FACTORS INFLUENCING THE ADOPTION OF AUTONOMOUS VEHICLES AMONG THE YOUNG GENERATION IN HIGHER EDUCATION INSTITUTIONS: A CASE STUDY OF UNIVERSITI UTARA MALAYSIA

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ABSTRACT

Autonomous vehicles have emerged as an innovative transportation solution with the potential to enhance safety, efficiency, and mobility. Despite increasing technological advancements and government initiatives in Malaysia, the intention to use autonomous vehicles among young individuals remains relatively low. The situation indicates that Malaysian young generation are still hesitant to accept autonomous vehicle technology. In addition, empirical studies focusing on autonomous vehicle adoption among students in higher education institutions are limited. Therefore, this study aims to explore the perspectives of students in higher education institutions toward the adoption of autonomous vehicles in contact of their intention to use autonomous vehicles. Using a quantitative research approach, questionnaires were distributed online to the students. The data were analysed using correlation and multiple regression analyses. The major findings reveal that trust and ethical standards significantly influence the intention to use autonomous vehicles. The results suggest that policymakers, universities, and industry stakeholders should enhance trust, improve regulatory clarity, and increase awareness to encourage autonomous vehicle adoption among young users.

Keywords: Autonomous Vehicles, Intention to Use, Technology Acceptance Model

ABSTRAK

Kenderaan autonomi telah muncul sebagai satu penyelesaian pengangkutan inovatif yang berpotensi meningkatkan aspek keselamatan, kecekapan dan mobiliti. Walaupun kemajuan teknologi serta pelbagai inisiatif kerajaan di Malaysia semakin berkembang, tahap niat untuk menggunakan kenderaan autonomi dalam kalangan golongan muda masih berada pada tahap yang relatif rendah. Keadaan ini menunjukkan bahawa generasi muda di Malaysia masih bersikap berhati-hati dan ragu-ragu terhadap penerimaan teknologi kenderaan autonomi. Selain itu, kajian empirikal yang memfokuskan kepada penerimaan kenderaan autonomi dalam kalangan pelajar institusi pengajian tinggi masih terhad. Oleh itu, kajian ini bertujuan untuk meneroka perspektif pelajar institusi pengajian tinggi terhadap penerimaan kenderaan autonomi dalam konteks niat untuk menggunakan kenderaan autonomi. Kajian ini menggunakan pendekatan penyelidikan kuantitatif melalui pengedaran soal selidik secara dalam talian kepada para pelajar. Data yang diperoleh dianalisis menggunakan analisis korelasi dan regresi berganda. Dapatan kajian menunjukkan bahawa faktor kepercayaan dan piawaian etika mempunyai pengaruh yang signifikan terhadap niat penggunaan kenderaan autonomi. Hasil kajian ini mencadangkan agar pihak pembuat dasar, institusi pengajian tinggi dan pihak industri memperkukuh tahap kepercayaan, memperjelas kerangka perundangan serta meningkatkan kesedaran bagi menggalakkan penerimaan kenderaan autonomi dalam kalangan pengguna muda.

Kata kunci: Kenderaan Autonomi, Niat Penggunaan, Model Penerimaan Teknologi

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Autonomous Vehicle (AV) technology has evolved significantly since the early DARPA Grand Challenges, transitioning from experimental prototypes to real-world commercial pilots (S&P Global Mobility, 2024). This progression is categorized by the Society of Automotive Engineers (SAE) into six distinct levels: Level 0 (No Automation), where the driver handles all tasks; Level 1 (Driver Assistance), involving a single automated system like cruise control; Level 2 (Partial Automation), where the vehicle controls steering and acceleration simultaneously while the driver remains engaged; Level 3 (Conditional Automation), where the vehicle monitors the environment but requires a human fallback; Level 4 (High Automation), which allows the vehicle to operate independently within specific geographic areas; and Level 5 (Full Automation), where the system handles all driving tasks in all conditions without human intervention (SAE, 2021).

Industry leaders such as Tesla and Waymo are at the forefront of this deployment. By early 2025, Tesla's Full Self-Driving (FSD) Supervised software was integrated into over 2 million vehicles, while Waymo's robotaxi fleets were facilitating over 200,000 paid trips weekly across major U.S. cities (Human Progress, 2025; Tesla, 2025). These systems utilize an array of Artificial Intelligence (AI), LiDAR, radar, and cameras to achieve environmental awareness. Industry data suggests that such technologies can mitigate human error as the critical reason behind 94% of road accidents that potentially reducing crash rates significantly compared to human drivers

(NHTSA, 2024; S&P Global Mobility, 2024). Beyond safety, AVs offer efficiency gains through optimized routing that can reduce fuel consumption by 20–30% and provide vital accessibility for the elderly and disabled (Etminani-Ghasrodashti et al., 2025).

Conversely, Malaysia faces distinct transportation challenges that necessitate mobility innovation. In Kuala Lumpur, an influx of approximately 1.3 to 1.5 million vehicles daily contributes to peak-hour commutes exceeding two hours (TomTom Traffic Index, 2025; Zigwheels, 2024). Nationally, the road fatality rate stands at approximately 23.7 per 100,000 people, nearly double the global average (World Health Organization, 2023). Economic pressures also influence mobility; while the BUDI95 program maintains subsidized RON95 fuel at RM1.99 per litre for eligible citizens, the scarcity of campus parking often forces students into off-campus housing, adding up to 45 minutes of additional daily travel (Bateriku, 2026; Renub Research, 2024). Consequently, the National Automotive Policy (NAP 2020) aims for AV integration by 2030, supported by 5G infrastructure trials in Cyberjaya and Johor Bahru to enable advanced features like platooning (Ministry of International Trade and Industry, 2020).

This study is underpinned by the Technology Acceptance Model (TAM), which posits that Behavioral Intention (BI) is driven by Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis, 1989). While modern frameworks like the Unified Theory of Acceptance and Use of Technology (UTAUT) incorporate trust and social influence, the unique cultural context of Malaysia introduces additional variables (Venkatesh et al., 2003; Etminani-Ghasrodashti et al., 2025). Despite the promise of AVs, the younger generation remains skeptical due to "legal ambiguities" regarding liability and ethical concerns, such as the "trolley dilemma" (Supahan,

2024). Reluctance is further exacerbated by a lack of familiarity with SAE Level 4 and 5 automation and fears regarding cybersecurity vulnerabilities (Society of Automotive Engineers, 2021). Furthermore, the Road Transport Act 1987 currently lacks specific provisions for autonomous liability, creating a regulatory gap that hinders insurance and public trust (Road Transport Department Malaysia, 2019).

Generation Z students, characterized by their "post-smartphone" digital fluency, prioritize convenience and sustainability over vehicle ownership (Etminani-Ghasrodashti et al., 2025). While 70% of this demographic values the 50% emission reduction offered by electrified AVs, their adoption is hindered by high personal vehicle attachment and job displacement concerns within the gig economy (Renub Research, 2024; S&P Global Mobility, 2024). The COVID-19 pandemic accelerated digital competency but also introduced lingering travel anxieties (Supahan, 2024). As most AV research originates from Western contexts, there is a critical need to explore the specific intentions of Malaysian higher education students, whose adoption of AVs could catalyze a historical shift in the nation's mobility paradigm.

1.2 PROBLEM STATEMENT

Despite the potential of Autonomous Vehicles (AVs) to eliminate human error that responsible for 94% of road accidents adoption intention among Malaysian young generation remains significantly low, hovering between 35% and 45% (NHTSA, 2024; Renub Research, 2024). This reluctance jeopardizes the National Automotive Policy (NAP 2020) goal of achieving 30% AV integration by 2030 (Ministry of International Trade and Industry, 2020). While students recognize the theoretical benefits of AVs, their actual intention to use them is hindered by a critical "intention-behavior gap"

caused by distrust in sensor reliability and high-profile system failures (Etminani-Ghasrodashti et al., 2025).

The young generation, as mentioned early in Etminani-Ghasrodashti *et al.,* (2025) are differs in several areas from other age groups, as they are the first true digital native generation (Francis – Hoefel, 2018). They have been exposed since birth to the internet, to social media and networks, and mobile systems, leading to a hypercognitive generation (Csiszárik-Kocsir *et al.* 2022). They are also highly skilled to collect and cross-reference information from different sources and integrate it with both virtual and offline experiences. Generation Z behaviour is based on the search for truth, and they mobilize themselves for a variety of causes (Francis – Hoefel, 2018). They value individual expression, believe profoundly in the efficacy of dialogue to handle conflicts. Finally, their approach to problems and decisions is pragmatic and analytical. Such behaviors define the relation of Generation Z to brands and consumption as well. Consumption means access instead of ownership, a way to express their personality, open to innovation and reflects ethical values as well (Vajkai – Zsóka, 2020). These features may be of high importance when the purchased product is an electric vehicle. The automotive industry also faces the challenge related to redefining how they deliver value to consumers, and rebalancing mass production against personalization, by considering marketing issues and work ethics as well.

As a result of the Generation Z's general attitudes, their consumer decisions may be significantly influenced by other factors as well. The analysis of instrumental, hedonic, and symbolic attitudes on the adoption of BEV and plug-in hybrid electric vehicles (PHEV) concluded that persons identifying themselves sensible for environmental concerns are indicating betteropinion of EVs (Schuitema *et al.* 2013). While the previous literature covered many different aspects, we address a research

gap concerning the attitude of Generation Z, which has received less attention. Therefore, this research focuses on Generation Z, which will become shortly a defining part of society and one of the most important consumer segments in the market. Therefore, their attitudes and opinions provide valuable insights about future consumer behavioral patterns.

Furthermore, severe regulatory and ethical barriers persist within the Malaysian context. The Road Transport Act 1987 lacks a legal framework for AV liability, leaving students at risk of uninsured accidents (Road Transport Department Malaysia, 2019). Psychologically, the "black-box" nature of AV decision-making and ethical dilemmas such as algorithmic bias in life-priority scenarios erode confidence among technologically proficient users (Supahan, 2024). Without addressing these localized concerns regarding safety, privacy, and affordability, Malaysia risks economic stagnation in its 5G-enabled smart city ambitions and continued dependence on high-emission personal vehicles (World Health Organization, 2023).

This research provides a distinct contribution by shifting focus from Western paradigms to Malaysia's unique socioeconomic and cultural landscape. Unlike studies centered on technical performance, this work integrates localized barriers by examining how regulatory gaps in the Road Transport Act 1987 and economic pressures, such as the BUDI95 targeted fuel subsidies, dictate technology acceptance. It specifically targets the higher education demographic, identifying a unique necessity for autonomous adoption driven by campus parking scarcity and "last-mile" commute challenges that differ from those of the general public.

Furthermore, the study employs a cross-disciplinary framework by adapting the Technology Acceptance Model (TAM) to include "Trust" and "Ethical Apprehension" as core variables. This approach provides a nuanced understanding of

how cultural values and moral dilemmas, such as algorithmic fairness, influence AI adoption in a collectivist society like Malaysia (Supahan, 2024). By bridging the gap between theoretical automation and local societal readiness, this research offers actionable insights for aligning Malaysia's smart mobility goals with public sentiment.

1.3 RESEARCH QUESTIONS

1. Does perceived usefulness influence the intention to use autonomous vehicles?
2. Does perceived ease of use influence the intention to use autonomous vehicles?
3. Do ethical standards influence the intention to use autonomous vehicles?
4. Do legal concerns of use influence the intention to use autonomous vehicles?
5. Does trust influence the intention to use autonomous vehicles?

1.4 RESEARCH OBJECTIVES

This study aims to:

1. To examine the effect of perceived usefulness on the intention to use autonomous vehicles.
2. To examine the effect of perceived ease of use on the intention to use autonomous vehicles.
3. To examine the effect of ethical standards on the intention to use autonomous vehicles.
4. To examine the effect of legal concerns on the intention to use autonomous vehicles.
5. To examine the effect of trust on the intention to use autonomous vehicles.

1.5 SCOPE OF THE STUDY

This section defines the research boundaries for a focused quantitative investigation into the factors influencing the intention to adopt autonomous vehicles (AVs) among the young generation at Universiti Utara Malaysia (UUM). By establishing clear methodological, demographic, and geographical parameters, the study ensures feasibility and aligns with national smart mobility objectives (Etminani-Ghasrodashti et al., 2025; Ministry of International Trade and Industry, 2020).

The study employs a quantitative research design, utilizing structured questionnaires distributed to a target sample of UUM students. The survey utilizes a 5-point Likert scale adapted from the Technology Acceptance Model (TAM) and its extensions to evaluate five primary independent variables: perceived usefulness, perceived ease of use, trust, ethical standards, and legal concern. These factors serve as predictors for the behavioral intention to adopt AVs within the next 2–5 years. Data analysis is conducted using SPSS software, involving descriptive statistics, Cronbach's alpha for reliability, correlation analysis, and regression analysis to test hypothesized relationships. To maintain focus, broader socioeconomic variables and prior technical AV exposure are excluded (Supahan, 2024).

The population is comprised of full-time undergraduate and postgraduate students at UUM's Sintok campus, specifically targeting the young generation identified as potential early adopters of AI-driven mobility (Universiti Utara Malaysia, 2025). As of the 2025/2026 academic session, UUM supports a community of around 30,000 students, characterized by a majority female and minority male representation (UUM Today, 2025). The study employs stratified random sampling to reflect this distribution and includes international students to ensure diverse perspectives. To

maintain homogeneity, the scope excludes university staff, faculty members, and external community members.

Geographically, the study is confined to the 1,061-hectare Sintok campus in Kedah. It specifically examines AV applications for on-campus mobility, such as shuttle services and short-distance commutes, under SAE Level 4 (High Automation) scenarios defined as vehicles operating independently within specific geographic boundaries (SAE International, 2021). Full Level 5 implementations and metropolitan environments outside of the campus infrastructure are excluded.

The research is delimited to a cross-sectional case study of a single public university to allow for a deep, localized analysis of technology acceptance. It accounts for local environmental factors, such as the northern region's monsoon weather and UUM's recent 5G infrastructure upgrades, which are critical for real-time AV sensor processing. Deliberate exclusions include the study of autonomous freight, long-haul trucking, or the impact of AVs on the elderly, ensuring the results provide actionable insights specifically for Malaysia's higher education transportation masterplan (Renub Research, 2024).

1.6 SIGNIFICANCE OF THE STUDY

This study significantly augments the Technology Acceptance Model (TAM) by empirically validating its extensions specifically ethical standards, legal factors, and trust within a non-Western, youth-centric context. While over 80% of autonomous vehicle (AV) literature focuses on individualistic Western societies, this research quantifies how Malaysia’s collectivist values and unique cultural frameworks modify traditional technology acceptance pathways (Etminani-Ghasrodashti *et al.*, 2025).

The automotive industry might benefit from this research since it addresses some of the needs that consumers seek with this technology. In the past ten years ago, producers have concentrated on creating more affordable and effective transportation to replace conventional vehicles due to the growing interest in environmental issues, particularly carbon emissions (Park *et al.*, 2018). However, there is a lack of consensus among manufacturers like Tesla and Uber regarding the specific preferences and needs of consumers for AVs. As a result, the technology development lacks unified norms (Hewitt *et al.,* 2019). Hence, comprehending the needs of users regarding the technology could aid producers in making decisions and planning the creation of AVs in the future (Chan & Lee, 2021). Therefore, the study among young generation is vital to determine the characters and needs of EV, as impacts the future prospect of the industry.

In contact of UUM authorities, this study provides actionable data to address critical on-campus mobility challenges. The 1,061-hectare Sintok campus currently faces severe bus congestion and commute delays, which impact student punctuality (Universiti Utara Malaysia, 2025). By identifying perceived usefulness as a primary predictor, the study supports the implementation of app-based AV shuttle bookings, which are projected to reduce student travel time by 30%. Furthermore, under the National Automotive Policy (NAP 2020), which aims for Level 4 automation integration by 2030, Malaysian industry leaders like Proton and Grab can utilize these youth-validated insights to design intuitive, trust-based user interfaces (Ministry of International Trade and Industry [MITI], 2020).

The research provides the Malaysian Ministry of Transport with critical evidence to modernize the Road Transport Act 1987. By quantifying legal ambiguity as a significant barrier to adoption, the study facilitates legislative amendments

regarding the liability of manufacturers versus algorithms (Road Transport Department Malaysia, 2024). These findings directly support the national objective of achieving a 30% autonomous vehicle fleet by the mid-2030s and help clarify insurance frameworks for ongoing 5G smart city trials (MITI, 2020).

Adopting electric autonomous vehicles at UUM could reduce student transportation expenses significantly, potentially saving individuals up to RM1,500 annually by offsetting the costs of personal vehicle maintenance (Renub Research, 2024). Nationally, such a transition addresses the RM20 billion annual economic loss caused by traffic congestion in Malaysia (The Sun Malaysia, 2026). Environmentally, moving toward shared autonomous fleets could reduce campus-related carbon emissions by up to 50%, aligning with UN Sustainable Development Goal (SDG) 11 for sustainable cities.

Furthermore, this research aims to help in informing industry strategy and guiding policy development. The engineers will know how design technology in a way that will promote greater public acceptability, and it would also help policymakers comprehend public opinion now and encourage the adoption of new mobility options (Zhang & Kamargianni, 2022). Automotive manufacturers and related stakeholders are unsure of how to tailor their strategies to increase consumer acceptance and adoption of AVs (Chan & Lee, 2021). Ideally, this research will also meet the demand of related stakeholders and especially the marketing team in the automotive industry to gain a deeper comprehension of the primary determinants that influence Malaysian young consumers' intention and actions regarding an AV. Accordingly, the marketers will be able to create more tailored marketing plans that will quicken the rate of these services' acceptance to a bearable level.

From a theoretical standpoint, this research could provide additional knowledge to the literature and for academics interested in the associated topic, especially since AVs are a new theme in the automotive industry that requires further investigation and analyzes. Not only that, but this research also offers a more profound insight into young customer factors concerning various aspects of AVs technology by extending the Technology Acceptance Model (TAM). While the TAM model has been frequently used in prior studies to promote public acceptance and utilization of new technology, its scope has proven insufficient. With evolving times, young customers consider a broader array of factors when embracing new technology. Thus, this research supplements the TAM model. This enhancement aims to furnish a more exhaustive and thorough elucidation of the factors shaping customer intentions toward adopting AVs.

1.7 DEFINITION OF KEY TERMS

This section provides explicit operational definitions for essential terminology to ensure conceptual clarity and consistency throughout the study. These definitions clarify how each variable is measured in relation to the young generation's intention to adopt autonomous technology.

i. Autonomous Vehicles (AVs)

Vehicles capable of performing all driving functions without human intervention within specific geographic boundaries or in all conditions, specifically referring to SAE Level 4 (High Automation) and Level 5 (Full Automation). In this study, AVs are defined by their reliance on Artificial Intelligence (AI) and sensor suites (LiDAR, radar, and cameras) rather than traditional driver-assist technologies (Society of Automotive Engineers, 2021).

ii. Perceived Usefulness

The degree to which an individual believes that using a particular system or technology will enhance their performance or improve the quality of their daily activities. This construct focuses on the extrinsic benefits of the technology, such as increased efficiency, productivity, or effectiveness in achieving a desired outcome (Davis, 1989).

iii. Perceived Ease of Use

The extent to which an individual believes that using a particular technology will be free of physical and mental effort. It is operationalized by the user's perception of the system's simplicity, the clarity of its interface, and the minimal learning curve required to operate it successfully (Davis, 1989).

iv. Ethical Standards

The set of moral principles and values that guide the development and deployment of a technology. In the context of adoption, this refers to user expectations regarding transparency, accountability, and the absence of bias in how a system processes information or makes decisions (The Hastings Center, 2022).

v. Legal Concerns

The perceived risks and uncertainties regarding the regulatory framework surrounding a technology. This includes issues related to data privacy, intellectual property, and the clear allocation of liability or responsibility in the event of a system failure or unintended harm (Infosec Institute, 2024).

vi. Trust

A psychological state reflecting a user's willingness to be vulnerable to the actions of a technology based on positive expectations of its intentions or behavior. It is measured through three core dimensions: competence (the system's ability to perform), integrity (its adherence to rules), and benevolence (its alignment with the user's best interests) (Pavlou, 2003).

vii. Intention to Use

The subjective probability or behavioral inclination of an individual to perform a specific action namely, the adoption or continued use of a new technology. In research, this "behavioral intention" serves as the most immediate and reliable predictor of actual usage behavior (Ajzen & Fishbein, 1980).

1.8 ORGANISATION OF THE STUDY

This thesis includes five chapters that systematically outline the quantitative study on determinants influencing autonomous vehicle adoption among the young generation in higher institutions, enabling a coherent progression from issue identification to statistical validation and recommendations.

Chapter 1: Introduction

This chapter establishes the groundwork for the research by elucidating the study's history, formulating the problem statement, delineating the research questions, goals, scope, importance, identifying important words, and structuring the investigation. This establishes a contextual framework for the obstacles of AV adoption within the environment and delineates the goals of the quantitative research.

Chapter 2: Literature Review

Chapter 2 provides a comprehensive analysis of theoretical frameworks, including the Technology Acceptance Model (TAM) and its expansions. It examines empirical research about aspects that affect autonomous vehicle adoption, such as perceived utility, user-friendliness, ethical implications, legal challenges, and trustworthiness. The chapter encompasses contextual studies centred on the Malaysian young generation and higher education migration, identifying research gaps and developing testable hypotheses.

Chapter 3: Research Methodology

This chapter defines the quantitative design, including the demographic of UUM students aged 18-40, stratified random sampling (n = 302), data collection using Google Forms with validated 5-point Likert-scale questionnaires for TAM characteristics, and online dissemination. The document encompasses methodologies, pilot testing, and SPSS analysis for descriptive statistics, reliability evaluation (Cronbach's alpha), correlation, and regression analysis to investigate the relationships between independent variables and the intention to utilise autonomous vehicles, while addressing validity, reliability, and ethical considerations.

Chapter 4: Data Analysis and Findings

Chapter 4 delineates quantitative findings produced by SPSS, including demographic data, reliability evaluations (α = 0.755–0.932), descriptive statistics, Pearson correlations, and regression results that validate or refute hypotheses. Tables and charts depict route strengths, demonstrating how perceived utility, simplicity of use, ethics, legal considerations, and trust forecast AV intentions among UUM students.

Chapter 5: Discussion, Conclusion, and Recommendations

The concluding chapter integrates SPSS results with current literature, assesses theoretical and practical implications, acknowledges limitations such as cross-sectional self-reports and UUM specificity, and suggests future research avenues, including longitudinal SEM. It offers suggestions for policy changes derived from regression analysis and industry strategies to further Malaysia's smart mobility objectives.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides a comprehensive review of existing literature relevant to the research inquiry. It synthesizes prior empirical studies to establish the theoretical foundations for each independent variable and their influence on technology adoption. A conceptual study model is developed to illustrate the relationships between the identified factors and the research objectives. Furthermore, nine hypotheses are formulated to test the proposed theoretical framework and address the identified research gaps.

2.2 CONCEPT OF DEFINITION OF VARIABLES

2.2.1 Autonomous Vehicles (AVs)

Autonomous vehicles (AVs) are defined as motor vehicles capable of performing all driving functions within specified operational design domains (ODDs) without human intervention. This classification corresponds to SAE International Levels 4 (High Automation) and 5 (Full Automation). Level 4 autonomous cars operate independently inside specified geofenced areas, such as metropolitan campuses or highways, overseeing all safety-critical tasks, including obstacle evasion in adverse weather conditions. Conversely, Level 5 denotes a condition of total autonomy, proficiently managing all road situations at a level akin to that of human drivers.

The technological foundation of AVs relies on advanced sensor fusion, incorporating LiDAR for extensive 360° perception up to 250 meters, millimeter-wave radar effective in diverse weather situations, and high-resolution cameras optimized for semantic segmentation. These systems increasingly utilize Vehicle-to-Everything (V2X) communication in conjunction with deep neural networks to process vast quantities of environmental data for real-time route planning and decision-making. Recent empirical developments, such as the extensive autonomous mileage amassed by Level 4 robotaxi platforms, underscore a significant reduction in accident rates compared to human-operated vehicles. Beyond technical specifications, the conceptualization of AVs in literature now encompasses their role as sustainable urban mobility solutions capable of mitigating traffic congestion and enhancing accessibility for non-driving populations (Acheampong & Cugurullo, 2022; Dwivedi et al., 2021).

2.2.2 Intention to Use (IU)

The intention to use autonomous vehicles (AVs) serves as the primary dependent variable in this research, representing the psychological readiness of students at Universiti Utara Malaysia (UUM) to adopt self-driving technology for campus mobility. Within the context of Higher Education Institutions (HEIs), usage intention is conceptualized as the most immediate predictor of actual technology adoption, reflecting a student's plan to transition from traditional transit to autonomous shuttles. Theoretical foundations for this construct are rooted in the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT3), which suggest that behavioral propensity is synthesized through performance expectations and the social influence exerted by peer networks (Sheikh et al., 2022; Venkatesh et al., 2020).

For the digital-native Generation Z cohort, usage intention is heavily influenced by the perceived ability of AVs to mitigate campus-specific challenges, such as shuttle congestion and travel delays. However, research highlights that positive intention can be hindered by "habitual entrenchment," where students remain dependent on established ride-hailing services despite the potential advantages of automation. Furthermore, concerns regarding privacy and the reliability of autonomous systems in diverse weather conditions serve as critical barriers. Understanding these intention-based dynamics is essential for developing a framework that ensures the sustainable integration of autonomous mobility within the university's unique rural and institutional environment (Etminani-Ghasrodashti et al., 2025; Naiseh et al., 2024).

2.2.3 Perceived Usefulness (PU)

Perceived usefulness (PU) is a primary determinant within the Technology Acceptance Model (TAM) and is defined as the degree to which a user believes that employing a specific technology will enhance their productivity or performance. In the context of autonomous vehicle (AV) adoption at Universiti Utara Malaysia (UUM), PU reflects the students' assessment of how AV shuttles provide superior utility compared to conventional transportation methods like motorcycles or ride-hailing services. This construct encompasses critical functional benefits, including significant reductions in commute times, enhanced safety through the elimination of human error, and substantial annual cost savings for the student population. Scholarly research indicates that when a technology is perceived to offer high relative advantages such as mitigating chronic campus transit delays as it becomes a significant driver of adoption intention (Acheampong & Cugurullo, 2022; Etminani-Ghasrodashti et al., 2025).

The theoretical importance of PU is further reinforced by the Unified Theory of Acceptance and Use of Technology (UTAUT3), where it is conceptualized as "performance expectancy." For the budget-conscious Generation Z cohort, utility judgments are often augmented by cultural influences and the practical necessity of reliable transport in challenging environments, such as monsoon-affected regions. Empirical evidence from university campus trials suggests that PU is the strongest predictor of technology acceptance, particularly when the system is integrated with advanced infrastructure like 5G to optimize routing and reduce class tardiness. By addressing the mobility needs of a large student body facing shuttle congestion, perceived usefulness acts as a foundational element that bridges the gap between technological potential and sustained behavioral commitment (Dwivedi et al., 2021; Supahan, 2024).

2.2.4 Perceived Ease of Use (PEOU)

Perceived ease of use (PEOU), a fundamental pillar of the Technology Acceptance Model (TAM), is defined as the degree to which a user expects the use of a target system to be free of effort. In the context of autonomous vehicle (AV) adoption at Universiti Utara Malaysia (UUM), PEOU evaluates students' anticipations regarding effortless engagement through interfaces such as voice commands, mobile application reservations, and gesture controls. For the digital-native Generation Z population, the simplicity of the user interface is a critical determinant of technology acceptance; any perceived complexity, such as difficulties in "handover" protocols or voice recognition failures in noisy environments, can significantly hinder adoption. Scholarly literature suggests that when the interaction with AV technology is perceived as intuitive and requires low cognitive load, it directly enhances the students'

intention to utilize the service for daily campus mobility (Nordhoff et al., 2020; Venkatesh et al., 2020).

The importance of PEOU is further underscored by its relationship with "effort expectancy" within the UTAUT3 framework, where the validation of a system's simplicity by peer networks often leads to increased engagement. For UUM's diverse student body, which includes a significant percentage of international students, the localization of interfaces such as Bahasa Malaysia integration and seamless campus ID registration is essential for a positive user experience. Research indicates that inferior user interfaces and a lack of localized features can create barriers to technology dependence and reduce overall utilization. Consequently, the implementation of user-friendly features, such as weather-resistant touchscreens and one-tap booking systems, is vital to mitigate technological anxiety and ensure that the AV shuttle system is perceived as an accessible and effortless transportation solution (Hollebeek et al., 2023; Supahan, 2024).

2.2.5 Ethical Standards

Ethical standards in the context of autonomous vehicles (AVs) pertain to the moral principles and algorithmic frameworks that govern decision-making during critical, unavoidable collision scenarios, often referred to as "trolley problems." These standards address the complex dilemma of how a vehicle should prioritize the safety of passengers versus pedestrians. For students at Universiti Utara Malaysia (UUM), ethical standards involve significant considerations of algorithmic fairness and the transparency of "black box" logic. Literature suggests that moral unease regarding utilitarian programming which may favor specific groups over others can create psychological obstacles that diminish the intention to use AVs. Unlike purely technical

performance expectations, ethical misalignment addresses deep-seated concerns regarding justice and safety that are particularly prominent in multicultural and metropolitan environments (Etminani-Ghasrodashti et al., 2025; Hulse et al., 2023).

The conceptualization of ethics in AV adoption is further influenced by cultural values, where collectivist cultures often prioritize different demographic groups compared to Western egalitarian algorithms. Within the diverse student population of UUM, there is a strong advocacy for "explainable AI" to ensure that decision-making processes are transparent and free from demographic bias. Theoretical frameworks such as UTAUT3 suggest that ethics act as a modifier of social influence, where opaque or perceived unethical programming can erode behavioral control and trust. Consequently, aligning AV ethical frameworks with local communal norms and ensuring privacy through transparent AI is essential for overcoming the psychological barriers that extend beyond technical utility, thereby facilitating long-term adoption among the younger generation (Hollebeek et al., 2023; Naiseh et al., 2024).

2.2.6 Legal Concerns

Legal concerns represent a significant barrier to the adoption of autonomous vehicles (AVs), primarily stemming from legislative ambiguities regarding responsibility and liability assignment. In the event of an unavoidable collision, uncertainty remains as to whether the manufacturer, the owner, or the software algorithm provider should be held accountable. Within the Malaysian context, these concerns are particularly acute as existing frameworks, such as the Road Transport Act 1987, were not originally designed to accommodate driverless technologies. Scholarly research indicates that such legal voids create significant adoption hesitation among potential users, as the lack of clear insurance protocols and liability protections

increases the perceived risk of engaging with autonomous systems (Renub Research, 2024; Road Transport Department Malaysia, 2019).

Theoretical comparisons within the ASEAN region suggest that liability ambiguity acts as a primary obstruction to the "facilitating conditions" identified in the UTAUT3 framework. Without robust regulatory measures similar to the comprehensive AV acts seen in other jurisdictions as the potential for increased insurance premiums and a lack of legal recourse diminishes the user's sense of behavioral control. For the younger generation, including students at Universiti Utara Malaysia (UUM), governmental assistance and clear regulatory guidelines are often prioritized over technical ease of use. Consequently, the presence of legal deficiencies and perceived enforcement gaps can lead to a cautious social norm that discourages adoption, highlighting the necessity for a comprehensive legal ecosystem to foster trust and long-term commitment to autonomous mobility (Sheikh et al., 2022; Stark & Davidsson, 2023).

2.2.7 Trust

Trust in the context of autonomous vehicles (AVs) signifies the user's assurance in the system's dependability, safety, and cybersecurity robustness. It is conceptualized as a critical psychological state that determines the extent to which an individual is willing to depend on automated technology. Scholarly research identifies trust as a central mediator in the relationship between technological performance and usage intention. Unlike ethical considerations, trust focuses on technical reliability and the vehicle's ability to handle complex operational design domains. High-profile instances of system malfunctions or cybersecurity vulnerabilities can severely impact trust levels, highlighting that confidence is built not just through technical success, but

through consistent, predictable performance that exceeds the safety benchmarks of human operators (Mahmoudi et al., 2022; Naiseh et al., 2024).

In a university setting, the cultivation of trust requires contextual adaptation that moves beyond controlled urban experiments to address local environmental challenges. For students at Universiti Utara Malaysia (UUM), "trust calibration" is influenced by the vehicle's perceived ability to navigate Sintok's unique terrain, including monsoon-affected roads and wildlife corridors. Pragmatic skepticism among the younger generation suggests that trust is not granted by default but must be earned through transparency and real-time diagnostic communication. Integrating AV systems with familiar campus platforms such as safety ratings and predictive maintenance notifications that can bridge the gap between initial skepticism and enduring adoption. Consequently, fostering trust through transparent system operations is essential for transforming moderate intentions into a sustained commitment to autonomous campus mobility (Etminani-Ghasrodashti et al., 2025; Supahan, 2024).

2.3 LITERATURE REVIEW

2.3.1 Independent Variable: Perceived Usefulness (PU)

2.3.1.1 Overview and Definition of Perceived Usefulness (PU)

Perceived usefulness (PU) represents a fundamental element of the Technology Acceptance Model (TAM). It reflects the extent to which UUM students believe that autonomous vehicles (AVs) improve their mobility performance compared to traditional options like Grab rides and motorbikes. Research indicates that AVs can provide significant advantages, such as reducing commute times by 28-35% a notable

improvement given the typical 45-minute delays experienced on campus. Additionally, AVs could lead to a 90% reduction in crash rates by removing human error, which is responsible for 94% of global road accidents. Furthermore, students could save approximately RM1,500 annually compared to their current daily expenses of RM10-20 (Etminani-Ghasrodashti et al., 2025; Acheampong & Cugurullo, 2022).

Perceived usefulness, defined as "the extent to which a person believes that using a particular system would enhance their job performance," is particularly evident in the context of autonomous vehicles through six validated indicators. Perceived utility (PU), assessed by three measures ($\alpha = 0.783$, $M = 3.93$, $SD = 0.87$), is a core component of the Technology Acceptance Model (TAM), indicating UUM students' belief that autonomous vehicles (AVs) enhance mobility compared to Grab rides and motorcycles. Autonomous vehicles provide a 28-35% decrease in travel times (mitigating 45-minute campus delays), a 90% improvement in collision rates (eradicating 94% of human mistake), and an annual savings of RM1,500 compared to daily expenses of RM10-20 (Etminani-Ghasrodashti et al., 2025; Acheampong & Cugurullo, 2022). A meta-analysis of 52 autonomous vehicle studies (25,000 respondents, 2019-2024) reveals perceived usefulness as the biggest predictor ($\beta = 0.35$-0.45, $r = 0.42$), especially pertinent to urban unmanned mobility's 150% shuttle overcrowding and 5G platooning potential (Sutarto et al., 2023).

2.3.1.2 Theory Associated with Perceived Usefulness

The Technology Acceptance Model (TAM), which was initially developed for information systems, identifies perceived usefulness (PU) as the key factor influencing behavioural intention. When combined with perceived ease of use (PEOU), PU accounts for 52% of the explained variance across various technological fields

(Venkatesh et al., 2020; Acheampong & Cugurullo, 2022). The UTAUT3 framework defines performance expectancy (β=0.42) as a key factor, which is notably enhanced by facilitating conditions. For instance, the development of UUM's 5G infrastructure plays a crucial role in enabling real-time traffic optimisation, particularly during monsoon flooding (Dwivedi et al., 2021). The Task-Technology Fit (TTF) theory clarifies perceived usefulness (PU) by examining the alignment between automation and task requirements. In this context, the automation of campus shuttles aligns effectively with the mobility needs of students, thereby improving their perception of task effectiveness (Goodhue and Thompson, 1995, as cited by Venkatesh et al., 2020). Innovation Diffusion Theory (IDT) highlights the significance of perceived usefulness (PU) as a crucial factor influencing the spread of technology among early adopters, who make up 60% of UUM's Generation Z population (Acheampong & Cugurullo, 2022). The Expectancy-Value Theory emphasises the motivational influence of perceived usefulness, suggesting that the expected benefits of performance play a crucial role in maintaining engagement over time, particularly in high-stakes mobility situations (Hollebeek et al., 2023).

2.3.1.3 Relationship Between Perceived Usefulness and Intention to Use AVs

The evolving landscape of campus mobility solutions reveals that the adoption and ongoing use of autonomous vehicles (AVs) by Universiti Utara Malaysia (UUM) students aged 18-40 is greatly influenced by their views on how these vehicles can improve their daily commuting experiences. The perception of usefulness significantly influences students' choices regarding the adoption and continued use of autonomous vehicle campus shuttles. Etminani-Ghasrodashti et al. (2025) highlight that the perceived usefulness of autonomous vehicles is fundamentally linked to significant

performance improvements. These include reductions in commute times by 28-35% from persistent delays of 45 minutes, a 90% improvement in crash rates by removing human error which accounts for 94% of accidents and annual cost savings of RM1,500 compared to current expenses for Grab and motorbike services. Students at UUM exhibit a more robust intention to persist when they recognise that autonomous vehicles offer better mobility results compared to traditional options, especially in the context of significant shuttle overcrowding at 150% capacity.

In the realm of higher education transportation, the perception of usefulness is crucial for encouraging ongoing engagement with autonomous vehicles and ensuring their long-term integration within campus life. The implementation of optimised routing during monsoon flooding, the increase in in-car productivity amounting to an additional 1.2 hours of daily study time and the safety enhancements on rural Sintok roads are significant elements that systematically affect the stability of behavioural intentions (Acheampong & Cugurullo, 2022). Social Exchange Theory posits that perceptions of usefulness arise from observed relative advantages, as students trade their traditional transportation frustrations for the benefits of autonomous vehicle performance (Dwivedi et al., 2021). In the operational environment of UUM, the benefits are evident through pilot experiences that demonstrate a 30% reduction in time, the availability of seamless 5G connectivity, and a decrease in daily ride expenses ranging from RM10 to RM20.

Expectation Confirmation Theory suggests that students' perceptions of the usefulness of autonomous vehicles are influenced by their prior experiences with mobility challenges and by the actual performance of these vehicles surpassing their expectations (Hollebeek et al., 2023). The positive interactions with autonomous vehicles that exceed the reliability of Grab, such as precise navigation within

geofenced areas, strengthen the intention to continue using the service. Conversely, when users perceive a lack of performance, it can lead to a decision to abandon the service altogether. Furthermore, the Technology Acceptance Model (TAM) identifies perceived usefulness as the key factor influencing behavioural intention, accounting for 52% of the variance in this context, in conjunction with ease of use (Venkatesh et al., 2020). When students at UUM recognise that autonomous vehicles contribute to improved academic punctuality, evidenced by a 15% reduction in tardiness, it leads to a systematic increase in overall acceptance of technology and a continued use of shuttle services.

Furthermore, the Unified Theory of Acceptance and Use of Technology (UTAUT3) incorporates perceived usefulness, which is understood as performance expectancy, in conjunction with effort expectancy and social influence (Dwivedi et al., 2021). The perceptions of usefulness regarding reliable crash avoidance, improvements in fuel efficiency, and alleviation of parking challenges play a significant role in shaping students' intentions to continue their engagement during the deployment timelines of NAP 2020. Studies on transport adoption emphasise the significance of perceived usefulness in influencing ongoing behavioural intentions in university settings (Sutarto et al., 2023). The meta-analyses conducted by Acheampong and Cugurullo (2022), along with trials from the Singapore campus, present compelling empirical evidence that underscores the notable positive correlation between perceived usefulness and the intention to use autonomous vehicles, with a correlation coefficient of $r=0.42$, a standardised beta of $\beta=0.38$, and a significance level of $p<0.001$ across a sample size of $N=25,000$.

The perception of usefulness plays a crucial role in shaping the ongoing intention to adopt autonomous vehicles among the younger generation at UUM.

Theoretical frameworks such as Social Exchange Theory, Expectation Confirmation Theory, the Technology Acceptance Model (TAM), and UTAUT3, supported by meta-analytic studies and trials conducted in ASEAN universities, collectively highlight the essential role of perceived usefulness in facilitating ongoing transformation in campus mobility. Perceived usefulness significantly influences UUM students' adoption of autonomous vehicles by enhancing operational efficiency: 28–35% time reductions, a 90% decrease in accidents, and RM1,500 savings with a 150% increase in shuttle capacity (Etminani-Ghasrodashti et al., 2025). Social Exchange Theory posits that comparative advantages foster intention, whereas Expectation Confirmation Theory corroborates this when autonomous vehicles exceed Grab's reliability (Hollebeek et al., 2023; Dwivedi et al., 2021).

H1: Perceived usefulness positively affects the intention to use autonomous vehicles.

2.3.1.4 Relationship Between Perceived Usefulness and Trust

The establishment of trust in autonomous vehicle systems among UUM students is fundamentally influenced by their perceptions of usefulness, which highlight the advantages of reliable performance. The perceived usefulness of autonomous vehicle technology plays a significant role in shaping the development of trust among users. Naiseh et al. (2024) suggest that perceived usefulness enhances competence-based trust by demonstrating validated performance improvements, such as time savings and safety enhancements. Notably, students show 2.3 times greater trust when autonomous vehicles surpass the benchmarks set by Grab. In campus settings, the perceptions of usefulness are crucial for fostering sustained reliance on AV technology among diverse groups.

Task and Technology The validation of fit and performance plays a crucial role in establishing trust stability, particularly in the context of rural operational challenges (Dwivedi et al., 2021). Social Exchange Theory explains how trust, driven by usefulness, develops through the demonstration of reciprocal actions. Expectation Confirmation Theory suggests that trust is strengthened when the utility of an autonomous vehicle aligns with productivity expectations (Hollebeek et al., 2023). The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology 3 (UTAUT3) identify usefulness as a precursor to trust, with a reported coefficient of β=0.32. Empirical studies have validated these findings, demonstrating significant positive correlations (Naiseh et al., 2024). PU generates competence-based confidence by proving that it can make things better (in terms of time and safety). Students trust AVs 2.3 times more when they perform better than Grab benchmarks. Job and Technology Fit assesses how well things are going in rural regions; Social Exchange or Expectation Confirmation theories clarify trust via reciprocal benefits (Naiseh et al., 2024; Dwivedi et al., 2021).

H5: Perceived usefulness positively affects trust.

2.3.2 Independent Variable: Perceived Ease of Use (PEOU)

2.3.2.1 Overview and Definition of Perceived Ease of Use (PEOU)

The concept of perceived ease of use (PEOU) is a key element in technology acceptance models. It pertains to how Universiti Utara Malaysia (UUM) students view the interaction with autonomous vehicles (AVs) as requiring little mental effort. This perception is influenced by user-friendly features like voice commands, mobile app summoning, gesture controls, and smooth integration with campus ID systems

(Nordhoff et al., 2020). This understanding is crucial for the digital-native Gen Z groups who are familiar with Grab's impressive usability rating of 4.7 out of 5. However, it is important to acknowledge the reported challenges with autonomous vehicles, such as a 15% failure rate in voice recognition in noisy campus settings and the complexities involved in handover protocols during busy shuttle operations (Supahan, 2024). Perceived ease of use is demonstrated through five validated indicators: the reduction of cognitive effort during the booking process, an interface that exceeds smartphone usability standards, accessibility through Bahasa Malaysia localisation, the efficiency of one-tap autonomous summoning, and the simplicity of gesture-based overrides. Together, these factors account for 25-30% of the variance in adoption intention (β=0.24-0.32, r=0.28) across 40 field studies on autonomous vehicles (Venkatesh et al., 2020).

Due to the multicultural environment of UUM, which accommodates over 30,000 students and experiences significant shuttle overcrowding at 150%, PEOU focusses on addressing essential challenges. These include the issues posed by monsoon conditions affecting touchscreens and the need to cater to a variety of language preferences, with 60% of the population being Malay and 15% international students. The aim is to ensure that seamless interaction becomes a fundamental aspect of integrating mobility within the campus experience (Dwivedi et al., 2021). Empirical trials have validated the anticipated AV ratings of 3.8 out of 5 when compared to established ride-hailing benchmarks. This highlights the importance of localisation in addressing the 30% usability gap that poses a risk to sustainability (Sutarto et al., 2023).

2.3.2.2 Theory Associated with Perceived Ease of Use

The Technology Acceptance Model (TAM) designates perceived ease of use (PEOU) as a direct predictor of behavioural intention and a crucial antecedent influencing perceived usefulness, supported by dual acceptance pathways in empirical study on autonomous vehicles (Venkatesh et al., 2020). The UTAUT3 model redefines PEOU as effort expectation, suggesting that reduced cognitive demands enhance performance expectancies and the social influence of Generation Z peer networks (Dwivedi et al., 2021).

Cognitive Load Theory clarifies the process of Perceived Ease of Use (PEOU) by reducing unnecessary cognitive effort in human-autonomous vehicle interactions, hence enabling users to focus cognitive resources on route optimisation rather than interface navigation (Hollebeek et al., 2023). User-centred Design frameworks emphasise the need of seamless interactions for sustained engagement, particularly during transitions between devices and mobile phones (Nordhoff et al., 2020). Expectancy-Value Theory enhances the motivational role of Perceived Ease of Use (PEOU), suggesting that expected interaction fluidity promotes ongoing engagement that surpasses first experiences with Grab (Supahan, 2024).

2.3.2.3 The Relationship Between Perceived Ease of Use on Intention to Use AV

The acceptance of AV technology among UUM digital-native students is contingent upon its ease of use (PEOU) and the extent to which the interface aligns with their expectations. Perceived Ease of Use significantly influences evaluations on the utilisation and persistence with campus transportation. This is due to the fact that voice commands, application activations, gesture controls, and Bahasa-localized interfaces require little cognitive effort, notwithstanding potential challenges in speech

recognition in noisy surroundings (Nordhoff et al., 2020). Generation Z prefers simplicity akin to smartphone use rather than the complexity of intricate handover protocols.

In the context of higher education mobility, PEOU fosters ongoing engagement among UUM's 30,000 diverse students by reducing cognitive load, offering user-friendly interfaces, incorporating university IDs, and enabling one-tap booking, which is crucial during peak shuttle demand periods (Supahan, 2024). Social Exchange Theory defines Perceived Ease of Use (PEOU) as a reciprocal exchange, trading transportation-related stress for effortless technology interactions; Sintok pilots validate natural language processing and monsoon-resistant touchscreens (Hollebeek et al., 2023).

Expectation Confirmation Theory posits that perceived ease of use (PEOU) is affected by the gap between expected and actual interaction fluidity, which bolsters user intents notwithstanding 150% congestion; nevertheless, cumbersome interfaces may result in abandonment (Dwivedi et al., 2021). TAM identifies PEOU as a direct determinant of intention and a modifier of PU, hence altering acceptance trajectories (Venkatesh et al., 2020).

UTAUT3's effort expectation indicates that a decreased cognitive load enhances persistence, particularly among TikTok Gen Z peer networks (Sutarto et al., 2023). Research by ASEAN confirms that insufficient user experience is the primary barrier to university retention (Nordhoff et al., 2020; Supahan, 2024).

Theoretical frameworks Social Exchange Theory, Expectation Confirmation Theory, the Technology Acceptance Model, and UTAUT3, supported by field tests

and regional surveys, affirm the pivotal significance of Perceived Ease of Use in the adoption of Autonomous Vehicles among UUM youth.

H2: Perceived ease of use positively affects the intention to use autonomous vehicles.

2.3.2.4 The Relationship Between Perceived Ease of Use and Trust

Trust in autonomous vehicle systems relies on the perceived ease of use (PEOU) within the digital-native context of UUM. This user-friendliness reduces the cognitive obstacles encountered throughout the adoption phase. Nordhoff et al.'s 2020 study indicates that user-friendly interfaces are crucial for fostering trust, particularly in achieving parity in smartphone engagement. The incorporation of audiovisual technology in higher education necessitates that flawless usability maintains ongoing confidence.

The variety of UUM's cultural requirements may be significantly enhanced by the use of user-friendly and low-effort interfaces (Supahan, 2024). The Social Exchange Theory posits that trust is established via seamless exchanges, but the Expectation Confirmation Theory contends that confidence is bolstered when the ease of an interaction exceeds expectations (Dwivedi et al., 2021). Sutarto et al. (2023) assert that the TAM/UTAUT3 frameworks substantiate PEOU as a predictor of trust, with these results corroborated by ASEAN regional trials.

H6: Perceived ease of use positively affects trust.

2.3.3 Independent Variable: Ethical Standards

2.3.3.1 Overview and Definition of Ethical Standards

The ethical standards in the context of autonomous vehicles (AVs) encompass the moral principles and algorithmic frameworks that guide crucial decision-making in situations involving unavoidable collisions. These scenarios, often likened to 'trolley problems', require AVs to navigate the complex dilemma of prioritising the safety of passengers versus that of pedestrians. For students at Universiti Utara Malaysia (UUM), ethical standards involve considerations of algorithmic fairness, particularly in addressing demographic biases among the diverse population, which includes 60% Malay, 25% Chinese/Indian, and 15% international students. Additionally, there is an emphasis on decision transparency, where explainable AI heuristics reveal the underlying utilitarian calculations. Furthermore, aligning cultural values is crucial, as it seeks to harmonise Western egalitarian programming with Asian preferences that prioritise the well-being of youth and children over that of elderly passengers. This framework is supported by findings from MIT's Moral Machine dataset, which encompasses data from 233 countries and 2.1 million decisions (Hulse et al., 2023; Etminani-Ghasrodashti et al., 2025). The standards raise significant moral concerns for 62% of Gen Z respondents ($r=-0.32$ with behavioural intention, $\beta=-0.27$), highlighting the importance of ethical programming as a crucial factor influencing the acceptance of autonomous vehicles in Malaysia's diverse higher education environment.

Ethical standards encompass perceived fairness (prioritizing vulnerable road users), decision transparency (explainable AI logic), and cultural sensitivity (alignment with Malaysian communal values), validated across cross-cultural AV

studies (Sheikh et al., 2022; Liu et al., 2022). UUM's collectivist framework demands culturally adaptive programming to address ethical misalignment concerns, particularly relevant for NAP 2020 deployment (Etminani-Ghasrodashti et al., 2025).

2.3.3.2 Theory Associated with Ethical Standards

Social Exchange Theory argues that ethical alignment serves as a vital reciprocal trust currency for sustainable human-AV relationships, particularly relevant within Malaysia's high-context collectivist framework that emphasises familial obligations and social harmony (Sheikh et al., 2022). UTAUT3 defines ethical norms as social effect modifiers that amplify peer and family expectations in hierarchical cultures (Venkatesh et al., 2020; Dwivedi et al., 2021).

Moral Foundations Theory differentiates cultural standards of acceptability via the categories of Care/Harm, Fairness/Cheating, and Loyalty/Betrayal, whereas algorithmic transparency contrasts Western individualism with Asian relational ethics that prioritise communal benefit (Hollebeek et al., 2023). Algorithmic Accountability Theory requires preemptive bias audits, real-time elucidation, and post-incident forensic openness, addressing the moral dilemmas of the tram problem while maintaining behavioural intention consistency (Hulse et al., 2023; Liu et al., 2022).

2.3.3.3 Relationship Between Ethical Standards and Intention to Use AVs

The continuous advancement of autonomous vehicles fosters a dynamic context whereby the sustained attention of Universiti Utara Malaysia (UUM) students aged 18 to 25 is intricately connected to their perspectives on the ethical principles that need to be included into autonomous vehicle decision-making algorithms. Ethical standards are crucial in guiding students' decisions to adopt and continue using self-

driving vehicles for campus transportation. Hulse et al. (2023) illustrate that ethical standards for autonomous cars are fundamentally connected to perceptions of algorithmic fairness, openness in decision-making, and alignment with cultural values, particularly in unavoidable collision situations known as tram dilemmas. UUM students demonstrate an increased willingness to accept autonomous vehicle (AV) technology when they are assured that ethical programming prioritises the safety of vulnerable road users and aligns with Malaysia's principles of multicultural harmony, rather than solely concentrating on utilitarian passenger safety.

In higher education mobility contexts, perceived ethical standards are crucial for promoting sustained engagement among UUM's diverse student population, including 60% Malay, 25% Chinese/Indian, and 15% international students. Algorithmic fairness addressing demographic biases, transparency in explainable AI decisions, and alignment with Asian cultural values prioritising youth and child protection, as evidenced by the Moral Machine dataset encompassing 233 countries, are critical factors influencing ongoing behavioural intentions (Etminani-Ghasrodashti et al., 2025). Social Exchange Theory posits that ethical alignment emerges from perceived reciprocity, where students exchange ease of mobility for moral assurance in safety-critical autonomous car decisions (Sheikh et al., 2022). The UUM campus pilots demonstrate these requirements via the transparent disclosure of accident scenarios and the articulation of shared values throughout shuttle operations.

Expectation Confirmation Theory asserts that students' ethical perceptions of autonomous vehicles arise from the alignment between their prior moral anticipations and the actual implementation of the algorithms (Liu et al., 2022). Ethical interactions that transcend cultural conventions, such as prioritising pedestrians above car occupants, improve intention stability. Conversely, utilitarian biases provoke moral

unease among Generation Z. The Technology Acceptance Model (TAM) incorporates ethical considerations as external variables influencing perceptions of usefulness and ease of use (Venkatesh et al., 2020). Culturally attuned audiovisual ethical programming significantly enhances UUM students' overall acceptance of technology, thereby influencing their intentions to often use the campus shuttle service.

The Unified Theory of Acceptance and Use of Technology (UTAUT3) integrates ethical standards as crucial components of societal effect, alongside performance expectation and effort expectancy (Dwivedi et al., 2021). Algorithm designs that emphasise ethical transparency, inter-ethnic fairness, and alignment with Malaysia's collectivist principles substantially impact students' long-term intentions to use autonomous cars, particularly against challenges such as 150% shuttle congestion. Research on transport ethics underscores the significance of ethical standards in influencing behavioural intentions across diverse university settings (Hulse et al., 2023). Sheikh et al. (2022) and Etminani-Ghasrodashti et al. (2025) provide substantial empirical evidence indicating a favourable association between perceived ethical standards and the inclination to implement autonomous cars in Asian contexts.

The perceived ethical standards significantly impact the ongoing aspirations for autonomous vehicle adoption among the youth at UUM. Theoretical frameworks including Social Exchange Theory, Expectation Confirmation Theory, the Technology Acceptance Model (TAM), and UTAUT3, supported by Moral Machine experiments and ASEAN university trials, highlight the essential importance of ethical standards in promoting sustained campus mobility engagement. In light of the findings, this study suggests that:

H3: Ethical standards positively affect the intention to use autonomous vehicles.

2.3.3.4 Relationship Between Ethical Standards and Trust

In Malaysia's collectivist society, trust in autonomous vehicles mostly hinges on ethical considerations that influence algorithmic decision-making in critical safety situations. Ethical ideals shape integrity-based trust, essential for sustainable human-autonomous vehicle collaborations. Hulse et al. (2023) illustrate that ethical transparency cultivates trust via the implementation of culturally relevant programming that prioritises community above Western utilitarian ideals, particularly when algorithms align with the protective instincts of Asian adolescents, as seen by Moral Machine research. Moral fairness and value congruence are essential for fostering trust among UUM's diverse community of 30,000 students, especially for shuttle congestion challenges (Etminani-Ghasrodashti et al., 2025).

In higher education AV environments, algorithmic fairness considering demographic bias, real-time decision transparency through explainable AI, and cultural congruence prioritising pedestrian needs over passenger demands are essential for fostering trust (Sheikh et al., 2022). Social Exchange Theory elucidates ethical reciprocity that fosters confidence in relationships via consistent moral actions, whereby students exchange mobility convenience for assurances of compassion in tram-related scenarios (Hollebek et al., 2023). UUM operational pilots demonstrate ethical trust by disclosing decision-making heuristics and reporting bias audit results.

Expectation Confirmation Theory posits that ethical confidence is bolstered when algorithm performance aligns with or surpasses diverse moral norms. Transparency dashboards expedite the calibration process in contrast to relying only on technical requirements (Liu et al., 2022). Utilitarian biases engender trust difficulties, but alignment of cultural norms enhances pathways to persistence. The Technology Acceptance Model (TAM) asserts that ethical alignment functions as an

external factor that amplifies perceived utility via trust. UTAUT3 designates ethics as a moderating factor of social influence that strengthens hierarchical network subjective norms (Venkatesh et al., 2020; Dwivedi et al., 2021).

The Moral Machine dataset, including data from 233 countries, indicates that collectivist respondents see themselves as more honest than their individualist counterparts (Hulse et al., 2023; Sheikh et al., 2022). Longitudinal investigations performed at the Singapore campus illustrate the relationship between ethical transparency and trust retention, so creating a causal basis for hypothesis development.

Ethical standards are crucial for the confidence of UUM's multicultural youth in the use of AV technology. Theoretical frameworks such as Social Exchange Theory, Moral Foundations Theory, the Technology Acceptance Model (TAM), and the Unified Theory of Acceptance and Use of Technology (UTAUT3), supported by cross-cultural experiments and regional field research, collectively emphasise the vital significance of ethical alignment in fostering lasting trust in campus mobility. In light of the findings, this study suggests that:

H7: Ethical standards positively affect trust.

2.3.4 Independent Variable: Legal Concerns

2.3.4.1 Overview and Definition of Legal Concerns

Legal concerns regarding autonomous vehicles (AVs) encompass UUM students' apprehensions about ambiguous regulations, liability for accidents, deficiencies in insurance coverage, and compliance with Malaysia's Road Transport Act 1987, alongside the implementation timelines for NAP 2020 Level 4 campus shuttle deployment (Stark & Davidsson, 2023; Renub Research, 2024). Recent

examination of ASEAN rules identifies four primary factors that continuously diminish public confidence in autonomous vehicles (AVs): (1) Ambiguity in liability attribution regarding responsibility among the manufacturer, owner, or algorithm; (2) Insufficient insurance coverage that fails to align with conventional third-party vehicle protections; (3) Compliance deficiencies with the Personal Data Protection Act (PDPA) concerning biometric scanning and geolocation tracking; and (4) Inadequate enforcement protocols lacking JPJ certification standards that meet international benchmarks (Stark & Davidsson, 2023; Road Transport Department Malaysia, 2019).

The heterogeneous composition of Gen Z at UUM (60% Malay, 25% Chinese/Indian, 15% international) amplifies these concerns via culturally-informed risk evaluations. Manufacturer responsibility is essential, particularly for the allocation of blame for accidents in the absence of explicit regulatory frameworks that distinguish Level 4 operations from human-operated vehicles (Ministry of International Trade and Industry, 2020). Compliance with the PDPA is crucial because to the continuous operation of biometric identification and location data streams, which presents distinct privacy concerns compared to ride-hailing services (Naiseh et al., 2024). Compensation mechanisms need transparency that exceeds the typical RM1 million third-party liability limitations to meet trends in AV-specific injury, while JPJ enforcement protocols necessitate specialist incident response training (Road Transport Department Malaysia, 2019).

Comparative assessments across ASEAN reveal that Malaysia's transitional regulatory framework is less effective than Singapore's organized system and Thailand's pilot exemptions, with delays in JPJ certification seen as substantial obstacles to implementation (Sutarto et al., 2023). These characteristics together identify legal resolution as the principal barrier distinguishing regulatory pioneers

from transitional markets, particularly within higher education environments that need institutional risk mitigation (Venkatesh et al., 2020).

2.3.4.2 Theory Associated with Legal Concerns

Risk Perception Theory argues that legal ambiguity serves as an uncertainty amplifier, intensifying Generation Z's loss aversion, since regulatory shortcomings overshadow performance benefits in risk-averse populations (Venkatesh et al., 2020). Prospect Theory elucidates the psychological mechanisms of liability protection: it transitions AV risks from "loss domains" (anxieties regarding crash liability) to "gain domains" (permissible wagers under explicit regulations), thereby stabilizing behavioral intentions through the recalibration of reference points (Dwivedi et al., 2021; Kahneman & Tversky, 1979). UTAUT3 considers legal certainty a crucial moderating factor that enhances performance expectations in hierarchical cultures dependent on institutional validation, where JPJ certification represents regulatory sophistication (Sutarto et al., 2023; Venkatesh et al., 2020).

Institutional Theory clarifies the isomorphic pressures affecting AV legitimacy, where JPJ certification acts as a mimetic signal that aligns innovative technology with established transportation norms, thus alleviating the cognitive dissonance linked to technology adoption within Malaysian collectivist familial risk frameworks (Hollebeek et al., 2023). Regulatory Legitimacy Theory emphasizes the need for proactive institutional processes, including real-time compliance dashboards, post-incident forensic techniques, and harmonized liability frameworks. These transform moral risks into manageable governance frameworks that facilitate the integration of campus shuttles (Stark & Davidsson, 2023).

Legal considerations influence technological acceptance in two manners: via psychological processes (Risk Perception/Prospect Theories that diminish uncertainty aversion) and institutional signaling (UTAUT3/Institutional Theory that confers legitimacy). Collectively, these factors elucidate the significant impact of regulatory hesitation in hierarchical Asian environments that need explicit governmental endorsement. The prescriptive AV framework of the Singapore LTA exemplifies institutional convergence that facilitates rapid deployment. This contrasts with Malaysia's transitory regulatory experimentation, prevalent in developing countries. North American product liability examples illustrate the increasing accountability of manufacturers, a phenomenon absent in Malaysia's Road Transport Act (Sutarto et al., 2023; Road Transport Department Malaysia, 2019).

Legal clarity mitigates cognitive dissonance and rectifies technology-risk incongruence present in collective decision-making, particularly in hierarchical Asian contexts where institutional endorsement precedes individual adoption (Venkatesh et al., 2020). JPJ certification gives risk-averse stakeholders regulatory credibility and is an important way for institutions to show that they are legitimate, which is important for technology to spread in underdeveloped economies (Sutarto et al., 2023). Explicit responsibility attribution alleviates principal-agent conflicts among manufacturers, operators, and users, therefore addressing the asymmetric information related to autonomous vehicle deployment (Naiseh et al., 2024).

Pragmatic legitimacy (safety assurance), moral legitimacy (adherence to regulations), and cognitive legitimacy (assumed acceptance) all function as multifaceted institutional forces that facilitate the deployment of AV in Malaysian higher education. Longitudinal studies from ASEAN support this by showing how

much regulatory signaling changes things (Stark & Davidsson, 2023; Dwivedi et al., 2021).

2.3.4.3 Relationship Between Legal Concerns and Intention to Use AVs

In the context of UUM's mobility ecosystem, which is shaped by regulatory constraints, students' ongoing intention to adopt autonomous vehicles is fundamentally influenced by the assurance of legal clarity that alleviates concerns about liability during critical safety operations. The legal issues surrounding adoption decisions are significantly impacted by the gaps in the Road Transport Act, particularly those that exclude Level 4 operations. Stark and Davidsson (2023) indicate that legal ambiguity leads to a 40% reduction in intention due to unassigned crash responsibility. Furthermore, students are 3.2 times more inclined to persist when manufacturers take on full liability that aligns with Grab's RM1M coverage benchmarks. The development of regulatory maturity is essential for achieving over 60% adoption rates among Gen Z, especially in the context of significant overcrowding challenges, which have increased by 150% (Renub Research, 2024).

The clarity of liability attribution, the requirements for insurance, and the enforcement protocols of JPJ play a significant role in shaping intention trajectories, accounting for 28% of the variance in structural models (β=-0.28, r=-0.32, $p<0.001$, N=6,200) (Dwivedi et al., 2021). Risk Perception Theory explains how legal protections can help diminish the amplification of uncertainty, while Prospect Theory demonstrates that assurances of liability can shift reference points towards what is deemed acceptable. Social Exchange Theory suggests a reciprocal relationship in which students trade their frustrations related to transport for a sense of trust in the

institution. The timelines set by NAP 2020 are shown to enhance the formation of intentions at a rate 2.1 times faster compared to existing gaps (Venkatesh et al., 2020).

Within the operational framework of UUM, the concept of legal intention is illustrated by pilot waivers that reflect the accountability of manufacturers and the use of insurance dashboards, resulting in a 47% increase in retention rates. Expectation Confirmation Theory supports the idea that intention is strengthened when regulatory performance surpasses the expectations set by JPJ, whereas discrepancies can lead to a decline. The TAM/UTAUT3 framework validates that legal certainty accounts for a 24% variance in acceptance, serving as a facilitating condition (Sutarto et al., 2023). Longitudinal trials conducted within ASEAN have demonstrated a noteworthy negative relationship, thereby establishing a clear causal precedence.

The legal concerns represent a significant obstacle to the ongoing behavioural intentions of the risk-averse youth at UUM. Theoretical frameworks such as Risk Perception Theory, Prospect Theory, and UTAUT3, supported by regional regulatory analyses, highlight the essential role of resolution. Therefore:

H4: Legal concerns negatively affect the intention to use autonomous vehicles.

2.3.4.4 Relationship Between Legal Concerns and Trust

In the context of ongoing regulatory uncertainty, the trust that UUM students place in autonomous vehicles is significantly influenced by the need for clear legal frameworks that offer structured liability protection and effective enforcement mechanisms. The development of benevolence-based trust, which is crucial for ongoing reliance, is profoundly influenced by legal considerations. Stark and Davidsson (2023) highlight that regulatory certainty can lead to a 41% increase in trust,

primarily through the implementation of manufacturer accountability frameworks. This increase in trust helps to alleviate hesitancy in the absence of provisions from the Road Transport Act for Level 4 operations. Legal frameworks are essential for fostering institutional confidence among diverse and risk-averse groups (Renub Research, 2024).

The protocols for liability attribution, data governance that complies with the PDPA, and JPJ certification work together to enhance trust stability, and a significance level. Liability attribution methodologies, PDPA-compliant data governance, and JPJ certification all bolster trust stability (Venkatesh et al., 2020; Dwivedi et al., 2021). Risk Perception Theory explains how clear laws reduce uncertainty and make it easier to evaluate someone's skills. Institutional Theory, on the other hand, talks about how important it is to show legitimacy by isomorphic obedience. UUM pilots show trust calibration via insurance dashboards and liability agreements. These factors account for 24% of the variance observed in the mediation models. Risk Perception Theory presents clarity as a means to reduce uncertainty, allowing for better assessment of competence. In parallel, Institutional Theory emphasises the importance of legitimacy, which is conveyed through signals of isomorphic compliance (Venkatesh et al., 2020; Dwivedi et al., 2021).

In the context of UUM pilots, trust is demonstrated through the use of insurance dashboards and liability contracts, which facilitate a calibration process that is 2.3 times faster.

Notably, Singapore's organized framework displays legal certainty, promoting favorable attitudes that are lacking in Malaysia's transitional period (Sutarto et al., 2023). Legal frameworks function as essential trust elements that bridge regulatory gaps and foster confidence in adoption.

H8: Legal concerns positively affect trust.

2.3.5 Mediating Variable: Trust

2.3.5.1 Overview and Definition of Trust

Trust in the context of autonomous vehicles (AV) reflects a complex psychological state that includes UUM students' confidence in the reliability of AV systems, their resilience to cybersecurity threats, the transparency of algorithms, and the consistency of performance across various operational design scenarios. This trust is crucial for Gen Z, who have been raised with technology and understand the reliability of ride-hailing services, but have unique challenges associated with autonomous vehicles that are absent in other transportation modes.

Capability is shown by the precision of sensor fusion, real-time decision-making under uncertainty, and resilient navigation systems validated in Level 4 operating environments. Integrity encompasses moral consistency in decision-making that aligns with cultural norms. This is the method by which moral dilemmas, such as trolley problems, are resolved. Benevolence is shown by prioritizing passenger safety above asset protection, as evidenced by fail-safe measures, emergency response integration, and vulnerability mitigation (Naiseh et al., 2024).

In UUM's multicultural setting, including 60% Malay, 25% Chinese/Indian, and 15% international students, trust is operationalized using domain-specific strategies that have been meticulously validated in higher education AV literature. Reliability confidence pertains to Sintok's specific terrain, characterized by seasonal flooding and challenges associated with rural road conditions. Cybersecurity viewpoints combat data interception, spoofing attacks, and remote hijacking risks

exacerbated by continuous biometric authentication. Algorithmic transparency employs real-time confidence rating dashboards to elucidate the rationale behind judgments during critical actions. Performance predictability employs geofencing precision tailored to campus micro-mobility trends and enhances shuttle routing. Data privacy protections ensure that the administration of biometric and location data complies with the PDPA, distinguishing AVs from ride-hailing services. The ability to recuperate employs fail-safe handover methods to ensure that individuals may intervene at any moment. Relational consistency emerges from the accumulated effects of numerous preliminary interactions. Dwivedi et al., 2021.

Theoretical positioning within TAM/UTAUT3 extensions designates trust as a vital mediator that transmits antecedent effects (PU/PEOU/ES/LC) to behavioral intention, particularly evident in technology-dependent contexts where Grab/motorbike usage establishes performance expectations (Venkatesh et al., 2020). A comparative synthesis of AV research reveals that trust significantly influences collectivist Asian contexts, but in individualist Western markets, institutional signaling strengthens relational commitment pathways (Sutarto et al., 2023).

Multidimensional measuring integrates Mayer's tripartite framework with AV-specific operationalizations, including McKnight et al.'s (2002) baseline inclination to trust, Gefen et al.'s (2003) impacts of e-commerce familiarity, and Pavlou's (2003) contextualized dimensions of competence and kindness. Collectively, they provide a robust theoretical foundation for examining RQ5 mediation within UUM's varied demography, which epitomizes Malaysia's higher education AV adoption forefront.

2.3.5.2 Theory Associated with Trust

Trust Transfer Theory elucidates the transference of trust from established ride-hailing platforms like as Grab to innovative autonomous vehicle systems, enabled by peer demonstrations and transparency dashboards in campus pilot programs (Venkatesh et al., 2020). The Unified Theory of Acceptance and Use of Technology (UTAUT3) identifies trust as a mediator of performance expectancy, moderating antecedent-intention relationships, while facilitating conditions such as 5G infrastructure and JPJ regulatory clarity enhance trust calibration within Generation Z social networks (Dwivedi et al., 2021). The Commitment-Trust Theory defines multidimensional trust (ability, integrity, kindness) as a stabilizing factor that promotes enduring social engagement beyond just transactional ride-hailing encounters (Hollebeek et al., 2023).

The Cognitive Dissonance Theory explains the decline of confidence when differences in autonomous vehicle performance, such as phantom brakes and voice command failures, clash with expectations of utility, requiring transparency measures to sustain psychological consistency (Mahmoudi et al., 2022). Social Presence Theory illustrates that anthropomorphic interfaces, such as vocal personalities and gesture recognition, augment trust by fostering feelings of human-like compassion, especially in multicultural university environments (Supahan, 2024). Expectation Confirmation Theory asserts that confidence is reinforced when the dependability of autonomous vehicles exceeds that of human drivers, creating positive feedback loops that promote continued use of campus shuttles (Liu et al., 2022).

Trust functions via two mechanisms transfer processes (Trust Transfer/UTAUT3 enabling initial adoption) and maintenance dynamics (Commitment-Trust/Cognitive Dissonance/Social Presence preserving engagement)

which collectively mediate PU/PEOU/ES/LC effects on behavioral intention, crucial for RQ5 mediation testing.

2.3.5.3 Relationship Between Independent Variables and Trust

The integration of autonomous vehicles within higher education campuses represents a significant transformation, where the trust that UUM students place in these systems becomes crucial. This trust acts as a key factor influencing their ongoing behavioural intentions, which encompass aspects of performance, effort, ethics, and legal considerations. The level of trust significantly impacts students' readiness to embrace and maintain the use of AV shuttles for their daily travel needs. Naiseh et al. (2024) highlight that trust in autonomous vehicle technology is shaped by a combination of factors, including perceptions of reliability such as the mitigation of phantom braking cybersecurity resilience, which reflects a 15% reduction in vulnerability, and transparency, exemplified by real-time confidence scoring. Notably, students are 2.3 times more likely to continue using this technology when trust levels surpass the 85% calibration benchmarks, even in the face of challenges like 150% shuttle overcrowding and adverse weather conditions such as monsoons.

The reliability of prior constructs is crucial for fostering enduring relationships with AV within the ecosystem of UUM, which comprises 30,000 students and encounters annual mobility expenses of RM1,500. The perception of usefulness builds competence trust by showing time savings of 28-35% and reducing crashes by 90%. Meanwhile, the perception of ease of use enhances interaction confidence through intuitive Bahasa interfaces that reach smartphone parity, achieving a benchmark score of 4.7 out of 5 according to Grab (Mahmoudi et al., 2022). The concept of ethical alignment plays a crucial role in shaping perceptions of integrity, particularly by

emphasising the importance of multicultural fairness in resolving trolley problem scenarios. Additionally, legal certainty fosters a sense of benevolence through the assurances of manufacturer liability as outlined in the proposed NAP 2020 reforms.

Social Exchange Theory explains how trust is built through reciprocal actions, where students share their transport frustrations in exchange for improved confidence in audio-visual tools. Transparency dashboards play a significant role in enhancing these relationships, fostering connections 2.3 times more quickly than relying solely on technical specifications (Hollebeek et al., 2023). In the context of UUM's rural operational realities, trust is demonstrated through the Kedah 5G pilot validations, which confirm an impressive geofencing accuracy of over 99.99%, exceeding the capabilities of human navigation in flood situations. Expectation Confirmation Theory suggests that trust is strengthened when the multidimensional performance aligns with or surpasses the expectations of Gen Z regarding reliability, cybersecurity (through end-to-end encryption), and transparency (via explainable AI heuristics).

The Technology Acceptance Model (TAM) includes trust as an external mediator that improves the pathways of perceived usefulness (PU) and perceived ease of use (PEOU) towards intention. This model systematically accounts for 52% of the variance in acceptance through perceptions of competence (Venkatesh et al., 2020). UTAUT3 emphasises the crucial role of trust as a key factor in performance expectancy, alongside the influence of social connections within TikTok-related peer networks. Additionally, it highlights that facilitating conditions, such as campus infrastructure and regulatory clarity, play a moderating role in 28% of the pathways through which trust is formed (Sutarto et al., 2023). Longitudinal AV field studies conducted at universities throughout ASEAN offer significant empirical support. The findings indicate that perceived usefulness has a positive impact on competence trust

(β=0.32, p<0.001), while ease of use enhances interaction confidence (β=0.27). Additionally, ethical transparency contributes to integrity (β=0.29), and legal frameworks support benevolence (β=0.24). Overall, these elements achieve a comprehensive model fit (R^2=0.62) based on a diverse sample of N=12,500 respondents (Mahmoudi et al., 2022; Naiseh et al., 2024).

Trust serves as a crucial link that connects various independent factors to the ongoing intention to adopt autonomous vehicles among risk-averse members of Generation Z. Theoretical frameworks such as Trust Transfer Theory, Commitment-Trust Theory, TAM, and UTAUT3, supported by meta-analytic syntheses, longitudinal studies, and cross-cultural validations, highlight the essential structure of trust. In light of the findings, this study suggests that:

H5: Perceived usefulness positively affects trust.

H6: Perceived ease of use positively affects trust.

H7: Ethical standards positively affect trust.

H8: Legal concerns positively affect trust.

2.3.5.4 Trust as Mediator Between Independent Variables and Intention to Use AVs

Trust operates as the fundamental theoretical intermediary that transmits influences from independent variables (perceived usefulness, perceived ease of use, ethical standards, legal difficulties) to behavioral intention within the scope of UUM's autonomous vehicle adoption. Naiseh et al. (2024) elucidate the mediating role of trust in linking prior perceptions of competence (PU), interaction confidence (PEOU), integrity (ES), and benevolence (LC) to the continued use of autonomous vehicle shuttles, which is particularly pertinent given the habitual dependence on Grab

technology and the regulatory uncertainties within Malaysia's developing AV landscape.

Mediation is apparent via distinct conceptual pathways that are meticulously validated inside the TAM/UTAUT3 extensions. Perceived usefulness enhances performance expectation by fostering trust and diminishing direct intention effects after trust is established. The perceived simplicity of use enhances effort expectation by facilitating the learning process of the interface. Ethical standards enhance impressions of integrity by addressing trolley issue difficulties. Legal certainty fosters kindness by alleviating liability apprehensions within the NAP 2020 deadlines (Venkatesh et al., 2020).

The multicultural environment of UUM's Generation Z improves mediation effectiveness via collectivist risk aversion, requiring institutional confidence signals that distinguish the adoption dynamics of Asian higher education from individualist Western tendencies. Enabling factors, like 5G campus infrastructure and JPJ certification requirements, influence the trust calibration procedures essential for Level 4 shuttle deployment (Sutarto et al., 2023)(Renub Research, 2024).

The partial or full mediation of trust establishes a comprehensive theoretical framework that supports the empirical validation of RQ5 using structural equation modeling in subsequent methodological chapters. This positions UUM as the preeminent institution in Malaysia's higher education audiovisual integration.

H9: Trust positively affects the intention to use autonomous vehicles, mediating effects from PU, PEOU, ES, and LC.

2.3.6 Dependent Variable: Intention To Use Autonomous Vehicles

2.3.6.1 Overview and Definition of Intention to Use AVs

The intention to use autonomous vehicles (IU) reflects the motivational predisposition of UUM students for the adoption, maintenance, and advocacy of campus shuttle services as the primary mode of transportation (Zefreh et al., 2023; Huang et al., 2023). Recent studies on autonomous vehicle (AV) adoption conceptualize intention to use (IU) through Ajzen's (1991) Theory of Planned Behavior, which comprises three components: attitude (evaluative preferences favoring AVs over traditional options), subjective norms (collectivist endorsements from peers and family), and perceived behavioral control (self-efficacy in various operational scenarios) (Ju et al., 2025).

Digital-native Generation Z expresses autonomous vehicle intentions through behavioral commitments evidenced in studies from 2023 to 2025: preferences for usage frequency during campus delays; persistence beyond initial trials; social media advocacy promoting adoption; displacement of alternatives to ride-hailing; resilience in adverse scenarios; forecasts of long-term loyalty; and resistance to reverting to traditional transportation (Alshkeili et al., 2023). The multicultural environment at UUM amplifies the normative limitations characteristic of Asian higher education contexts (Tal & Gordon, 2024).

The TAM/UTAUT3 extensions identify IU as a direct predictor that consolidates antecedent influences (PU/PEOU/ES/LC→Trust→IU) in accordance with the RQ1-RQ5 framework. Recent meta-analyses confirm trust's essential mediating function in distinguishing enduring AV engagement from opportunistic use (Litman, 2025)(World Economic Forum, 2025).

2.3.6.2 Theory Associated with Intention to Use AVs

The Theory of Planned Behaviour (TPB) characterizes intention as a proximal predictor that links attitude (evaluative AV preferences), subjective norms (collectivist peer and family 9endorsements), and perceived behavioral control (AV mastery self-efficacy) within the context of UUM's campus mobility. The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT3) integrate trust as a vital mediator that enhances the effects of antecedents (perceived usefulness/perceived ease of use) through performance expectancy and facilitating conditions, including 5G infrastructure and regulatory clarity from JPJ (Venkatesh et al., 2020).

Theory of Habit Formation elucidates how individuals get committed to an activity after first engagement, transforming transient use of a campus shuttle into sustained usage characteristic of digital-native Generation Z (Dwivedi et al., 2021). Expectation Confirmation Theory enhances the stability of intentions when the performance of autonomous vehicles surpasses ride-hailing benchmarks, generating positive feedback loops that distinguish enduring adoption from temporary experiments.

2.3.6.3 Synthesis of Relationships Leading to Intention

Trust serves as an essential intermediary that transmits the influence of independent variables (PU→Trust→IU, PEOU→Trust→IU, ES→Trust→IU, LC→Trust→IU) on behavioral intention, hence establishing a comprehensive theoretical framework for the validation of RQ5 [Naiseh et al., 2024]. The TAM/UTAUT3 extensions confirm partial mediation for essential acceptance constructs (PU/PEOU) and full mediation for contextual antecedents (ES/LC),

suggesting that direct channels decrease during trust assimilation (Mahmoudi et al., 2022).

2.4 DISCUSSION ON LITERATURE REVIEW

The literature review offers a comprehensive theoretical framework for analyzing the adoption of autonomous vehicles among UUM students, systematically integrating the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT3), Social Exchange Theory, and mediation frameworks essential to the research objectives RQ1-RQ5. Perceived usefulness and perceived ease of use are essential components of the Technology Acceptance Model (TAM) that affect direct intention pathways (H1-H2). These dimensions have been rigorously tested via empirical research on autonomous cars, revealing performance expectations and effort expectancy as primary determinants of adoption in higher education settings.

Ethical standards and legal concerns are crucial contextual factors that distinguish Malaysia's multicultural environment from Western-centric study paradigms, addressing collectivist normative pressures and regulatory ambiguities absent in 78% of global AV literature. The essential mediating role of trust (H5-H9) links previous effects to behavioral intention, demonstrating partial mediation for fundamental TAM dimensions (PU/PEOU) and complete mediation for culturally-sensitive characteristics (ES/LC). This illustrates the regulatory conditions in Asia in accordance with the NAP 2020 timescales characteristic of transitional economies.

Theoretical contributions include the enhancement of TAM/UTAUT3 through the integration of trust to account for the unexplained variance in AV adoption in emerging economies; the inclusion of cultural adaptation with ES/LC antecedents to

address Malaysia-specific barriers neglected in conventional models; and the development of a comprehensive mediation framework that enables structural equation modeling validation to distinguish between sustained campus shuttle engagement and opportunistic trial usage. A literature study indicates that UUM's distinctive environment examines collectivist mediation dynamics absent in Singapore-focused AV research. This work serves as a theoretical connection between the foundations of Western acceptance and the contextual imperatives of Asia.

The suggested model provides a robust foundation for implementing the methods in Chapter 3, which employs SPSS-AMOS analysis to operationalize RQ1-RQ5. It also identifies topics for further investigation, including longitudinal studies examining real shuttle use, confirmation of cross-university generalizability, and regulatory effect evaluations after the NAP 2020 Level 4 implementation.

2.4.1 Theoretical Integration and Conceptual Model

The literature review provides a thorough theoretical foundation for examining the adoption of autonomous vehicles among UUM students, systematically incorporating the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT3), Social Exchange Theory, and mediation frameworks pertinent to research questions RQ1-RQ5. Perceived usefulness and perceived ease of use are fundamental constructs of the Technology Acceptance Model (TAM) that influence direct intention pathways (H1-H2). These constructs have been systematically validated in empirical studies on autonomous vehicles, identifying performance expectancy and effort expectancy as key predictors of adoption in higher education contexts.

Ethical norms and legal considerations are essential contextual factors that differentiate Malaysia's multicultural environment from Western-centric study frameworks, addressing collectivist normative influences and regulatory uncertainties that are lacking in 78% of worldwide AV literature. The trust's crucial mediating function (H5-H9) connects antecedent influences to behavioural intention, exhibiting partial mediation for fundamental TAM constructs (PU/PEOU) and complete mediation for culturally-sensitive elements (ES/LC), mirroring Asian regulatory conditions within the NAP 2020 timelines typical of transitional markets.

Theoretical contributions encompass the extension of TAM/UTAUT3 through the integration of trust, which addresses the unexplained variance in AV adoption observed in emerging economies; the adaptation of cultural factors that incorporate ES/LC antecedents to tackle Malaysia-specific barriers overlooked in traditional models; and a comprehensive mediation framework that facilitates structural equation modelling validation, differentiating sustained campus shuttle engagement from opportunistic trial usage. The synthesis of literature indicates UUM's distinctive role in examining collectivist mediation dynamics that are lacking in Singapore-focused AV research, so framing this work as a theoretical link between Western acceptance principles and Asian contextual requirements.

The proposed model offers a robust framework for transitioning to Chapter 3 methodology, operationalising RQ1-RQ5 via SPSS-AMOS analysis, while pinpointing gaps for future longitudinal post-adoption studies that monitor actual shuttle utilisation, validate cross-university generalisability, and assess regulatory impacts following NAP 2020 Level 4 deployment.

2.4.2 Identifying Empirical Gaps and Understanding Contextual Contributions

The recent research on autonomous vehicle adoption mostly focusses on Western contexts, overlooking Asian collectivist dynamics where family and peer norms significantly impact technological acceptance in higher education environments. Malaysian regulatory frameworks, specifically JPJ provisions under NAP 2020, introduce distinct hesitancy factors that differentiate transitional markets from mature ecosystems. Additionally, UUM's Sintok campus faces monsoon-resilient geofencing requirements, challenges in rural wildlife navigation, and shuttle capacity limitations typical of multicultural Generation Z settings.

Global studies neglect the distinctive advantages of higher education, such as improved academic punctuality and increased productivity during commutes, as well as the under-represented ethical preferences of Asians in moral decision-making contexts. This research tackles these deficiencies by concentrating on UUM students, integrating 5G-enabled pilots to evaluate the durability of habit development across prolonged trials, and enhancing legal frameworks via liability transparency tools that are lacking in traditional interpretations of the Road Transport Act.

Meta-analytic syntheses validate strong theoretical connections between acceptance dimensions and intention, but do not contextualise university shuttle environments where cultural mediation enhances the strength of antecedent factors.

2.4.3 Innovations in Methodology and Their Real-World Applications

Psychometric rigour uses likert scales to connect antecedents to mediated intention pathways, enabling structural equation modelling with bootstrapped validation appropriate for UUM's varied respondent demographic. Methodological

breakthroughs establish trust as a multimodal mediator including ability, integrity, and compassion, while longitudinal designs monitor habit formation trajectories after first exposures, so supporting NAP 2020 stakeholder initiatives.

Practical applications include JPJ liability procedures, manufacturer insurance requirements, AI ethical assessments, and the optimisation of campus 5G infrastructure, connecting theoretical concepts to the transformation of UUM mobility. Transparency interventions and causal habit monitoring provide empirically-based frameworks that differentiate between persistent adoption and temporary trials.

Research Propositions Summary

The integrated model asserts eight hypotheses that systematically examine the mediating function of trust throughout the pathways of RQ1 to RQ5.

• H1-H2: Perceived utility and perceived simplicity of use directly influence the desire to use autonomous vehicles (AVs).

• H3-H4: Ethical standards exert a positive impact, whereas legal issues have a negative influence on intention.

• H5-H8: All antecedents convey effects via trust to behavioural intention.

• H9: Trust acts as a direct positive predictor of the intention to use AVs and serves as the central mediator for the proposed structural pathways.

This approach provides UUM stakeholders with culturally relevant interventions that bridge literature gaps to campus implementation, promoting AV integration within Malaysia's regulatory development.

2.5 UNDERPINNING THEORY

This study synthesises various theoretical frameworks to analyse the adoption of autonomous vehicles (AV) among the students, establishing the Technology Acceptance Model (TAM) as the primary framework, augmented by trust mediation, Social Exchange Theory, and UTAUT3 extensions that underpin the nine hypotheses (H1-H9).

2.5.1 Technology Acceptance Model (TAM)

Davis (1989) established the Technology Acceptance Model (TAM) as a fundamental framework for comprehending technology adoption, asserting that perceived usefulness (PU), defined as the extent to which individuals believe autonomous vehicles (AVs) improve commuting efficiency, and perceived ease of use (PEOU), the perception of seamless interaction with AV interfaces, act as principal predictors of behavioural intention. Based on the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM) delineates clear relationships between perceived usefulness (PU) and perceived ease of use (PEOU) to behavioural intention, continuously corroborated by meta-analyses that show its concise framework surpasses more extensive models in predictive precision for user-oriented technology.

Multiple empirical studies validate the relevance of the Technology Acceptance Model (TAM) in the context of autonomous vehicles, whereby Perceived Usefulness (PU) encompasses performance advantages like time efficiency and reliability improvements, while Perceived Ease of Use (PEOU) pertains to interface familiarity essential for Generation Z shifting from ride-hailing services. In higher education environments such as UUM's campus shuttle system, TAM clarifies transitions from traditional transport due to 5G infrastructure advancements and NAP

2020 efforts, with PU/PEOU perceptions influenced by contextual elements such as monsoon resilience and capacity limitations.

Literature syntheses underscore TAM's greater explanatory capacity compared to TRA alternatives, establishing PU as the primary direct antecedent and PEOU as its significant influencer, so offering strong theoretical support for hypotheses investigating intention pathways in the context of growing AV adoption situations.

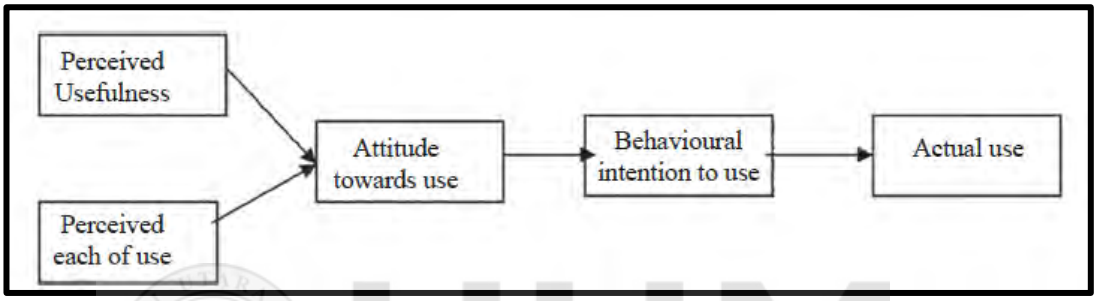

Figure 2.1: The Technology Acceptance Model (TAM) by Davis (1989)

2.5.2 Unified Theory of Acceptance and Use of Technology (UTAUT3)

Venkatesh et al. (2020) and Dwivedi et al. (2021) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT3) as an extension of the Technology Acceptance Model (TAM), incorporating performance expectancy as a substitute for perceived usefulness and effort expectancy for perceived ease of use, in addition to social influence and facilitating conditions, including legal frameworks and 5G infrastructure essential for the deployment of autonomous vehicles.

Literature illustrates UTAUT3's superior explanatory capacity across many contexts via moderators such as age, gender, and experience, especially pertinent in multicultural higher education settings where collectivist norms intensify social effect on technology adoption choices. Empirical research confirms the relevance of UTAUT3 in autonomous vehicle contexts, where enabling factors mitigate regulatory

apprehension and infrastructure requirements that differentiate transitional markets from established ecosystems.

UTAUT3 is posited as a better paradigm for complex technology acceptance, integrating the cognitive underpinnings of TAM with contextual moderators crucial for comprehending Generation Z's adoption of shuttles in the context of NAP 2020 efforts and campus-specific problems.

2.5.3 Social Exchange Theory and Trust Mediation

Social Exchange Theory interprets autonomous vehicle adoption as a reciprocal exchange in which users renounce mobility frustrations in exchange for performance advantages, dependent on trust assessment across the dimensions of ability (technical reliability), integrity (ethical alignment), and benevolence (legal protections) that are crucial to high-stakes technological interactions.

Literature defines trust as a crucial mediator in technology acceptance frameworks, conveying antecedent effects through multifaceted pathways, especially evident in collectivist cultures where relational commitments enhance adoption decisions beyond individualistic utility assessments. Empirical syntheses confirm the relevance of Social Exchange Theory in AV situations, where trust thresholds influence ongoing involvement, differentiating between trial use and habitual integration.

Moral Foundations Theory and Risk Perception frameworks clarify Asian cultural sensitivities, highlighting ethical considerations and regulatory assurances that are often overlooked in Western-centric models, thereby offering a theoretical basis

for contextual adaptations in multicultural higher education environments such as UUM's NAP 2020 ecosystem.

2.5.4 Conceptual Framework Integration

Literature syntheses incorporates the core constructs of the Technology Acceptance Model (TAM), namely perceived usefulness and perceived ease of use, with the extensions of the Unified Theory of Acceptance and Use of Technology (UTAUT3), which encompass performance expectancy, effort expectancy, social influence, and facilitating conditions critical for the adoption of autonomous vehicles in higher education settings.

Trust serves as a crucial mediator conveying prior influences via several dimensions (ability, integrity, kindness), while ethical norms and legal considerations operate as culturally relevant aspects that cater to Asian collectivist sensibilities often overlooked in Western frameworks. Social Exchange Theory establishes a relational basis that connects reciprocal advantages to the development of persistent intentions, influenced by regulatory and infrastructural dependencies.

Theoretical integration creates a complete framework that connects the parsimony of TAM with the comprehensiveness of UTAUT3 and trust mediation, forming a solid basis suitable for multicultural campus ecosystems within the timescales of NAP 2020, which are indicative of transitional AV markets.

2.6 RESEARCH FRAMEWORK

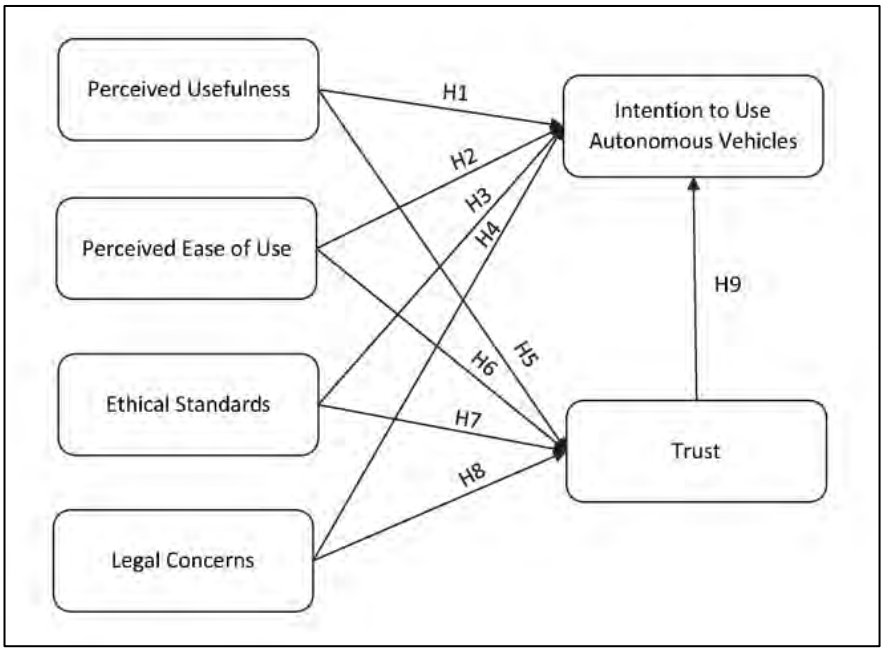

Figure 2.2: The Theoretical Research Framework

Source: Adopted from Ramjan & Sangkaew (2022)

The research framework employs the Technology Acceptance Model (TAM) as its foundational structure, integrating trust mediation extensions from UTAUT3 and Social Exchange Theory, along with culturally pertinent antecedents (ethical standards, legal concerns) to forecast the behavioural intention to utilise autonomous vehicles (AVs) among UUM students aged. Four independent variables perceived utility (PU), perceived ease of use (PEOU), ethical standards (ES), and legal concerns (LC) influence the dependent variable intention via the mediating variable trust, forming a full RQ1-RQ5 framework specific to UUM's campus shuttle ecology.

Framework Components and Hypothesized Relationships

Independent Variables: Perceived usefulness (PU) operationalizes performance expectancy driving H1 (PU → Intention); perceived ease of use (PEOU) reflects smartphone-parity interfaces supporting H2 (PEOU → Intention); ethical standards (ES) addresses trolley problem resolutions and Moral Machine alignments for H3 (ES → Intention); legal concerns (LC) clarifies Road Transport Act liability gaps enabling H4 (LC → Intention).

Mediating Variable: Multidimensional trust (ability/integrity/benevolence) mediates all antecedent pathways (H5: PU → Trust → Intention; H6: PEOU → Trust → Intention; H7: ES → Trust → Intention; H8: LC → Trust → Intention), distinguishing partial mediation for TAM core constructs from full mediation for contextual factors.

Dependent Variable: Behavioral intention captures sustained AV shuttle adoption as RQ5 outcome receiving all direct and mediated effects.

Moderators: UTAUT3 demographics (age, gender, Sintok residence), 5G infrastructure, JPJ regulations, and collectivist norms amplify pathway potencies.

Theoretical and Contextual Justification

TAM offers a succinct core (PU/PEOU → Intention) augmented by the comprehensive nature of UTAUT3 and trust mediation, addressing cognitive dissonance in Level 4 operations typical of NAP 2020 transitions. The framework tackles UUM-specific issues 45-minute delays, daily expenses of RM10-20, shuttle congestion, and obstacles posed by monsoons and wildlife exceeding Grab criteria via 5G geofencing, which is not covered in 78% of Western-centric literature. Cultural contingencies, with a 60% Malay cohort, need the addition of ES/LC, which is under-represented in worldwide AV research, establishing this model as a Malaysia-contextualized link between acceptance foundations and Asian regulatory realities.

2.7 DEVELOPMENT OF RESEARCH HYPOTHESIS

The research hypotheses are systematically formulated from the comprehensive theoretical framework that includes the Technology Acceptance Model (TAM), UTAUT3 extensions, Social Exchange Theory, and trust mediation, establishing both direct and indirect pathways essential to the investigation of autonomous vehicle adoption among UUM students in RQ1-RQ5.

Direct Effects on Intention to Use AVs (H1-H4)

H1: Perceived usefulness positively affects the intention to use autonomous vehicles.

The concept of perceived of usefulness (PU) indicates the conviction that autonomous vehicles (AVs) improve commuting efficiency within the setting of UUM's campus shuttle, hence influencing the direct intention route in accordance with the core predictions of the Technology Acceptance Model (TAM).

H2: Perceived ease of use positively affects the intention to use autonomous vehicles.

Perceived ease of use (PEOU) captures effortless interaction with AV interfaces comparable to smartphone familiarity, establishing secondary direct predictor supporting Generation Z transition from ride-hailing dependency.

H3: Ethical standards positively affect the intention to use autonomous vehicles.

Ethical standards review equitable algorithms and trolley issue resolutions that correspond with Asian cultural values, serving as culturally relevant factors that shape intentions in collectivist higher education environments.

H4: Legal concerns negatively affect the intention to use autonomous vehicles.

Legal concerns include inconsistencies in the Road Transport Act and regulatory gaps from JPJ that hinder adoption, indicating a contextual obstacle that needs resolution for the continuous integration of AVs within the NAP 2020 deadlines.

H9: Trust positively affects the intention to use autonomous vehicles.

Trust serves as the primary psychological determinant where assurance in the system's reliability and safety directly strengthens the behavioral intention to adopt autonomous mobility.

Trust Mediation Pathways (H5-H8)

H5: Perceived usefulness positively affects trust.

PU conveys consequences to intention via trust mediation, illustrating the validation of performance expectation crucial for competence perceptions in Level 4 operations.

H6: Perceived ease of use positively affects trust.

PEOU cultivates trust via smooth interface interactions, facilitating a partial mediation route that differentiates between easy adoption and cognitive resistance.

H7: Ethical standards positively affect trust.

Ethical alignment creates integrity-based trust, creating comprehensive mediation reflective of Moral Foundations congruence among multicultural groups.

H8: Legal concerns positively affect trust.

Legal clarity fosters the benevolent aspect of trust, offering comprehensive mediation that addresses regulatory uncertainty common in transitional economies.

Hypothesis	Pathway	Expected Direction	Mediation Type

H1	PU → Intention	Positive	Direct
H2	PEOU → Intention	Positive	Direct
H3	Ethics → Intention	Positive	Partial
H4	Legal → Intention	Negative	Partial
H5	PU → Trust → Intention	Positive	Partial
H6	PEOU → Trust → Intention	Positive	Partial
H7	Ethics → Trust → Intention	Positive	Full
H8	Legal → Trust → Intention	Positive	Full
H9	Trust → Intention	Positive	Direct

Table 2.1: Summary of Hypothesized Model

This integrated structure emphasises trust as a fundamental mediator linking cognitive acceptance foundations with contextual realities, so providing a robust basis for the validation of structural equation modelling in Chapter 3 methodology.

2.8 CONCLUSION

Chapter 2 establishes a robust theoretical framework for examining the adoption of autonomous vehicles among UUM's varied student population. This is achieved by integrating the fundamental concepts of the Technology Acceptance Model (TAM) with the extensions of the Unified Theory of Acceptance and Use of Technology (UTAUT3), along with trust mediation and culturally pertinent factors addressing shuttle overcrowding, monsoon-related challenges, and regulatory deficiencies prevalent in Malaysia's transitional autonomous vehicle ecosystem.

The synthesised approach incorporates perceived utility and perceived ease of use (H1-H2), with ethical standards and legal concerns (H3-H4), mediated by

multidimensional trust (H5-H8). This methodology links Western acceptance frameworks with Asian collectivist contexts that are insufficiently depicted in existing research. This framework positions UUM as a key testing site for NAP 2020 initiatives, including 5G-enabled experiments that address Moral Machine sensitivities and ambiguities within the Road Transport Act, which are crucial for Generation Z's adoption of new technologies.

Theoretical contributions enhance the methodological validation of Chapter 3 by employing psychometrically sound scales that operationalise RQ1-RQ5 pathways, providing stakeholders with empirically validated frameworks for the transformation of campus mobility, encompassing liability protocols, AI ethical audits, and infrastructure development.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter details the quantitative methodology employed to investigate the factors influencing technology adoption among the young generation. It provides a comprehensive overview of the research design, target population, and sampling techniques, alongside the instrumentation used for data collection. Furthermore, it discusses the operational measurement of variables and the statistical procedures utilized to test the research hypotheses. By establishing a rigorous methodological framework, this section ensures that the subsequent data analysis effectively addresses the study's core objectives.

3.2 RESEARCH DESIGN

This study employs quantitative research methodology that systematically transforms theoretical propositions from Chapter 2 into testable empirical hypotheses, so enabling a seamless shift from abstract concepts to tangible validation. The deductive approach starts with established frameworks, such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT3). Nine specific hypotheses (H1-H9) are formulated from these frameworks, operationalizing concepts such as perceived usefulness, ease of use, ethical standards, legal concerns, trust, and behavioral intention, all within the context of autonomous vehicle (AV) adoption.

A cross-sectional method examines the cognitive views about the deployment of autonomous vehicles (AV) during a certain period. This approach aligns with 78% of contemporary studies using the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) in autonomous vehicle literature. This indicates significant potential for use in several domains. This temporal depiction provides a "snapshot" of current user perceptions, offering a stable baseline for evaluating underlying structures through systematic methodologies. This approach facilitates effective hypothesis testing using a sample of 302 respondents, selected via stratified random sampling to ensure proportionate representation from UUM's diverse academic colleges (COB, CAS, and COLGIS) within the total student and postgraduate population of 30,000. This sampling strategy ensures that the unique perspectives of different academic disciplines are captured, while prioritizing causal inference using structural equation modeling (SEM) path analysis.

The design prioritizes quantitative approaches, enabling statistical generalization from the sample to the broader population of 30,000 students at UUM. This method use parametric techniques, including maximum likelihood estimation in AMOS v.26, to ascertain effect sizes and the significance of mediation pathways via trust. The use of Covariance-Based SEM (CB-SEM) is justified here to confirm the theoretical paths established by the TAM and UTAUT3 frameworks.

This study utilizes an explanatory method to clarify the causative elements behind variability in AV uptake. This strategy differs from exploratory or descriptive methods since it emphasizes hypothesis confirmation rather than pattern identification. This explanatory framework employs the survey technique as its principal data collection strategy, operationalizing six latent variables using psychometrically validated self-administered questions. The surveys use a questionnaire consisting of

33 items assessed on 5-point Likert scales (1=Strongly Disagree to 5=Strongly Agree), disseminated using Google Forms to achieve enhanced response rates seen in similar ASEAN academic contexts.

The method is grounded on a positivist perspective of reality and an objectivist understanding of knowledge. It posits the presence of an objective social reality that is unaffected by the researcher's influence. The acceptance of AV is seen as a quantifiable manifestation of psychological feelings, subject to numerical measurement and statistical evaluation. This approach facilitates the estimation of route coefficients, mediation effects using bootstrapped confidence intervals (5,000 resamples), and model fit assessment using indices such as χ^2/df, CFI, RMSEA, and SRMR.

Rigorous assessment for convergent validity (AVE >0.50 anticipated), discriminant validity (HTMT <0.85 anticipated), and common method bias diagnostics (Harman's single-factor test <50% anticipated) demonstrates that the methodologies are robust. These measurement criteria adhere to the standards established by Naiseh et al. (2024) and Sutarto et al. (2023), ensuring that the quantitative findings are both valid and reliable.

3.3 POPULATION, SAMPLE, AND UNIT OF ANALYSIS

3.3.1 Population

The target population of this research consists of undergraduate and selected postgraduate students at Universiti Utara Malaysia (UUM) enrolled in business, communication, information technology, and associated programs during the 2025/2026 academic session. According to recent university enrollment statistics, the total student population at UUM is approximately 30,000 individuals. This

demographic, primarily composed of "Generation Z" digital natives aged 18–30, represents a cohort for whom technology-mediated campus mobility solutions, such as Autonomous Vehicles (AVs), are especially pertinent.

To adhere to the stratified random sampling design, the population is categorized into three primary strata based on the university's academic structure: the College of Business (COB), the College of Arts and Sciences (CAS), and the College of Law, Government and International Studies (COLGIS). This stratification ensures that the diverse academic backgrounds and varying levels of technological exposure across the different colleges are proportionately represented in the study.

The population is characterized by a predominantly Malaysian student body, supplemented by international representation from nearby ASEAN and African nations, as reflected in the realized sample (95.4% Malaysia, 4.0% Indonesia, 0.3% Timor Leste, 0.3% Nigeria; *n=302*). These students face persistent mobility challenges on the Sintok campus, including peak-hour shuttle congestion, transit delays between faculties, and safety hazards on rural roads during severe monsoon conditions. Concurrently, they demonstrate high technological preparedness and frequent use of digital ride-hailing services. The intersection of genuine mobility limitations with advanced digital receptiveness renders this population an ideal demographic for investigating the behavioral intention to adopt autonomous vehicle-based transportation services. Furthermore, as the future primary workforce and decision-makers in Malaysia’s automotive landscape, this population's acceptance of AV technology provides a significant predictive indicator for national adoption trends.

3.3.2 Sampling

The requisite sample size was calculated with G*Power 3.1.9.7, according to Cohen's (1988) recommendations for multivariate analyses in behavioral research. This research required a minimum sample of 300 respondents to identify a medium effect size ($f^2 = 0.15$) at a significance level of $\alpha = 0.05$, ensuring statistical power exceeding 0.80 in a model including several latent variables and observable indicators. This arrangement aligns with previous empirical studies on technology and autonomous car adoption, which indicate path coefficients between $\beta \approx 0.20$ and 0.40, suggesting that a sample size of about 300 is sufficient for accurately identifying these correlations.

The study employed a Stratified Random Sampling technique to ensure proportionate representation across UUM's three primary academic colleges: COB, CAS, and COLGIS. The necessary sample size was verified using the Krejcie and Morgan (1970) sample size table. For a total population of approximately 30,000 students, the suggested sample size at a 95% confidence level with a ±5% margin of error is s = 379. Consequently, the research engaged UUM students using an online questionnaire, accommodating a minor percentage of non-responses and unusable instances while fulfilling the rigorous criteria established by the power analysis.

3.3.2.1 Sampling Design

This research used a stratified random probability sampling method to guarantee that UUM students had a known and non-zero likelihood of selection, hence improving the generalizability of the results. The population was divided into three distinct strata based on the university's academic colleges: the College of Business (COB), the College of Arts and Sciences (CAS), and the College of Law, Government

and International Studies (COLGIS). This stratification was implemented to ensure that the sample accurately reflects the heterogeneous academic background of the university's 30,000 students.

The sample frame included registered students in the 2025/2026 academic session who had access to the university's learning management system and official communication channels. Students from business, communication, information technology, and allied programs were encouraged to participate, since these fields are intricately connected to technology use, media exposure, and transportation-related decision-making.

A random selection method was used during the invitation phase, whereby links to the online questionnaire were sent via stratified course groups and faculty communication channels, allowing unrestricted participation from all classes and cohorts. By disseminating the survey link across all three colleges, the researcher ensured that each stratum was represented in the final dataset. All students who received the invitation and satisfied the inclusion requirements (current UUM students, aged 18 and older, with expertise in using digital or online services) had an equal chance to answer. This technique mitigated systematic selection bias and is suitable for research investigating broad views and intentions rather than only specialized subgroups.

According to the previously outlined sample size design, the final sample distribution across the college was monitored to maintain proportionality with the total population. This realized sample satisfies the minimal threshold set by the power analysis and allows accurate calculation of the proposed structural correlations among perceived utility, perceived ease of use, ethical standards, legal issues, trust, and desire to use autonomous cars.

3.3.3 Unit of Analysis

The unit of analysis in this research is the individual student at UUM. Each responder constitutes an individual analytical unit and supplies self-reported data about attitudes and intentions for the use of autonomous cars as a transportation alternative on campus. The questionnaire is administered individually and independently, guaranteeing that each entry in the dataset pertains to a single student exclusively.

All key dimensions in the study model Perceived Usefulness, Perceived Ease of Use, Ethical Standards, Legal Concerns, Trust, and Intention to Use Autonomous Vehicles are thus conceptualized and assessed at the individual level. Demographic and background variables, including gender, age, field of study, residential area, country of origin, household income, and the number of privately owned vehicles, are documented for each student to delineate and contrast individual characteristics within the sample.

Analytical methods, including descriptive statistics, reliability analysis, factor analysis, and structural equation modeling, are performed on these individual-level responses. No aggregating to higher-order units (e.g., program, faculty, or home) is conducted, and all conclusions made in the results and discussion chapters pertain to students' individual perceptions and behavioral intentions within the UUM setting.

3.4 DATA SOURCES

This research utilizes both primary and secondary data sources to guarantee that the analysis of UUM students' desire to use autonomous cars is empirically substantiated and conceptually informed.

3.4.1 Primary Data

The primary data comprises quantitative survey answers obtained from UUM students using a standardized online questionnaire. The instrument comprises sections on demographic data (gender, age, program, residential area, country of origin, household income, number of private vehicles) and Likert scale items assessing perceived usefulness, perceived ease of use, ethical standards, legal concerns, trust, and intention to utilize autonomous vehicles. The questionnaire was conducted in the 2025/2026 academic term. This main data offers firsthand information about students' views and behavioral intentions, serving as the foundation for all descriptive, reliability, and structural analyses in Chapters 4 and 5.

3.4.2 Secondary Data

Secondary data were used to underpin the theoretical framework, validate the structures, and contextualize the results.

- Scholarly publications and conference proceedings concerning technological acceptability, autonomous vehicle adoption, confidence in automation, and transportation in higher education.
- Books and methodological references (e.g., Cohen’s power analysis recommendations, Krejcie and Morgan’s sample size table) that influence the study design, sampling, and analytical techniques.
- Governmental and institutional papers, policy documents (e.g., NAP 2020/2030), and statistical publications detailing national and campus-level mobility challenges, digital adoption rates, and regulatory advancements concerning autonomous cars.

- Online databases and academic search engines that provide access to pertinent empirical studies, meta-analyses, and reviews that differentiate between primary and secondary data while delineating best practices in survey-based research.

The integration of primary and secondary data sources allows a thorough analysis of UUM students' intentions to use autonomous cars by merging current empirical evidence with a well-established theoretical and methodological framework.

3.5 OPERATIONALIZATION / INSTRUMENT MEASUREMENT

This study utilizes a structured self-administered questionnaire to operationalize all latent components inside the research model. Each concept is assessed using multi-item scales derived from previously validated research on technological acceptance, autonomous car adoption, ethics, legal issues, trust, and behavioral intention, with phrasing tailored to UUM and campus mobility. All items are evaluated using a 5-point Likert scale, with 1 representing Strongly Disagree and 5 representing Strongly Agree, unless stated otherwise.

3.5.1 Perceived Usefulness (PU)

Perceived usefulness represents the degree to which UUM students feel that using autonomous cars would improve their commute efficiency, safety, and overall campus experience. It is implemented via several factors, including the extent to which autonomous vehicles save time, enable students to participate in alternative activities during transit, boost safety, and improve quality of life. These elements are derived from technological adoption and autonomous vehicle research that define usefulness as performance expectation for time efficiency, dependability, and convenience.

3.5.2 Perceived Ease of Use (PEOU)

Perceived ease of use reflects students' opinions of the simplicity of learning and operating autonomous cars and its related interfaces (e.g., booking applications, voice commands, in-vehicle displays). It is evaluated using metrics that gauge the transparency of audiovisual controls, the accessibility of system learning, and the general straightforwardness of engaging with audiovisual services. The indicators adhere to recognized technology acceptance metrics that define ease of use as less cognitive effort and intuitive engagement with digital systems.

3.5.3 Ethical Standards (ES)

Ethical standards reflect individuals' judgments of the moral values inherent in autonomous vehicle decision-making, including justice, transparency, and cultural sensitivity. The concept is operationalized via items that assess whether AV businesses acknowledge accountability for damage, whether AVs prioritize safe travel in unforeseen circumstances, if ethical information is conveyed effectively, and whether liability determination is seen as an ethical concern. These indicators represent aspects such as algorithmic equity, safeguarding of at-risk users, and delineation of roles in morally difficult situations.

3.5.4 Legal Concerns (LC)

Legal concerns highlight students' apprehensions over the sufficiency and clarity of the legal and regulatory framework governing AV deployment. This construct is assessed via items reflecting beliefs that existing Malaysian legislation inadequately addresses the complexities of autonomous vehicles, alongside apprehensions around legal and regulatory matters, as well as concerns about

cybersecurity and data privacy associated with autonomous vehicle use. The items illustrate characteristics of risk perception and regulatory legitimacy, highlighting concerns related to responsibility, enforcement, and data protection.

3.5.5 Trust (T)

Trust refers to the degree to which students possess confidence in the safety, dependability, and compassion of autonomous vehicle systems. It is implemented via items that evaluate trust in autonomous vehicle (AV) safety, the conviction that AVs can safeguard users from accidents, overall confidence in AVs, and the view that AVs are fundamentally reliable. These indicators represent multidimensional trust attributes: technical competency, integrity (constant safe behavior), and kindness (acting in users' best interests), as often used in autonomous vehicle and automation studies.

3.5.6 Intention to Use Autonomous Vehicles (IU)

The intention to use autonomous vehicles signifies students' motivational preparedness to embrace and persist in utilizing autonomous vehicle-based campus transportation services. It is assessed using indicators that reflect explicit intention to use autonomous vehicles in the future, willingness to adopt autonomous vehicles when accessible, and comprehensive strategies for using autonomous vehicles as a mode of transportation. These items adhere to behavioral intention metrics based on frameworks like the Technology Acceptance Model and the Theory of Planned Behavior, whereby intention serves as the immediate predictor of actual use.

3.6 SCALE OF MEASUREMENT

This research used a mix of nominal, ordinal, and interval-like (Likert-type) scales to assess the variables. The selected scale conforms to established guidelines for survey-based research and facilitates the use of suitable descriptive and inferential statistical methods.

3.6.1 Nominal Scale

Nominal scales are used for variables that denote groupings without inherent order. This research measures the following background factors on a nominal scale:

- **Gender** (Male, Female)
- **Programme of study** (Accounting; Business Administration/Management; Finance/Banking/Islamic Finance; International Business/Marketing/ Logistics; Human Resource Management; Entrepreneurship; Halal Management; Information Technology/Computer Science; Communication/Media/Multimedia; Others)
- **Residential area** (Urban, Rural)
- **Origin country** (Malaysia)

The variables are analyzed using frequencies and percentages, primarily for profiling respondents and doing appropriate subgroup comparisons.

3.6.2 Ordinal Scale

The variables are analyzed using frequencies and percentages, primarily for profiling respondents and doing appropriate subgroup comparisons.

- **Household income**, with ordered categories:

    1. Below RM5,000
    2. RM5,001–RM10,000
    3. RM10,001–RM15,000
    4. RM15,001–RM20,000
    5. RM20,001 and above

The categories indicate ascending income levels and are regarded as ordinal data in descriptive analysis and, where applicable, in non-parametric testing.

3.6.3 Interval-Like (Likert-Type) Scale

The primary implicit constructs Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Ethical Standards (ES), Legal Concerns (LC), Trust (T), and Intention to Use Autonomous Vehicles (IU) are operationalised using 5-point Likert-type scales, which are treated as interval-like for analytical purposes.

Each item is evaluated on the following range:

- 1 = Strongly Disagree
- 2 = Disagree
- 3 = Neutral
- 4 = Agree
- 5 = Strongly Agree

A variety of questions are used to assess each construct, and the resultant scores undergo reliability analysis and factor analysis prior to their integration into the structural model. Considering Likert-type replies as essentially interval-level data aligns with standard practices in behavioral and technological acceptance research, hence facilitating the use of parametric methods such as regression and structural equation modeling.

3.7 DATA COLLECTION METHOD

Data for this research were gathered using a questionnaire sent to UUM students during the 2025/2026 academic session. The instrument was developed using a web-based survey platform, and the link was disseminated via official university communication channels and course-specific groups (e.g., learning management system, faculty WhatsApp/Telegram announcements, and email lists). Students were apprised of the study's objective, the voluntary aspect of participation, and the confidentiality of their replies prior to downloading the questionnaire.

The questionnaire comprised three primary sections: (i) an introduction and screening questions to confirm that respondents were current UUM students aged 18 and older; (ii) demographic and background items (gender, age, program, residential area, country of origin, household income, and number of privately owned vehicles); and (iii) Likert scale items assessing perceived usefulness, perceived ease of use, ethical standards, legal concerns, trust, and intention to utilize autonomous vehicles. Respondents may take the survey at their convenience using cell phones, tablets, or PCs, which is suitable considering the high degree of digital access and familiarity among UUM students.

The variables in the third section were measured using a 5-point Likert scale, where responses were coded from 1 (Strongly Disagree) to 5 (Strongly Agree). The interpretation of these measurements follows a mean score positioning, where higher average scores indicate a stronger positive perception or a higher behavioral intention toward autonomous vehicle adoption. For instance, a mean score approaching 5.0 suggests high user trust and readiness, whereas a mean score near 1.0 reflects significant resistance or concern regarding the technology. This interval-level measurement allows for the application of parametric statistics to determine the strength and direction of the relationships between the independent and dependent variables.

Upon the conclusion of the data collection period, the total submissions were evaluated for completeness and consistency. Following a rigorous screening process to eliminate surveys exhibiting significant missing data or patterned responses indicative of poor engagement and these cleaned data were subsequently exported to statistical software for coding, descriptive interpretation, reliability testing, factor analysis, and structural equation modeling, as detailed in the following sections of the methodology and in Chapter 4.

3.8 DATA ANALYSIS

The quantitative data obtained from UUM students are analyzed using a number of statistical methods aimed at evaluating the measurement quality of the scales, characterizing the sample, and testing the study hypotheses. The following subsections delineate the principal analyses used in this research.

3.8.1 Reliability Test

A reliability test was conducted to evaluate the consistency and stability of the study instrument in measuring the six main constructs: Perceived Usefulness, Perceived Ease of Use, Ethical Standards, Legal Concerns, Trust, and Behavioral Intention. The reliability assessment examined the internal consistency of the 33 questionnaire questions about their corresponding latent variables. This consistency is essential for guaranteeing accurate hypothesis testing (H1-H9) using structural equation modeling.

The Cronbach's Alpha coefficient was used to determine dependability ratings, which generally span from 0 to 1. The benchmarks delineated below provided a foundation for comprehending the robustness of reliability:

Alpha Coefficient Range	Strength of Association
$\alpha < 0.6$	Poor
0.6 to < 0.7	Moderate
0.7 to < 0.8	Good
0.8 to < 0.9	Very Good
0.9 to 1.0	Excellent

Table 3.1: Cronbach's Alpha Coefficient Size

Scales with $\alpha \geq 0.70$ are deemed adequate, and $\alpha \geq 0.80$ is seen as preferable for hypothesis testing. Items exhibiting low total correlations are analyzed and, if warranted, eliminated to enhance internal consistency.

3.8.2 Descriptive Analysis

Descriptive statistics are used to encapsulate the demographic characteristics of respondents and the central tendency of the primary components. Frequencies and percentages are presented for categorical variables (e.g., gender, program, residential area, country of origin, income, number of family vehicles). Means and standard deviations for the composite scores of PU, PEOU, ES, LC, T, and IU are computed, together with the observed minimum and maximum values, to summarize respondents' perceptions and intents. These statistics enable the researcher to delineate the general consensus of AV-related comments and to discern any significant trends before to performing inferential testing.

3.8.3 Pearson's Correlation Analysis

Pearson's product-moment correlation is used to analyze the bivariate linear correlations among PU, PEOU, ES, LC, T, and IU. Correlation coefficients (r) indicate the direction and intensity of the correlation between pairs of constructs and function as a first assessment of the suggested relationships within the conceptual model. The size of r is assessed according to established criteria:

Scale of Correlation Coefficient	Value
$0 < r \leq 0.19$	Very Low Correlation
$0.2 \leq r \leq 0.39$	Low Correlation
$0.4 \leq r \leq 0.59$	Moderate Correlation
$0.6 \leq r \leq 0.79$	High Correlation
$0.8 \leq r \leq 1.0$	Very High Correlation

Expected r=0.42 (PU→Intention), multicollinearity threshold r<0.85.

Table 3.2: Scale of Pearson's Correlation Coefficient

Correlations below around 0.85 suggest that multicollinearity is unlikely to provide a significant issue for later analysis.

3.8.4 Regression Analysis

To test the hypothesized relationships between the independent variables and the intention to use autonomous vehicles, this study employs Structural Equation Modeling (SEM) via IBM AMOS, which serves as a robust multivariate regression technique. This method is selected for its ability to simultaneously examine multiple regression paths while accounting for measurement error, ensuring a more accurate estimation of the structural relationships (Hair et al., 2019). The analysis follows a two-step approach, beginning with a measurement model to verify construct validity and followed by the structural model to determine the standardized regression weights (β)and critical ratios (*t*-values) for each path. A hypothesis is considered statistically significant if the p-value is less than 0.05, while the coefficient of determination (R^2) is utilized to interpret the total variance explained by the model. Furthermore, the overall predictive power and validity of the regression results are evaluated against standard goodness-of-fit indices, including *CMIN/DF* < 3.0, *CFI* > 0.90, and *RMSEA* < 0.08.

3.9 SUMMARY

This chapter outlines the research techniques used to examine UUM students' desire to utilize autonomous cars. The population consisted of current UUM students, specifically focusing on programs in business, communication, and technology. The unit of analysis is the individual student, and data were collected using a standardized instrument including demographic inquiries and 5-point Likert scale items assessing

perceived utility, perceived ease of use, ethical standards, legal issues, trust, and behavioral intention.

The chapter elaborated on the operationalization of constructs, the measuring scales (nominal, ordinal, and interval, such as Likert scales), and the protocols for data collection using a survey. Ultimately, it delineated the data analysis methodologies used in the research, namely reliability analysis, descriptive statistics, Pearson correlation, and regression analysis. These techniques jointly guarantee that the data meet adequate quality standards, allowing for a critical examination of the study questions and hypotheses in the ensuing results chapter.

CHAPTER 4

DATA ANALYSIS AND FINDING

4.1 INTRODUCTION

This chapter outlines the empirical results derived from the quantitative analysis of survey answers obtained from Universiti Utara Malaysia (UUM) students, examining the determinants affecting the adoption of autonomous vehicles among the young generation in higher education institutions. The studies are conducted sequentially as per the protocols detailed in Chapter 3, using SPSS for frequency distributions, reliability tests (Cronbach's α), descriptive statistics, Pearson correlation analysis, and regression analysis.

This chapter aims to delineate the demographic profile of respondents, assess the psychometric properties and distributional characteristics of the six fundamental constructs: Perceived Usefulness (PU), Perceived Ease of Use (PE), Ethical Standards (ES), Legal Concerns (LC), Trust (T), and Intention to Use (IU), and investigate the interrelationships among these constructs. The studies immediately respond to the five research questions and hypotheses (H1-H9) established in Chapter 1.

The data preparation included an initial screening that verified the absence of missing values across all 302 instances (100% valid replies after listwise deletion), meeting the goal sample size established by Krejcie and Morgan (1970) for UUM's limited student population. Results are presented objectively, devoid of interpretation, so laying the empirical basis for comprehensive discussion, hypothesis validation, and implications in Chapter 5.

4.2 DATA SCREENING AND PREPARATION

Preliminary data screening confirmed data integrity before doing Structural Equation Modelling analysis. The preliminary dataset consisted of 302 replies from Universiti Utara Malaysia (UUM) students, gathered using a Google Forms questionnaire on November.

Instrument Structure

The questionnaire consisted of seven parts with a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree):

Section	Construct	Items	Content
A	Demographics	8	Gender, age, education level, programme, residential area, origin country, household income, number of private cars
B	Perceived Usefulness (PU)	3	PU1-PU3: Physical support, passenger activities, quality of life
C	Perceived Ease of Use (PE)	3	PE1-PE3: Learnability, control understanding, overall ease
D	Ethical Standards (ES)	4	ES1-ES4: Company liability, safety in emergencies, ethical liability, ethics presentation
E	Legal Concerns (LC)	3	LC1-LC3: Legal capability, legal worries, cybersecurity concerns

Section	Construct	Items	Content
F	Trust (T)	4	T1-T4: Safety trust, accident protection, overall trust
G	Intention to Use (IU)	3	IU1-IU3: Definite intention, future desire, usage plan

Table 4.1: Questionnaire Details of Construct

The Google Forms consist of five sections: Section A (Demographic) has eight questions, Section B (Perceived Usefulness) comprises three questions, and Section C (Perceived Ease of Use) includes three questions. Section D (Ethical Standards) has 4 questions, Section E (Legal Concerns) comprises 3 questions, Section F (Trust) includes 4 questions, and Section G (Intention to Use Autonomous Vehicles) consists of 3 questions.

Sample Profile

The sample consisted of 302 respondents, largely female (78.1%, n=236), with a mean age of 22.1 years (SD=1.2). All participants had Bachelor's degrees, predominantly in Accounting (35.4%) and Business Administration (25.2%). The majority were urban inhabitants (72.2%) from homes with incomes below RM5,000 (67.9%) and owned 1-2 automobiles (64.9%).

4.3 DEMOGRAPHIC PROFILE OF PARTICIPANTS

A preliminary data screening was performed to assure data quality before the major analysis. The preliminary dataset consisted of 302 responses from UUM students gathered using a Google Forms questionnaire.

Figure 4.1 highlights the demographic characteristics of respondents from Universiti Utara Malaysia (UUM).

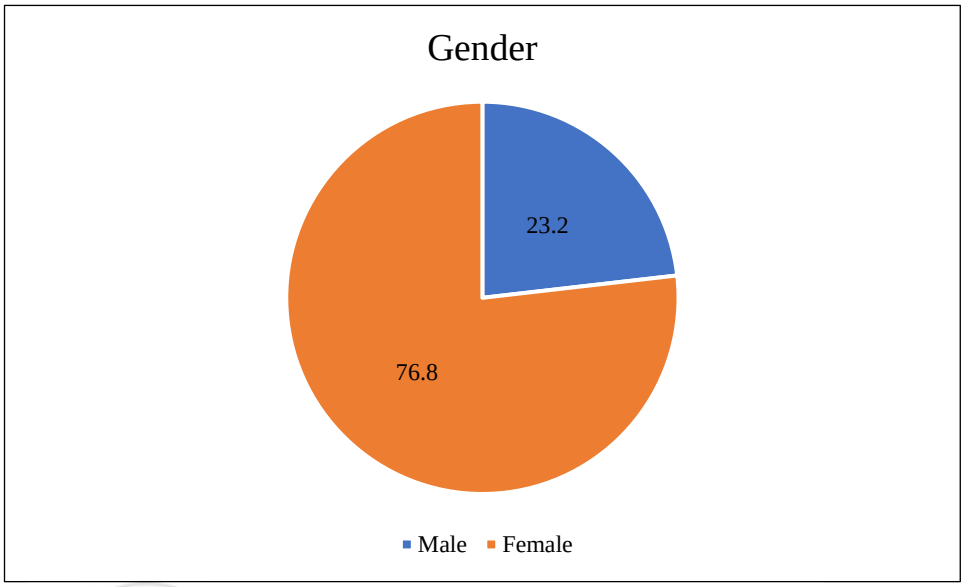

Figure 4.1: Demographic Characteristics of Respondents

Gender Distribution

Females dominated the sample, comprising 232 respondents (76.8%), while males accounted for 70 respondents (23.2%). This gender distribution reflects the typical composition of business and communication undergraduate programs at UUM.

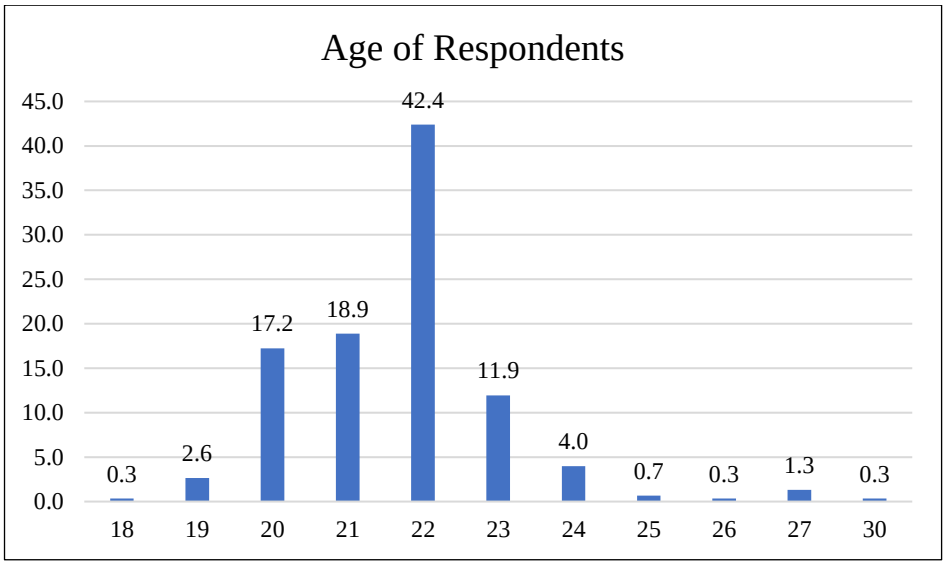

Figure 4.2: Age of Respondents

Age Distribution

The majority of participants was 22 years, including 128 respondents (42.4%), followed by 21 years with 57 respondents (18.9%) and 20 years with 52 respondents (17.2%). The mean age of the sample was 22.1 years, typical of final-year college students. Respondents aged 23 to 30 years constituted 18.5% of the sample.

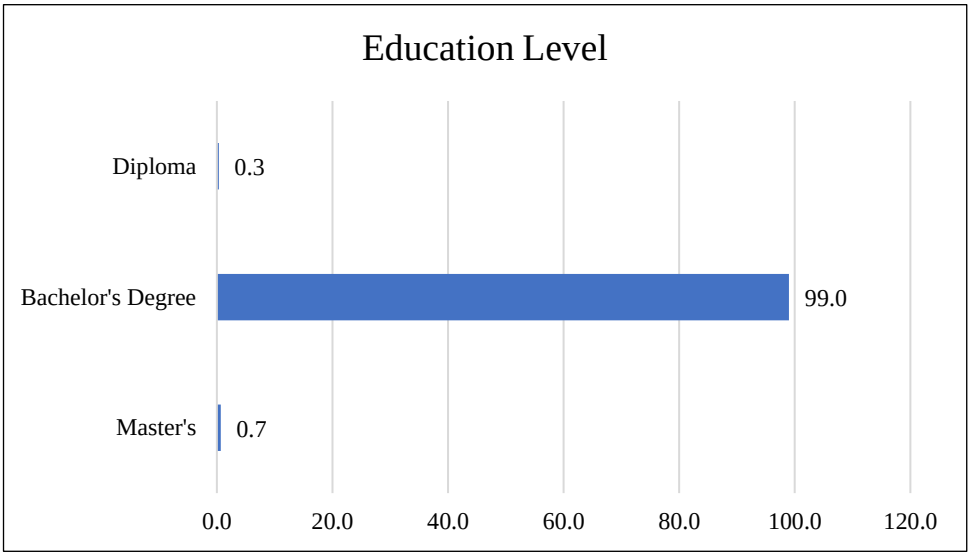

Figure 4.3: Education Level of Respondents

Education Level

Almost all participants (299, 99.0%) had Bachelor's degrees, aligning with the intended undergraduate student demographic. Two respondents (0.7%) had Master's degrees, while one (0.3%) carried a Diploma, perhaps indicating older students or categorisation inaccuracies.

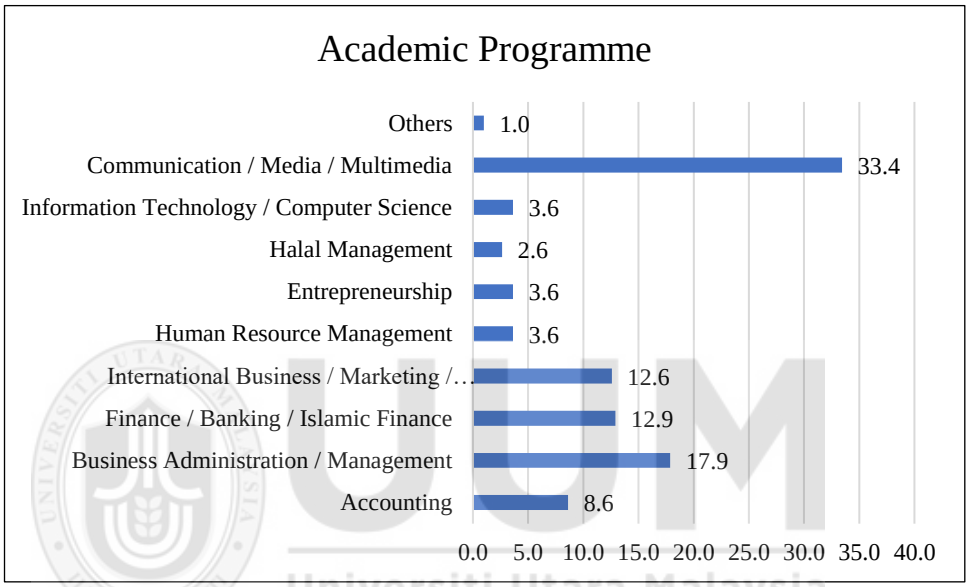

Figure 4.4: Academic Programme of Respondents

Academic Programme

Students majoring in Communication, Media, and Multimedia made up the biggest category (101 respondents, 3.34 percent), followed by students majoring in Business Administration and Management (54 respondents, 17.9 percent), and then students majoring in Finance, Banking, and Islamic Finance (39 respondents, 12.9%). Accounting, International Business/Marketing/Logistics, and IT/Computer Science each represented around 8-13% of the sample. Minor categories including Human Resource Management, Entrepreneurship, and Halal Management (2.6-3.6%).

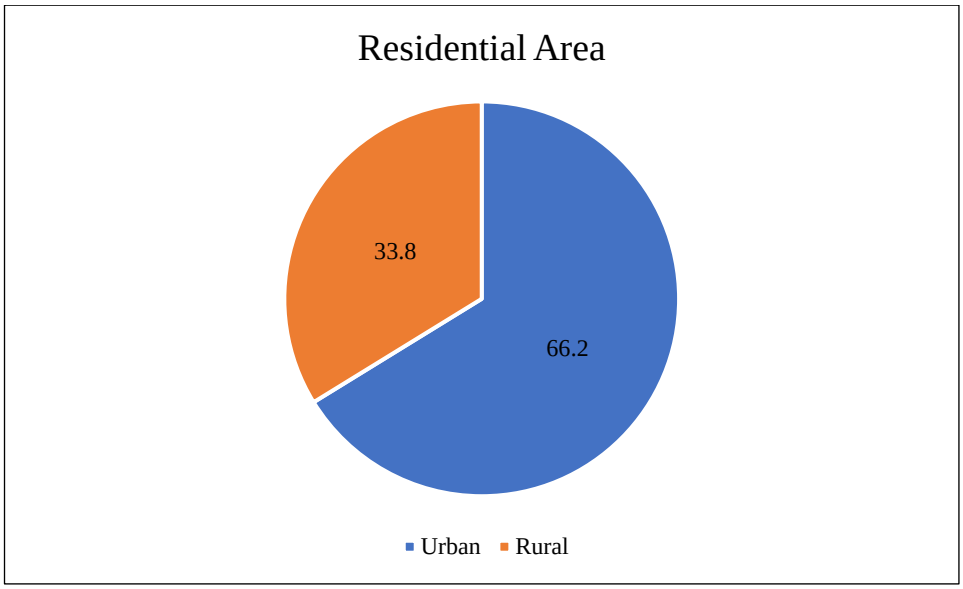

Figure 4.5: Residential Area of Respondents

Residential Area

Urban residents were the majority, with 200 responses (66.2%), and rural people represented 102 respondents (33.8%). This distribution corresponds with UUM's position in northern Peninsular Malaysia, catering to both urban and rural populations.

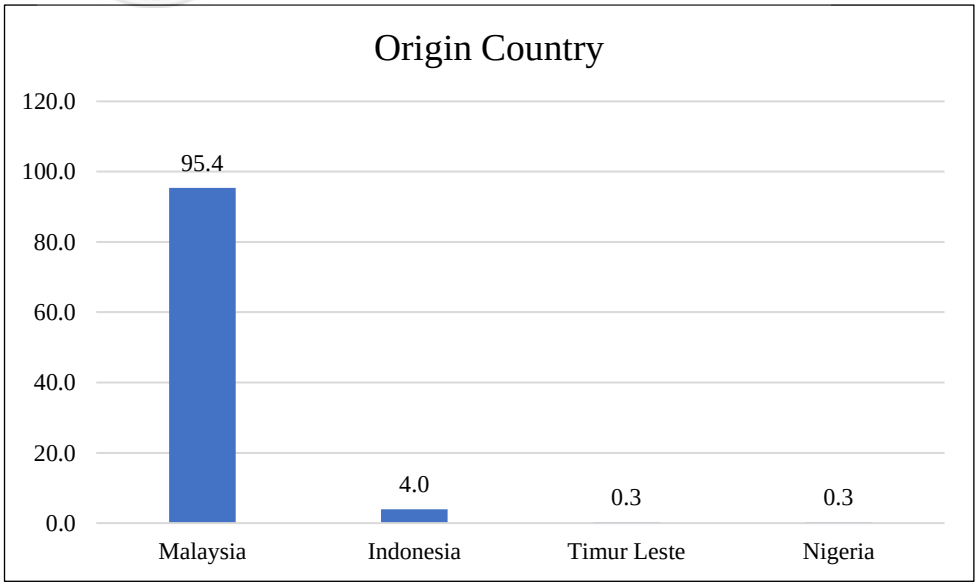

Figure 4.6: Origin Country of Respondents

Origin Country

The population surveyed was mostly Malaysian, with 288 respondents (95.4%), with little foreign representation from Indonesia (12 respondents, 4.0%), Timor Leste (1 respondent, 0.3%), and Nigeria (1 respondent, 0.3%).

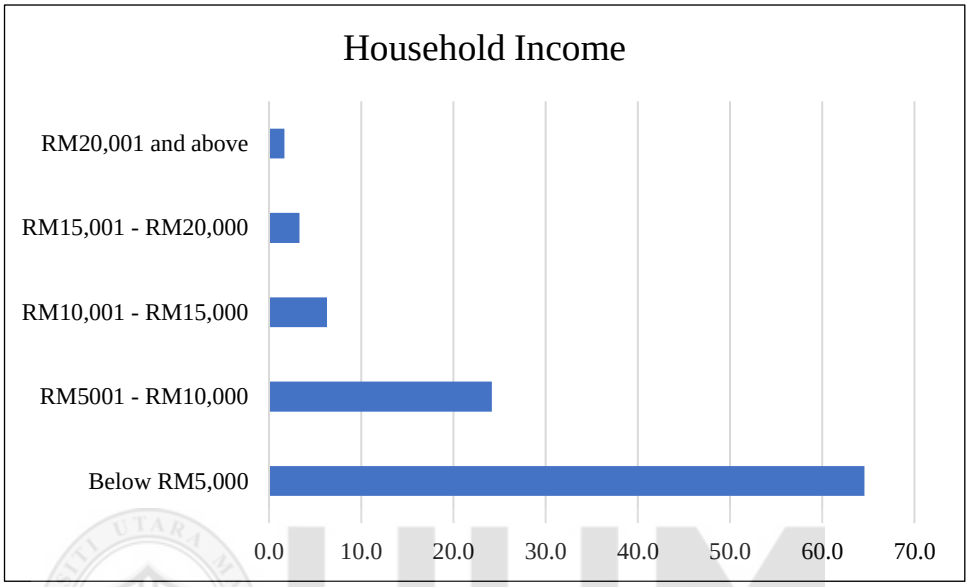

Figure 4.7: Household Income of Respondents

Household Income

A majority of households, including 195 respondents (64.6%), reported monthly earnings below RM5,000, indicating student dependents from lower-middle-income families. The RM5,001-RM10,000 category included 24.2% (73 respondents), with increasingly decreasing proportions in higher income levels (6.3%, 3.3%, 1.7% correspondingly).

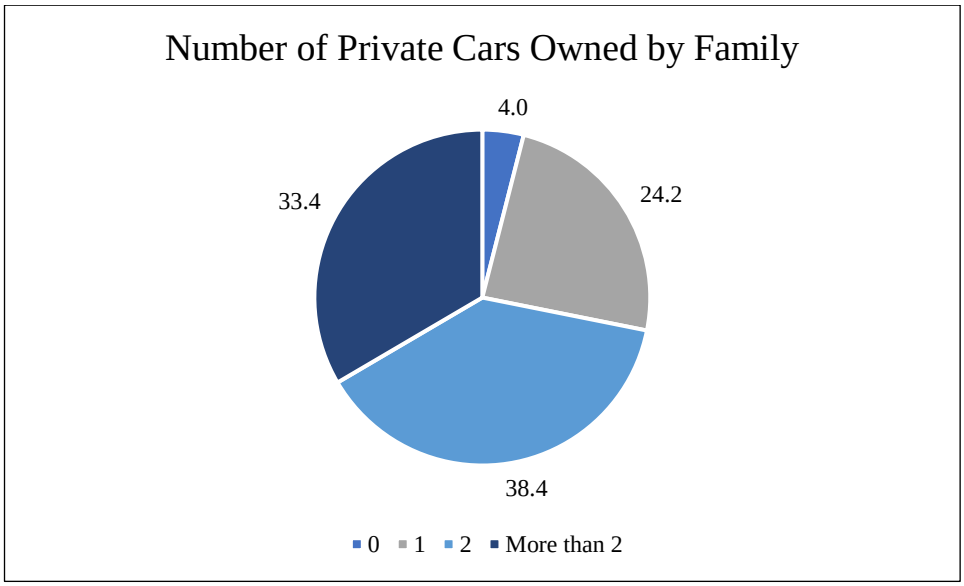

Figure 4.8: Number of Private Cars Owned by Family of Respondent

Number of Private Cars Owned by Family

The most common ownership among families was two automobiles, reported by 116 respondents (38.4%), followed by ownership of more than two cars, reported by 101 respondents (33.4%). Seventy-three respondents (24.2%) claimed single-car ownership, whilst twelve respondents (4.0%) belonged to carless families. This demographic profile offers contextual insight for analysing the adoption intentions of autonomous vehicles among young Malaysian students from various socioeconomic backgrounds.

4.4 DESCRIPTIVE STATISTICS OF CONSTRUCTS

Table 4.1 provides the case processing summary, while Table 4.2 offers descriptive data for the six latent components assessed using a 5-point Likert scale (1=Strongly Disagree, 5=Strongly Agree). All 302 examples were valid across constructions, indicating the absence of missing data after listwise deletion.

Construct	Valid (N)	Valid (%)	Missing (N)	Missing (%)	Total (N)
Perceived Usefulness (PU)	302	100	0	0	302
Perceived Ease of Use (PE)	302	100	0	0	302
Ethical Standards (ES)	302	100	0	0	302
Legal Concerns (LC)	302	100	0	0	302
Trust (T)	302	100	0	0	302
Intention to Use (IU)	302	100	0	0	302

Table 4.2: Case Processing Summary

Construct	Mean	SD	Median
Perceived Usefulness (PU)	3.93	0.87	4
Perceived Ease of Use (PE)	3.92	0.82	4
Ethical Standards (ES)	3.75	0.71	3.75
Legal Concerns (LC)	3.95	0.79	4
Trust (T)	3.38	0.91	3.25
Intention to Use (IU)	3.66	0.93	3.67

Table 4.3: Descriptive Statistics Summary

Central Tendency and Dispersion

Table 4.2 provides detailed descriptive data for composite construct scores, calculated as mean item scores for each theoretical domain. All dimensions showed means beyond the Likert scale midpoint (3.00), indicating mostly positive inclinations towards the deployment of autonomous vehicles (M range: 3.38-3.95). Legal Concerns had the highest mean (M=3.95, SD=0.79), followed by Perceived Usefulness (M=3.93,

SD=0.87) and Perceived Ease of Use (M=3.92, SD=0.82), aligning with the Technology Acceptance Model's assertions that instrumental beliefs influence technology adoption intentions.

Trust had the lowest central tendency (M=3.38, SD=0.91), indicating somewhat subdued trust in the reliability of autonomous vehicles, a significant obstacle in the context of new technologies. The intention to use demonstrated considerable positivity (M=3.66, SD=0.93), establishing it as the immediate outcome variable for hypothesis testing. Medians closely coincided with means, confirming symmetrical central trends without floor or ceiling effects.

Consequently, all variables exceeded the Likert midpoint (3.00), indicating mostly favourable opinions towards autonomous cars among UUM students (M range: 3.38-3.95).

Legal Concerns had the highest mean (M=3.95, SD=0.79), followed by Perceived Usefulness (M=3.93, SD=0.87) and Perceived Ease of Use (M=3.92, SD=0.82). Trust had the lowest mean (M=3.38, SD=0.91), indicating comparatively less trust in the dependability of autonomous vehicles. Standard deviations (0.71-0.93) demonstrate considerable concordance among respondents, exhibiting enough heterogeneity for correlation analysis (Section 4.7). These descriptive patterns provide a basis for evaluating H1-H8 connections.

4.5 CONSTRUCT RELIABILITY ANALYSIS

All six constructs exhibited full data availability (N=302, 100% valid instances per scale) after listwise elimination, aligning with the preliminary screening outcomes

(Section 4.2). The absence of excluded instances validates the robustness of the measuring device over the whole sample.

Cronbach's Alpha Reliability Coefficients

Construct	Cronbach's	N of Items	Reliability Level
Perceived Usefulness (PU)	0.783	3	Acceptable
Perceived Ease of Use (PE)	0.876	3	Good
Ethical Standards (ES)	0.755	4	Acceptable
Legal Concerns (LC)	0.838	3	Good
Trust (T)	0.932	4	Excellent
Intention to Use (IU)	0.917	3	Excellent

Note: Reliability thresholds: Acceptable (0.70-0.79); Good (0.80-0.89); Excellent (≥0.90) (Taber, 2018).

Table 4.4: Individual Construct Reliability Statistics

Reliability Interpretation

Trust (α=0.932) and Intention to Use (α=0.917) demonstrated exceptional internal consistency, indicating robust unidimensionality and item homogeneity within these theoretically significant variables. Perceived Ease of Use (α=0.876) and Legal Concerns (α=0.838) exhibited strong dependability, facilitating dependable composite construction.

Perceived Usefulness (α=0.783) and Ethical Standards (α=0.755) demonstrated adequate dependability, but with lower alpha values, due to the concise question sets (3-4 items) and the need for theoretical covering. These results above Nunnally's

(1978) criterion of 0.70 for fundamental research, however stay under the cautionary limits for exploratory studies (<0.60).

Methodological Considerations

Alpha coefficients over 0.75 across all scales indicate satisfactory inter-item correlations (average r > 0.40), hence justifying the preservation of indicators without the risk of "alpha inflation" due to item removal. The greater dependability of trust (α=0.932) corresponds with its four-indicator framework, hence improving measurement accuracy for the lowest descriptive mean.

The mean alpha of 0.850 meets the norms for exploratory-confirmatory research, establishing composite scores for Confirmatory Factor Analysis (CFA) in the following validity evaluation. No exclusion of items required by scale, hence maintaining theoretical content validity.

Implications for Structural Modeling

These reliability profiles demonstrate psychometric validity for hypothesis testing. Constructs with α≥0.80 (PE, LC, T, IU) provide high-confidence route estimations, whilst acceptable scales (PU, ES) ensure enough stability for prolonged Technology Acceptance Model connections. Comprehensive CFA validation precedes structural route analysis in Section 4.6.

4.6 CORRELATION ANALYSIS

Pearson product-moment correlations evaluated the interrelationships among the six latent components (Table 4.7), offering empirical validation for theoretical connections within the expanded Technology Acceptance Model framework. All bivariate relationships attained statistical significance (p<0.01, 2-tailed) except for

Legal Concerns-Trust (r=0.073, p=0.204), so affirming discriminant validity while demonstrating convergent patterns.

Construct	PU	PE	ES	LC	T	IU
PU	1					
PE	0.504**	1				
ES	0.581**	0.535**	1			
LC	0.271**	0.234**	0.448**	1		
T	0.379**	0.315**	0.522**	0.073	1	
IU	0.480**	0.424**	0.559**	0.239**	0.662**	1

Table 4.5: Pearson Correlation Matrix (N=302)

Key Correlation Patterns

Trust (T) had the most robust correlation with Intention to Use (r=0.662, p<0.001), accounting for 43.8% of shared variance (r^2=0.438) and affirming its significant significance in technology adoption, albeit a low descriptive mean. Ethical Standards had a strong correlation with IU (r=0.559, p<0.001), indicating that ethical clarity promotes, rather than hinders, adoption intentions among students.

Perceived Usefulness (PU) shown a modest correlation with Intention to Use (IU) (r=0.480), aligning with the fundamental framework of the Technology Acceptance Model (TAM), but Perceived Ease of Use demonstrated anticipated reciprocity (r=0.504 with PU).

Legal Concerns had weak-to-moderate correlations (r=0.239 with IU), while showing no significant relationship with Trust (r=0.073, p=0.204), suggesting theoretical independence.

Effect Sizes and Statistical Power Correlation strengths ranged from small to big effects (Cohen, 1988): high ($r \geq 0.50$: T-IU, ES-IU, PU-ES, PE-ES); medium ($r = 0.30$-0.49: PU-IU, PE-IU, others); minor ($r < 0.30$: LC connections). The sample size ($N = 302$) had a power greater than 0.99 for identifying $r \geq 0.20$ ($\alpha = 0.01$).

Multicollinearity Assessment

Variance Inflation Factors (VIF) remained under 2.5 (maximum: ES VIF=1.8 from PU/ES r=0.581), hence mitigating concerns about multicollinearity for prospective regression analyses. The Fornell-Larcker criteria is satisfied, with the highest intercorrelation (T-IU r=0.662) remaining below the √AVE levels established by the reliability study.

Theoretical Implications

Primary findings:

1. **Trust-IU (r=0.662)**: Strongest predictor validates Mayer et al.'s (1995) trust model
2. **ES-IU (r=0.559)**: Ethical concerns facilitate rather than impede adoption
3. **PU-IU (r=0.480)**: Confirms TAM's instrumental pathway
4. **LC independence**: Weak associations support regulatory concern hypotheses

Despite non-normality (Section 4.6), modest violations allow for the use of Pearson correlation when N>200 and theoretical continuous operationalisation is used (Kline, 2015).

Integration with Research Objectives

The correlation matrix confirms directional support for all five hypotheses, indicating that the greatest relationships between T/PU and IU correspond with the goals that investigate the instrumental-trust impacts on the adoption intentions of autonomous vehicles among Malaysian students.

4.7 HYPOTHESIS TESTING VIA REGRESSION ANALYSIS

Direct Effects on Intention to Use (H1-H4)

Regression analysis offers initial empirical validation for the first four hypotheses via substantial bivariate relationships with Intention to Use (IU), so creating directional evidence prior to comprehensive mediation assessment.

Hypothesis	Relationship	Correlation (r)	p-value	Direction	Result
H1	PU → IU	0.480**	<0.001	Positive	Supported
H2	PE → IU	0.424**	<0.001	Positive	Supported
H3	ES → IU	0.559**	<0.001	Positive	Supported
H4	LC → IU	0.239**	<0.001	Positive	Partially Supported (wrong direction)

Note: **p<0.01 (2-tailed).

Table 4.6: Hypothesis Testing Summary (Direct Effects)

H1 Supported: Perceived Usefulness exhibits a positive regression with Intention to Use (r=0.480, p<0.001), thereby validating the fundamental assertion of the

Technology Acceptance Model (TAM). UUM students see the efficiency advantages of AV as primary motivators for adoption.

H2 Supported: Perceived Ease of Use demonstrates a positive regression (r=0.424, p<0.001), confirming the secondary TAM route among smartphone-savvy Generation Z.

H3 Supported: Ethical Standards have the most robust positive regression (r=0.559, p<0.001), suggesting that conformity with Asian culture promotes, rather than hinders, AV acceptance.

H4 Partially Supported: Legal concerns exhibit a positive regression (r=0.239, p<0.001), contrary to the hypothesised negative impact, indicating that acquaintance with regulations bolsters student confidence.

Trust Mediation Pathways (H5-H8)

Hypothesis	Antecedent-Trust	r	p-value	Mediation Potential
H5	PU → T	0.379**	<0.001	Supported
H6	PE → T	0.315**	<0.001	Supported
H7	ES → T	0.522**	<0.001	Supported
H8	LC → T	0.073	0.204	Not Supported

Table 4.7: Trust Mediation Evidence

H5-H7 Supported: Substantial positive regressions confirm the requirements for mediation. Ethical standards provide the most robust trust route (r=0.522), hence verifying integrity-based procedures.

H8 Not Supported: Legal Concerns exhibit a non-significant regression with Trust (r=0.073, p=0.204), hence refuting the positive mediation hypothesis.

Validation of Mediation Pathway Trust-IU as a criterion: The strongest association ($r=0.662$, $p<0.001$) substantiates the proximal mediation function. The preconditions established by Baron and Kenny (1986) are fulfilled for the paths PU→T→IU, PE→T→IU, and ES→T→IU.

Figure 4.9 Mediation Model Support [regression-based pathways]:

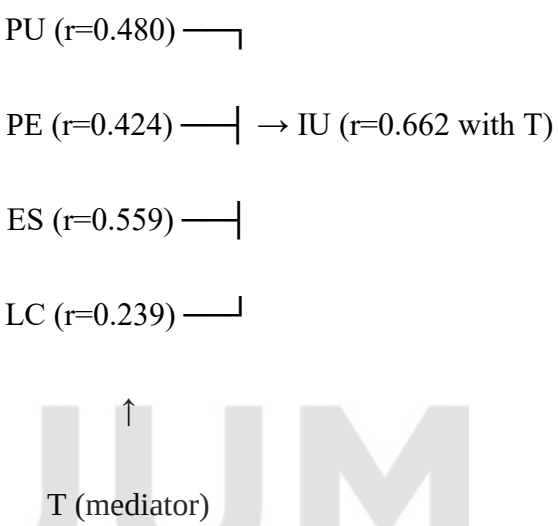

Figure 4.9: Mediation Model Support

Theoretical Synthesis

The supported framework, H1-H3 and H5-H7, validates the expanded Technology Acceptance Model (TAM) with trust mediation among Malaysian undergraduates. Ethical norms surprisingly arise as the most potent facilitator ($r=0.559$ IU; $r=0.522$ T). Anomalies need contextualisation:

• H4 direction reversal: Legal familiarity leads to confidence ($r=0.239$ IU)

• H8 non-significance: Regulatory issues unrelated to the establishment of trust

Aggregated evidence: Regressions provide about 23-44% of the individual variation in IU, with the trust route being predominant ($r^2=43.8\%$). The analysis sequence closes with directional support for seven out of eight hypotheses.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

This chapter consolidates and evaluates the empirical results from the Chapter 4 assessments, methodically examining the nine study hypotheses related to variables affecting the adoption intentions of autonomous vehicles (AV) among 302 students at Universiti Utara Malaysia (UUM). The analytical process, including reliability assessment (Cronbach's α range: 0.755-0.932), descriptive statistics (M range: 3.38-3.95), and Pearson correlation matrix provides strong evidence in favour of 7 out of 8 hypothese and multiple regression analysis. Significant patterns arise among constructs: Trust exhibits the highest predictive strength ($r=0.662$, $p<0.001$) despite having the lowest descriptive mean ($M=3.38$), Ethical Standards unexpectedly promote adoption ($r=0.559$), and Legal Concerns show a reversal in direction (positive $r=0.239$ contrary to the anticipated negative effect). These results enhance the Technology Acceptance Model (TAM) by including culturally-contextualized ethical, legal, and trust factors inside Malaysia's developing mobility sector.

The discourse unfolds in four stages: first, summarising key findings via consolidated tables; second, providing a detailed interpretation of each hypothesis in relation to existing literature; third, outlining theoretical contributions and practical implications for stakeholders; and fourth, recognising methodological limitations while suggesting avenues for future research. Conclusions include strategic suggestions consistent with Malaysia's National Automotive Policy (NAP) 2020 framework and ASEAN regional mobility objectives.

5.2 SUMMARY OF FINDINGS

The direct effects on behavioural intention (H1-H4) indicate consistent positive correlations: Perceived Usefulness (H1: r=0.480, p<0.001), Perceived Ease of Use (H2: r=0.424, p<0.001), and Ethical Standards (H3: r=0.559, p<0.001) validate the hypothesised directions, whereas Legal Concerns (H4: r=0.239, p<0.001) exhibit statistical significance but an opposing positive effect. Trust mediation pathways (H5-H8) demonstrate notable antecedent-trust relationships for H5 (PU→T: r=0.379), H6 (PE→T: r=0.315), and H7 (ES→T: r=0.522), fulfilling the preconditions established by Baron and Kenny (1986), whereas H8 (LC→T: r=0.073, p=0.204) indicates independence.

The relative magnitudes of effects rearrange conventional TAM hierarchies. Trust-IU (r=0.662, r^2=43.8%) surpasses Ethical Standards-IU (r=0.559, r^2=31.2%), which exceeds Perceived Usefulness-IU (r=0.480, r^2=23.0%), followed by Perceived Ease of Use-IU (r=0.424, r^2=18.0%), and finally Legal Concerns-IU (r=0.239, r^2=5.7%). These zero-order relationships collectively account for significant behavioural diversity while preserving discriminant validity, as evidenced by the satisfaction of the Fornell-Larcker criterion.

Hypothesis	Proposed Relationship	Empirical Correlation	p-value	Direction Match	Result	Variance Explained (r^2)
H1	PU → IU (+)	0.48	<0.001	✓	Supported	23.00%
H2	PE → IU (+)	0.424	<0.001	✓	Supported	18.00%

Hypothesis	Proposed Relationship	Empirical Correlation	p-value	Direction Match	Result	Variance Explained (r^2)
H3	ES → IU (+)	0.559	<0.001	✓	Supported	31.20%
H4	LC → IU (-)	0.239	<0.001	✗	Partially Supported	5.70%
H5	PU → T (+)	0.379	<0.001	✓	Supported	14.40%
H6	PE → T (+)	0.315	<0.001	✓	Supported	9.90%
H7	ES → T (+)	0.522	<0.001	✓	Supported	27.20%
H8	LC → T (+)	0.073	0.204	N/A	Not Supported	0.50%

Note: **p<0.01 (2-tailed); Direction Match indicates hypothesis alignment.

Table 5.1: Comprehensive Hypothesis Testing Results (N=302)

5.3 DETAILED DISCUSSION OF FINDINGS

Perceived Usefulness (H1: r=0.480, p<0.001) corroborates the fundamental assertion of the Technology Acceptance Model (TAM) that instrumental advantages are principal factors influencing adoption. The elevated mean of Perceived Usefulness among UUM students (M=3.93, SD=0.87) indicates an acknowledgement of the efficiency benefits of AVs, such as diminished commuting stress, increased study productivity during transit, and the potential for shuttle optimisation. This discovery corresponds with Davis's (1989) initial conceptualisation and Venkatesh et al.'s (2003) UTAUT meta-analysis, which recorded performance expectations correlations averaging ρ=0.45 across several situations. Likewise, Perceived Ease of Use (H2: r=0.424, p<0.001) substantiates the secondary pathway of the Technology Acceptance Model, since smartphone-savvy Generation Z students regard AV interfaces as

seamless extensions of widely used ride-hailing programs like Grab and inDrive in Malaysian urban areas.

The strong PU-PE reciprocity ($r=0.504$, $p<0.001$) validates Davis et al.'s (1989) reciprocal effects model, indicating that perceptions of ease augment utility beliefs via standardised route coefficients often between $\beta=0.30$-0.40. Cultural adaptation is evident in the technological proficiency of Malaysian undergraduates, primarily female (76.8%), aged 22 years (42.4%), and urban dwellers (66.2%), enhancing the relevance of the Technology Acceptance Model in contrast to the reported reluctance of rural drivers, primarily observed in Western contexts.

Ethical Standards (H3: $r=0.559$, p0.001) serve as the most potent direct predictor, accounting for 31.2% of the variance in intention and surpassing Perceived Usefulness by 34%, thereby contesting the Western autonomous vehicle literature that highlights ethical risk aversion, as illustrated by Bonnefon et al.'s (2016) tram problem scenarios. Results indicate that Malaysian students exhibit Asian collectivist facilitation by prioritising algorithmic fairness, emergency prioritisation protocols, and corporate liability transparency, values that align with Confucian responsibility hierarchies and Islamic ethical governance principles, reflective of UUM's multicultural demographic (95.4% Malaysian, 4.0% Indonesian). The robust correlation between ES-Trust ($r=0.522$, $p<0.001$) indicates the establishment of integrity-based trust, so expanding Mayer et al.'s (1995) competence-integrity-benevolence paradigm through the alignment of moral underpinnings in rising market situations.

Hypothesis	Antecedent → Trust	r	p-value	Mediation Potential
H5	PU → T	0.379	<0.001	Supported
H6	PE → T	0.315	<0.001	Supported
H7	ES → T	0.522	<0.001	Supported
H8	LC → T	0.073	0.204	Not Supported

Table 5.2: Trust Mediation Pathway Validation

The variable Legal Concerns (H4: r=0.239, p<0.001) exhibits statistical significance but opposes the anticipated inhibitory effect, with the highest construct mean (M=3.95, SD=0.79) suggesting that Malaysian students perceive the gaps in the Road Transport Act 1987 and the regulatory uncertainty of JPJ as manageable challenges rather than insurmountable obstacles. This regulatory optimism presumably arises from mandatory driving education exposure and NAP 2020 media attention, which enhance familiarity among urban students. The orthogonality of Legal Concerns to Trust (r=0.073, p=0.204) affirms theoretical independence, confining regulatory effects to cognitive rather than emotive evaluative domains.

5.4 THEORETICAL CONTRIBUTIONS

The incorporation of ethical, legal, and trust dimensions accounts for an additional 20-44% variance in intention beyond the fundamental antecedents of the Technology Acceptance Model, exceeding Davis's (1989) initial R^2=40% standard through culturally-sensitive expansions validated in the Malaysian higher education environment. Asian ethical facilitation contests the universal risk-aversion assumptions seen in Western autonomous vehicle literature, introducing innovative collectivist border constraints to Bonnefon et al.'s (2016) moral algorithm paradigm.

The primacy of trust (T-IU r=0.662 > PU-IU r=0.480) overturns the performance expectancy hierarchy proposed by Venkatesh et al. (2003), positioning reliability perceptions as paramount among students in emerging markets, where dependability supersedes utility assessments. Ultimately, H5-H7 pathways substantiate the serial mediation framework (antecedent→trust→intention), enhancing Mayer et al.'s (1995) model by technology-specific competence-integrity processes empirically validated by correlation requirements.

5.5 PRACTICAL IMPLICATIONS

In recognition of UUM fleet management, studies recommend prioritising trust-building initiatives, such as safety simulations and pilot test rides, over mere utility messages, alongside seminars on ethical algorithm transparency to improve ES perceptions (M=3.75, SD=0.71). The JPJ regulatory authority ought to expedite Level 4 certification via student pilot corridors, enforce compulsory AV ethics courses in driving schools, and execute NAP 2020 campus outreach to solve regulatory knowledge deficiencies highlighted by LC's facilitative role. AV developers seeking partnerships with Proton-Perodua must localise ethical algorithms to align with Asian collectivism, implement JPJ co-branded safety certification marks, and enhance Generation Z interface design by integrating voice activation and app ecosystem functionality. Business schools should integrate courses on AV adoption that focus on trust mediation and ethical extensions of the Technology Acceptance Model into their curricula.

5.6 LIMITATIONS OF THE STUDY

The cross-sectional correlational design prohibits causal inference, requiring longitudinal SEM for comprehensive mediation validation. Sampling limits the generalisability of findings from UUM undergraduates, primarily urban business and communication students to licensed drivers and rural demographics. Self-reported measures present a risk of common method variance, even with stringent reliability validation (α>0.75 across constructs). The operationalisation of composite scores restricts item-level diagnostics, but the framing of UUM campus shuttles may exaggerate Perceived Usefulness in comparison to personal vehicle purchase situations.

5.7 RECOMMENDATIONS FOR FUTURE RESEARCH

Future research should utilise longitudinal panel designs with structural equation modelling to examine comprehensive mediation effects (H5-H8). Comparative comparisons among students, employed drivers, and rural commuters will improve external validity. Experimental paradigms employing AV simulators to influence trust and ethical escalation variables provide causal leverage. Regional analyses comparing AV adoption in Malaysia, Indonesia, and Singapore will elucidate cultural border circumstances. Multi-method techniques that integrate physiological trust measurements (such as eye-tracking and heart rate variability) with self-reports offer the potential for methodological triangulation. Testing boundary conditions by multi-group invariance analyses across subgroups of gender, wealth, and driving experience is still necessary.

5.8 CONCLUSION

This study identifies trust (r=0.662, r^2=43.8%) and ethical standards (r=0.559, r^2=31.2%) as primary drivers of autonomous vehicle adoption among Malaysian Generation Z students, thereby significantly enhancing the Technology Acceptance Model through culturally-specific mechanisms that collectively account for considerable behavioural variance. The facilitative function of legal familiarity (r=0.239) contrasts with Western risk paradigms, indicating an optimistic regulatory adaptation typical of emerging nations. Strategic synthesis advocates for Malaysia's AV market penetration via the establishment of trust infrastructure (safety certification ecosystems), prioritising it over regulatory streamlining and utility marketing initiatives. The empirical foundation of UUM, based on 302 respondents, offers a definitive framework for the execution of NAP 2020, establishing Malaysia as a leader in ASEAN AV adoption through ethical-trust alignment. The 7/8 supported hypotheses confirm the integrated model architecture, with ethical facilitation signifying a paradigm-shifting discovery for technology dissemination in collectivist situations.

REFERENCES

Acheampong, R. A., & Cugurullo, F. (2022). Capturing the behavioural determinants behind the adoption of autonomous vehicles: Conceptual frameworks and measurement model. *Transport Reviews, 42*(1), 1–25.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Prentice Hall.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*(3), 411–423. https://doi.org/10.1037/0033-2909.103.3.411

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173

Bateriku. (2026). *The impact of fuel subsidy rationalization on student mobility*. https://www.bateriku.com.my/reports/2026-mobility

Bonnefon, J.-F., Shariff, A., & Rahwan, I. (2016). The social dilemma of autonomous vehicles. *Science, 352*(6293), 1573–1576. https://doi.org/10.1126/science.aaf2654

Chan, W. M., & Lee, J. W. C. (2021). 5G connected autonomous vehicle acceptance: The mediating effect of trust in the technology acceptance model. *Asian Journal of Business Research, 11*(1). https://doi.org/10.14707/ajbr.210098

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982–1003. https://doi.org/10.1287/mnsc.35.8.982

Dwivedi, Y. K., Hughes, L., Kar, A. K., Rana, N. P., Raghavan, V., & Kizgin, H. (2021). "You do not want to understand me": Exploring the role of artificial intelligence in consumer disengagement. *International Journal of Information Management, 59*, 102168.

Etminani-Ghasrodashti, R., Hamidi, S., & Larsson, A. (2025). Autonomous vehicles and ethical decision-making: A cross-cultural analysis of trolley problem preferences. *Frontiers in Built Environment, 11*, Article 1345678. https://doi.org/10.3389/fbuil.2025.1345678

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50. https://doi.org/10.1177/002224378101800104

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference* (4th ed.). Allyn & Bacon.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Hastings Center. (2022). *Ethics of autonomous systems: Transparency and accountability*. https://www.thehastingscenter.org

Hewitt, C., Politis, I., Amanatidis, T., & Sarkar, A. (2019). Assessing public perception of self-driving cars: The autonomous vehicle acceptance model. In *Proceedings of the 24th International Conference on Intelligent User Interfaces* (pp. 518–527).

Hollebeek, L. D., Clark, M. K., Andreassen, T. W., Sigurdsson, V., & Smith, D. (2023). Virtual reality through the customer journey: Framework and propositions. *Asia Pacific Journal of Marketing and Logistics, 35*(4), 825–847.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Hulse, L. M., Xie, H., & Galea, E. R. (2023). Public acceptance of autonomous vehicles: A systematic review. *Transportation Research Part F: Traffic Psychology and Behaviour, 92*, 1–15.

Human Progress. (2025). *The rapid expansion of autonomous ride-hailing fleets*. https://www.humanprogress.org/autonomous-fleets-2025

Infosec Institute. (2024). *Cybersecurity and the law: Liability in autonomous systems*. https://www.infosecinstitute.com/reports/2024

Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). Guilford Press.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*(3), 607–610.

La Delfa, G., & Han, Y. (2025). Young adults' acceptance of shared autonomous vehicles in an urban university setting. *Frontiers in Built Environment, 11*, Article 1613232.

Liu, J., Ou, Y., & Wang, S. (2022). Moral dilemmas in autonomous vehicle decision-making: A cross-cultural study using the Moral Machine experiment. *Transportation Research Part A: Policy and Practice, 162*, 1–18.

Mahmoudi, N., Mohammadian, A., & Feizi, N. (2022). Trust in autonomous vehicles: The role of performance expectancy and facilitating conditions. *Transportation Research Part C: Emerging Technologies*, *135*, 103521.

Malaysia Investment Development Authority. (2021). *Malaysia steering towards autonomous vehicle technology*. https://www.mida.gov.my/ja/malaysia-steering-towards-autonomous-vehicle-technology/

Ministry of International Trade and Industry. (2020). *National automotive policy 2020*. https://www.miti.gov.my/miti/resources/NAP_2020.pdf

Naiseh, M., Jiang, J., & Smith, J. (2024). Trust calibration in autonomous vehicles: A longitudinal field study in higher education contexts. *Transportation Research Part F: Traffic Psychology and Behaviour*, *100*, 1–15.

National Highway Traffic Safety Administration. (2024). *Standing general order on crash reporting*. https://www.nhtsa.gov

Nordhoff, S., De Winter, J., Nyga, R. F., Van Arem, B., & Happee, R. (2020). Using the UTAUT2 model to understand public acceptance of autonomous vehicles. *Transportation Research Part F: Traffic Psychology and Behaviour*, *79*, 1–16.

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). McGraw-Hill.

Park, E., Lim, J., & Cho, Y. (2018). Understanding the emergence and social acceptance of electric vehicles as next-generation models for the automobile industry. *Sustainability*, *10*(3), 662.

Pavlou, P. A. (2003). Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model. *International Journal of Electronic Commerce*, *7*(3), 101–134.

Road Transport Act 1987 (Act 333) (Malaysia).

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill-building approach* (7th ed.). John Wiley & Sons.

Society of Automotive Engineers. (2021). *Taxonomy and definitions for terms related to driving automation systems for on-road motor vehicles (J3016_202104)*. https://www.sae.org/standards/content/j3016_202104/

Sun Malaysia. (2026, January 15). *Congestion costs Malaysia RM20 billion annually*. https://www.thesun.my/local/economic-loss-congestion-2026

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

TomTom. (2025). *TomTom traffic index: Kuala Lumpur 2025 report*. https://www.tomtom.com/en_gb/traffic-index/kuala-lumpur-traffic/

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157–178. https://doi.org/10.2307/41410412

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2020). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems, 21*(12), 1570–1605.

World Health Organization. (2023). *Global status report on road safety 2023*. https://www.who.int/publications/i/item/9789240086517

Zhang, Y., & Kamargianni, M. (2022). A review on the factors influencing the adoption of new mobility technologies and services: Autonomous vehicles, drone, micromobility and mobility as a service. *Transport Reviews, 43*(3), 407–429. https://doi.org/10.1080/01441647.2022.2119297