, while Perceived Usefulness (PU) was found to be a non-significant "baseline" requirement for the digitally native workforce. For a digitally native workforce, basic functional utility is a "hygiene factor" assumed baseline that provides no incremental motivation for adoption. Future research should utilize longitudinal designs and qualitative methods to explore the post-adoption phases and long-term sustainability of telematics integration.
Keywords: Telematics adoption, TAM, UTAUT, Perceived Trust, User Attitude, Malaysian logistics

1. INTRODUCTION

Malaysia's strategic location at the heart of Southeast Asia has established it as a regional logistics powerhouse, with the industry projected to reach a market value of USD 31.2 billion by 2026 and a steady compound annual growth rate (CAGR) of 5.1% (DOSM, 2024). This is not merely a geographic coincidence; it is the cornerstone of Malaysia's status as a regional powerhouse. This study focusses on 41,474 companies with core activities of land transport for freight trucking, container haulage and cold chain logistics (DOSM, 2024).

As per mention to Government of Malaysia (2025), from 2021 to 2025, 116,880 unit of lorries have been registered to the Jabatan Pengangkutan Jalan, but only 75,487 unit obtain Class 'A' permit installed by telematic system as per Code 13 and 14 in "Buku Panduan Dan Kod Amalan Industri S.P.A.D. – Keselamatan Untuk Pengendali Berlesen Perkhidmatan Kenderaan Barangan. Implementation of the telematics system is around 64.55% of the overall registered lorries.

Previous studies indicate that user acceptance of technology is influenced by multiple factors derived from theoretical frameworks like the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Tandijono, 2023). Tian et al., (2020). Factors such as perceived usefulness (PU) and perceived ease of use (PEOU) have been widely reported as key determinants of technology acceptance in various domains, including healthcare information systems (Tandijono, 2023) and insurance telematics (Tian et al., 2020). Additionally, social influences and user attitudes have been identified as important catalysts in technology acceptance, suggesting that peer perception and the organisational culture prevalent in logistics companies may also play a significant role (Tian et al., 2020; Almunawar et al., 2020).

Empirical evidence from related fields indicates that user characteristics such as previous experience with technology, educational background, and age can significantly impact perceptions and attitudes towards system use (Philip et al., 2020; Alsahafi et al., 2020). It is posited that fostering a positive user attitude may enhance overall acceptance of telematics systems in logistics settings. Thus, this study aims to fill the existing gap in the literature by exploring the interplay among perceived usefulness, perceived ease of use, user attitude, and acceptance specific to telematics systems in the Malaysian logistics sector. By addressing these dimensions, the study seeks to provide actionable insights into how logistics companies can promote telematics system acceptance, ultimately contributing to improved operational efficiency and competitiveness in the industry.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 The Underpinning Theory

This study utilizes a hybrid theoretical framework combining TAM and UTAUT. TAM focuses on individual system perceptions, while UTAUT accounts for the organizational environment. TAM primarily focuses on two key constructs: perceived ease of use and perceived usefulness, which significantly predict technology acceptance (Pálsdóttir, 2024). However, it has been criticised for overwhelmingly centring on individual decision-making processes, often neglecting the broader organisational context where technology is implemented (Addotey-Delove et al., 2022). In contrast, UTAUT builds upon TAM and expands the understanding of technology adoption by introducing additional constructs such as social influence and facilitating conditions, which account for the user's environment and organisational support (Rahman et al., 2023). These added layers from UTAUT provide a necessary context that TAM lacks, addressing the interplay between user characteristics and external influences such as organisational culture and support systems (Aleisa, 2024).

This necessity for a hybrid approach becomes evident in health informatics, where emotional, cultural, and organisational barriers play critical roles in how technologies are adopted among healthcare workers (Hajesmaeel-Gohari et al., 2022; Jacob et al., 2025). The combined frameworks can thus inform a more tailored evaluation of telematic systems in such settings by considering both individual motivations and the organisational or proactive support to adoption (Corbett et al., 2025).

Research shows that integrating TAM and UTAUT can lead to improved explanatory power regarding technology acceptance in various domains, including healthcare (Xu et al., 2021). These enhancements permit the incorporation of qualitative insights that may elucidate why users either resist or embrace telematic systems, giving rise to deeper awareness among stakeholders about the potential facilitators and barriers to technology uptake.

Diving down to the logistics industry scope, three key papers were identified for the last five years. All three papers use TAM and UTAUT as the underpinning theory in their studies. Nguyen et al (2025) also use TAM to measure acceptance of a logistic robot. Perceived Trust is measured as a new variable to extend the existing TAM. While Kapser & Abdelrahman (2020) use UTAUT with 500 consumers to measure acceptance of autonomous delivery vehicles. Risk and trust also measured as independent variable. Hence Perceived trust show a significant relationship with the acceptance of telematics system.

2.2 The Acceptance of Telematic Systems Among Logistic Companies in Malaysia.

One of the primary drivers of telematics system adoption in logistics is the need for enhanced safety, as mentioned in the problem statement. Research indicates that telematics systems can play a crucial role in reducing road traffic incidents (RTIs) through various interventions, including real-time feedback to drivers and improved communication with emergency services (Safavi-Naini et al., 2024). Such systems monitor driver behaviour and can provide critical insights that lead to safer driving practices. Furthermore, while integrations of telematics with AI have potential, the specific application within logistics and real-time data accessibility needs more direct evidence (AÇAR & Clarke, 2021).

Moreover, telematic systems can contribute to environmental sustainability, aligning with broader economic and ecological goals. For instance, companies are urged to adopt circular economy practices, emphasising reduced resource consumption and waste. Telematic systems facilitate this by enabling more precise control over logistics operations, reducing fuel consumption and emissions. This shift is particularly pertinent for small and medium-sized enterprises (SMEs) in the UK, necessitating innovative solutions to enhance competitiveness and sustainability (Dey et al., 2022).

Lastly, the successful implementation of telematics systems requires not only technological solutions but also a cultural shift within organisations. Companies must foster a culture that embraces change and innovation, addressing psychological barriers that may deter personnel from adopting new technologies. By doing so, logistics companies can maximise the potential benefits of telematics and position themselves for future growth in an increasingly competitive market.

2.3 User Attitude as Moderator in Technology Acceptance and Use

Empirical demonstrations show that attitude interacts with perceived usefulness and ease of use to condition downstream intentions and usage, consistent with moderated mediation readings of TAM/UTAUT constructs (Dwivedi et al., 2020). This framing aligns with established moderation theory in attitude–behaviour research, where the attitude–behaviour relationship may be strengthened or weakened depending on contextual factors such as task difficulty (Vahdat et al., 2020). System usability, user feedback, and constructs like attitude toward using and intention to use recur as central determinants, with attitude potentially moderating the relation between usability signals and adoption outcomes (Nadal et al., 2020). In chronic condition management, attitude and self-efficacy beliefs further condition the translation of acceptance into sustained use of smart medical devices (e.g., smart insoles) (Macdonald et al., 2019).

The same goes for education and virtual learning. Attitude toward technology frequently acts as a moderator in e-learning acceptance, with external variables such as perceived severity of the pandemic shaping how TAM/UTAUT determinants translate into intention and actual use (Amankwa & Asiedu, 2022). In post-COVID-19 scenarios, evolving attitudes can modify the adoption trajectory of educational technologies (Ishaq et al., 2021). When more physical classes return to normal, user attitudes towards e-learning or line class reduce.

2.4 Hypothesis Development

The adoption and acceptance of telematic systems in logistics are governed by five primary factors anchored in the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). First, Perceived Usefulness (PU) drives adoption when systems demonstrate tangible operational value—such as real-time vehicle tracking, optimized routing, reduced operational costs, and enhanced supply chain sustainability. Integrating telematics with IoT and blockchain further elevates PU by ensuring data integrity, traceability, and cross-organizational transparency.

H1 posits a significant relationship between perceived usefulness and the acceptance of telematic systems.

Second, Perceived Ease of Use (PEOU) accelerates initial uptake by minimizing cognitive load and training burdens through intuitive interfaces, such as route-planning dashboards. However, PEOU's impact can be overshadowed if the system lacks utility, or if users face complex navigation and data privacy concerns.

H2 proposes a significant relationship between perceived ease of use and telematic system acceptance.

Third, Social Influence (SI) shapes adoption intentions through executive endorsement, peer usage, organizational culture, and external regulatory mandates. Leadership backing and visible success stories help translate social expectations into sustained system usage.

H3, which states there is a significant relationship between social influence and system acceptance.

Fourth, Facilitating Conditions (FC)—encompassing technical infrastructure, reliable hardware, network connectivity, and responsive IT support—provide the essential foundation for deployment. While FC interacts with PU and PEOU to improve user experiences, certain organizational contexts reveal that infrastructure alone may not directly drive adoption if other individual benefits are lacking.

H4 argues that a significant relationship exists between facilitating conditions and system acceptance.

Finally, Perceived Trust (PT) is crucial in data-rich environments to mitigate concerns over cybersecurity, data privacy, and system reliability. Fostering trust through secure, transparent data governance amplifies the positive effects of PU and PEOU.

H5, which asserts a significant relationship between perceived trust and the acceptance of telematic systems.

User attitude serves as a crucial moderating factor in the acceptance of telematic systems within logistics, significantly shaping how external determinants translate into actual technology adoption. Shaped by digital literacy, system functionality, audio-visual quality, and user satisfaction, positive user attitudes enhance overall confidence in system performance. Furthermore, environmental elements—such as organizational dynamics, professional support, socio-cultural factors, and structured training programs—play a vital role in fostering user readiness and nurturing favourable perceptions. By cultivating a positive user attitude and demonstrating technological value, organizations can significantly strengthen adoption pathways.

H1a: User attitude moderates the relationship between perceived usefulness (PU) and the acceptance of the telematic system.

H2a: User attitude moderates the relationship between perceived ease of use (PEOU) and the acceptance of the telematic system.

H3a: User attitude moderates the relationship between social influence (SI) and the acceptance of the telematic system.

H4a: User attitude moderates the relationship between Facilitating Condition (FC) and the acceptance of the telematic system.

H5a: User attitude moderates the relationship between perceived trust (PT) and the acceptance of the telematic system.

3. RESEARCH METHODOLOGY

The quantitative research methodology designed to investigate telematic system adoption within Malaysian logistics firms. Guided by the Technology Acceptance Model (TAM), the study evaluates key predictors including Perceived Usefulness, Perceived Ease of Use, Social Influence, Facilitating Conditions, Trust, and User Attitude. A pilot test involving 30 logistics operators from the Land Public Transport Agency (APAD) database was conducted to refine the research instrument, demonstrating strong internal consistency and convergent validity across all constructs.

Stratified random sampling was implemented in this study to account for regional variations in logistics performance, socio-economic contexts, and overall operational activities across Malaysia. From a total target population of 41,471 logistics companies, the researcher established distinct geographical strata focusing on three primary logistics hubs: the Central Region (encompassing Selangor and Kuala Lumpur), the Northern Region, and the Southern Region (including Johor). By dividing the sample frame into these specific regional groups, the methodology

ensured that the study captured an accurate structural representation of the national industry. Consequently, the final collected sample of 382 participating companies comprised 154 firms from the Central Region (40%), 114 from the Northern Region (30%), and 114 from the Southern Region (30%). The higher sample proportion drawn from the Central region directly aligns with the stratified strategy, reflecting the heavy concentration of corporate logistics headquarters situated within that core hub.

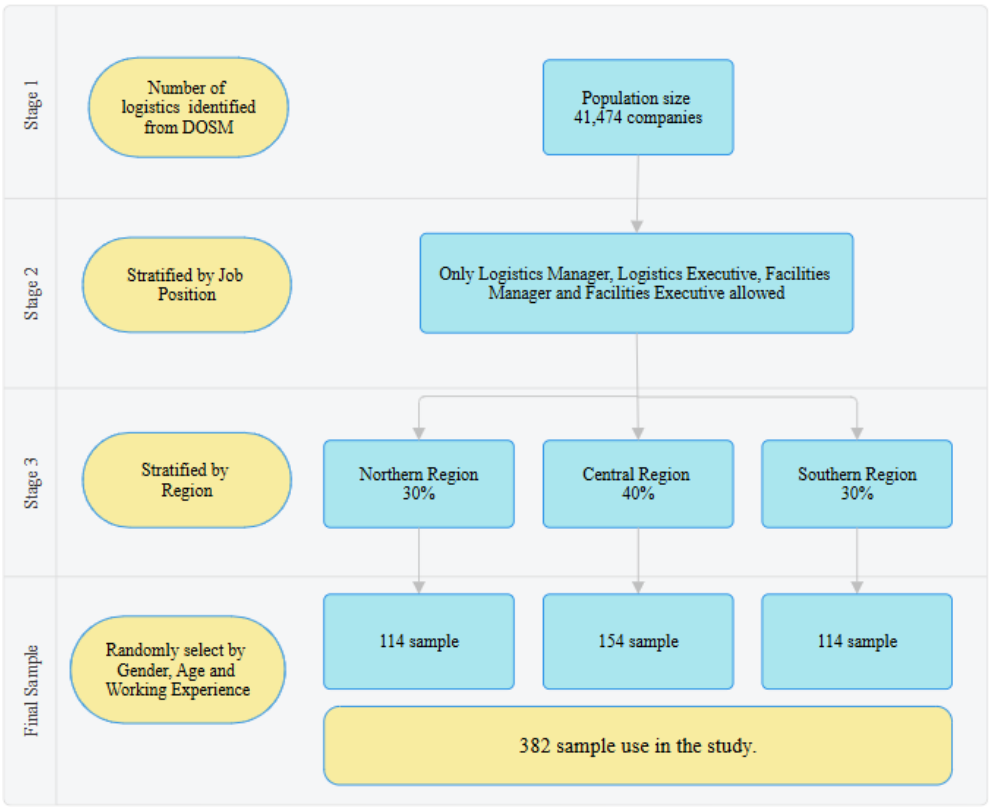

Figure 1: Stratified Sampling Method use in this study

In evaluating the dataset, Kolmogorov-Smirnov and Shapiro-Wilk normality tests confirmed a non-normal data distribution, justifying the use of Partial Least Squares Structural Equation Modelling (PLS-SEM) as a non-parametric analytical approach. Subsequently, Confirmatory Tetrad Analysis (CTA-PLS) identified significant tetrads across all constructs, confirming their empirical nature as formative measurement models. To optimize indicator variance and eliminate structural distortion, a critical item-drop analysis was executed to remove problematic indicators such as PU3, PEOU3, SI3, FC3, PT2, UA3, and AT3. Finally, redundancy analysis was conducted to assess the convergent validity of the refined formative models. By linking the constructs to global single-item measures, the resulting path coefficients significantly exceeded the standard benchmark, confirming high statistical reliability and robust convergent validity for subsequent structural testing.

4. RESEARCH FINDING

4.1 Respond Rete

The questionnaire was distributed from 2 channels of communication to the target respondent. The number of responses tabled in Table 4.1 as below:

Table 4.1

Number of Distributed Questionnaire and Respond Rate

No	Distribution location	Number of distributions	Number of Respond	Respond Rate %
1	Land Public Transport Agency (APAD)	1270 emails	324	25.51%
2	LinkedIn Connections	236 direct messages	64	27.11%
	Total	1506 emails	388	25.75%

Note: data collection duration 2 weeks from 3rd October until 17th October 2025

4.2 Profile of Participating Companies

This study targets three main logistic hubs in Malaysia. I managed to get respondent all three regions. This study also aims to investigate the current adoption level of the telematic system among the respondents. The number of respondents by region and current adoption level table below:

Table 4.2

Profile of Participating Companies

Demographic variable	Category	Frequency	Percentage %
Region	Central	154	40%
	Northern	114	30%
	Southern	114	30%
	Total	382	100%
Usage	Yes	212	55.50 %
	No	36	9.40 %
	Plan to use	96	25.10 %
	No plan to use	38	9.90%
	Total	382	100%

Source: own source

The sample's geographical distribution is dominated by the Northern region, which contributes almost half of the total participants (154 or 40%). The Southern region (114 or 30%) and Central region (114 or 30%) make up the remaining half. This heavy concentration in the Northern region due to most headquarters located at central region. More sample collected from central region as part of stratified sampling method.

The usage variable, likely pertaining to a specific technology or system relevant to the research, indicates a strong existing user base. A clear majority of 55.50% (212 participants) are current users ("Yes"). Furthermore, a large portion of non-users are classified as those who "Plan to use" (96 or 25.10%). The total percentage of current users and planned users is 80.60%, which means the research captures the perspectives of highly engaged (or soon-to-be engaged) companies. Conversely, only 9.90% have "No plan to use".

4.3 Profile of Respondent

From the 388 data sets recorded, 382 are complete data sets and accepted for this study. This study is also getting demographic data such as gender, age, working position and working experience. Profile of respondent tabled in Table 4.3.2 below:

Table 4.3

Profile of Participating Companies

Demographic variable	Category	Frequency	Percentage %
Gender	Male	284	74.30%
	Female	98	25.70%
Age	21-30	70	18.30%
	31-40	175	45.80%
	41-50	89	23.30%
	51-60	48	12.60%
Position	Facilities Manager	67	17.50 %
	Logistic Manager	152	30.90%
	Facilities Executive	106	25.10%
	Logistic Executive	57	14.90%
Experience	0-5	16	4.20%
	6-10	116	30.40%
	11-15	129	33.80%
	16-20	85	22.30%
	21 and above	36	9.40%
	Total	382 respondents	100%

Source: own source

The demographic profile of the 382 respondents from Malaysian logistics firms reflects a predominantly male and highly experienced workforce. Gender analysis revealed a significant male majority, comprising 74.30% (n = 284) of the sample, while females accounted for 25.70% (n = 98). In terms of age, mid-career professionals dominated, with the largest cohort aged 31–40 (45.80%), followed by those aged 41–50 (23.30%), 20–30 (18.30%), and 51–60 (12.60%). This indicates a workforce with a strong blend of professional maturity and tech-savviness.

Occupational roles were cantered on key decision-makers and operational leaders: Logistic Managers formed the largest group at 30.90%, followed by Facilities Executives (25.10%), Facilities Managers (17.50%), and Logistic Executives (14.90%). Furthermore, participants possessed substantial industry familiarity, as 64.20% had 6 to 15 years of experience (33.80% with 11–15 years; 30.40% with 6–10 years). A further 31.70% held over 16 years of experience, whereas entry-level professionals (0–5 years) represented only 4.20%. Collectively, the high concentration of seasoned managers and executives enhances the credibility of the findings regarding telematics adoption.

4.4 Descriptive Statistics of the Latent Variables

Descriptive statistics of latent variables are fundamental in psychological research, sociological studies, and fields that employ structural equation modelling (SEM). Latent variables, which are not directly observable, are inferred from measurable indicators or observed variables.

Table 4.5

Descriptive Statistics of the Latent Variables

Var	Mean	Median	Observed Min	Observed Max	Standard Deviation	Excess Kurtosis	Skewness
AT	0.000	0.520	-2.838	1.204	1.000	-0.392	-0.791
FC	0.000	0.218	-3.408	1.134	1.000	0.524	-0.988
PEOU	0.000	0.305	-2.231	1.292	1.000	-0.041	-1.059
PT	0.000	0.127	-2.122	1.158	1.000	-0.774	-0.662
PU	0.000	0.446	-2.664	1.010	1.000	-0.241	-0.964
SI	0.000	0.531	-2.341	1.200	1.000	-0.665	-0.798
UA	0.000	0.412	-2.396	1.280	1.000	-0.919	-0.511

Source: Own source

The descriptive statistics for the seven latent variables, Acceptance of telematic (AT), Facilitating Conditions (FC), Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Social Influence (SI), Trust (PT), and User Attitude (UA). All variables were evaluated to assess data normality based on established academic thresholds. The empirical results showed that all latent variables strictly adhered to these criteria. Skewness values ranged from -1.059 (PEOU) to -0.511 (UA), reflecting a slight left-skew that remains within acceptable bounds. Excess kurtosis values ranged from -0.919 (UA) to 0.524 (FC), also comfortably within the permissible limit. Because the latent variables showed no extreme deviations from normality, the data's structural integrity was confirmed for further multivariate analysis using PLS-SEM.

4.5 Summary of Hypothesis

Besides evaluating the coefficient of determination (R2), a measure called effect size (f2) was examined. Effect size (f2) is changed in R2 value when a particular exogenous construct is deleted from the model (Hair et al., 2014). This is to evaluate whether the deleted construct has a substantive impact on the endogenous construct (Hair et al., 2014). According to Cohen (1988), the f2 values of .10 represent a small effect; while 0.30 represent medium effect; and 0.50 represent large effect.

Table 4.19 presents the results of a statistical analysis testing hypotheses on what drives the Acceptance of Technology (AT) for telematic systems in Malaysian logistic companies. The table evaluates the direct effects of five key factors: Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Social Influence (SI), Facilitating Conditions (FC), and Perceived Trust (PT). Furthermore, it tests how User Attitude (UA) moderates (strengthens or weakens) the relationship between each of these factors and AT.

Table 4.19

Summary of Hypothesis Testing

Hypothesis	Structural Path	Path Coefficient (β)	p-value	Significance Level (α=0.05)	Decision
H1	(PU) → (AT)	0.003	0.959	p>0.05 (non-Significant)	Not Supported
H2	(PEOU) → (AT)	0.177	0.031	p<0.05 (Significant)	Supported
H3	(SI) → (AT)	0.103	0.089	p>0.05 (non-Significant)	Not Supported
H4	(FC) → (AT)	0.103	0.008	p<0.01 (Significant)	Supported

H5	(PT) → (AT)	0.666	0.000	p<0.001 (Significant)	Supported
H1a	PU×Moderator→(UA)	0.019	0.644	p>0.05 (non-Significant)	Not Supported
H2a	PEOU×Moderator→(UA)	-0.139	0.054	p>0.05 (non-Significant)	Not Supported
H3a	SI×Moderator→(UA)	0.178	0.000	p<0.001 (Significant)	Supported
H4a	FC×Moderator→(UA)	0.076	0.021	p<0.05 (Significant)	Supported
H5a	PT×Moderator→(UA)	-0.098	0.091	p>0.05 (non-Significant)	Not Supported

In PLS-SEM, the Effect Size (f^2) measures the change in the coefficient of determination (R^2) when a specific exogenous construct is omitted from the structural model. While p-values indicate whether an effect exists, f^2 evaluates the practical magnitude or importance of that effect on the target construct (Cohen, 1988; Hair et al., 2021). Target construct Acceptance of Telematics (AT) achieves a very high variance explained (R^2 = 0.946), the denominator (R^2 = 0.054$) is small. Consequently, construct contributions will reflect distinct effect size categories.

5. Conclusion and Recommendation

5.1 Conclusions

The data analysis yields critical insights for addressing academic and industrial gaps regarding telematic system acceptance among Malaysian logistics firms. The theoretical model integrates Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) from TAM, Social Influence (SI) and Facilitating Conditions (FC) from UTAUT, alongside Perceived Trust (PT) and User Attitude (UA) as a moderating variable.

The demographic profile features a slightly female-dominated sample (52.90%) consisting primarily of digitally native, early to mid-career professionals. Over 76% of respondents are aged 35 or under, 71.20% possess ten or fewer years of experience, and most serve as Logistics Executives (31.20%) or Logistics Managers (30.90%). System engagement is high, with over 92% currently using (58.10%) or planning to adopt (34.00%) telematics.

By explicitly linking each Research Objective to its empirical outcome, the overall study achieves an explanatory power of **R^2 = 89.7% to 94.6%** for technology acceptance. The findings provide clear directives for this study. Focus on Perceive Trust (PT). Address data security and transparent operational usage, as trust is the single largest driver of acceptance. Prioritize the Usability rather than interface design (PEOU). Design intuitive, low-friction interfaces tailored to digital natives. Activate Social Culture (UA x SI). Pair peer champion networks with positive attitude-building campaigns to maximize technology integration.

5.2 Limitations

This study's limitations centre on four key methodological and conceptual areas. First, the cross-sectional design collects data at a single point in time, which prevents establishing clear temporal sequences and limits the ability to draw definitive causal conclusions. Second, the exclusive focus on Malaysian logistics firms restricts the generalizability of the findings to international contexts operating under different regulatory, infrastructural, and cultural environments. Third, despite using stratified random sampling, potential coverage errors such as omitting micro-firms and differential non-response rates leave residual biases that may compromise external validity. Finally, the relying strictly on TAM and UTAUT excluded critical variables like Perceived Risk, introducing omitted-variable bias that likely explains the non-significant statistical results observed for Perceived Trust. Future research should

adopt longitudinal designs, expand to cross-national samples, and incorporate risk metrics to enhance overall model validity.

5.3 Recommendations

Future research on telematics adoption in logistics should pursue three key directions. First, scholars should expand the geographical and cultural scope beyond Malaysia to other national contexts such as ASEAN or Western markets to test boundary conditions and improve generalizability across differing regulatory and infrastructural environments.

Second, integrating qualitative and mixed-methods approaches (e.g., semi-structured interviews, focus groups, and direct workplace observations) will provide deeper contextual insights into underlying adoption barriers, explain non-significant empirical findings like *Perceived Trust*, and unpack complex socio-technical dynamics that quantitative surveys overlook.

Finally, studies should shift focus toward post-adoption phases by examining sustained utilization, deep integration, and entrenchment of telematic systems over time. Investigating temporal dynamics, habit formation, user satisfaction, and long-term optimization activities will ensure that technology adoption translates into lasting operational and safety benefits.

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