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Societal acceptance of urban air mobility based on the technology adoption framework

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ABSTRACT

Urban air mobility (UAM) is regarded as a sustainable alternative for intercity and intracity passenger transportation. The objective of this study is to identify the psychological and attitudinal factors that predict behavioral intentions to adopt UAM. This study integrates the unified theory of acceptance and use of technology with the initial trust model to explain the adoption intention among potential users of UAM. Results show that social influence and initial trust are the most significant predictor of the usage intention, which, together with performance expectancy, facilitating conditions, and structural assurance, lead to positive attitudes toward UAM. Initial trust was dependent on all six antecedents considered, but most largely on structural assurance. These findings emphasize the role of institutional safety nets, including regulations and legal resources, in increasing initial trust and promoting initial diffusion of UAM. They also offer guidance for designing interventions to improve the societal acceptance of UAM.

1. Introduction

The transportation sector remains heavily reliant on fossil fuels, accounting for 37% of CO_2 emissions from all end-use sectors in 2021 (International Energy Agency, 2022a). Despite the unprecedented decline in global CO_2 emissions in 2020 due to various pandemic measures, the transportation sector observed a resurgence in these emissions in 2021, evidenced by the 8% growth in global CO_2 emissions to approximately 7.7 Gt CO_2 (International Energy Agency, 2022a). Sustainable transportation methods encompass vehicle electrification, energy-efficient operations, and the use of alternative fuels, accompanied by a shift toward low-carbon mobility. Although road transportation produces the largest portion of global CO_2 emissions, aviation has recently demonstrated a sharp increase in its contribution relative to other sectors, notably generating 720 Mt. of CO_2 emissions in 2021 (International Energy Agency, 2022b). With the demand for aviation services gradually rebounding since 2021, there is an increasing need to advance active measures to meet the net zero goal in the transportation sector (International Air Transport Association, 2022).

In response to continued rapid urbanization, new types of transportation modes grounded in the concept of smart mobility have been developed to address social, economic, and environmental challenges (e.g., Abduljabbar et al., 2021; Guo et al., 2022; Lee and Lee, 2022; So et al., 2020). Urban air mobility (UAM) has notably gained popularity, disrupting traditional boundaries between the road and aviation sectors while mitigating traffic congestion and contributing to environmental sustainability (Hamilton, 2018). UAM is generally defined as a subset of advanced air mobility that aims to offer safe and efficient aviation transportation services using highly automated aircraft for urban and suburban travel (Federal Aviation Administration, 2022). A UAM system can carry both passengers and cargo as an air transportation service, offering a potential solution to traffic congestion in densely populated

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urban environments. Several scholars have attempted to understand the environmental impact of introducing UAM. For example, Zhao et al. (2022) recently conducted a comparative analysis of air pollutant emissions from ground transportation and multimodal UAM. Greenhouse gas emissions per passenger–kilometer were found to be 50% and 6% lower for electrically propelled vertical takeoff and landing (eVTOL) vehicles compared to internal combustion engine vehicles and electric vehicles, respectively (Kasliwal et al., 2019). Furthermore, UAM could potentially reduce travel times by 3–13% for motorized trips (Rothfeld et al., 2021).

Among various types of UAM aircraft, the VTOL type is frequently discussed due to its durability and maneuverability, which is demonstrated by its ability to hover, take off, and land vertically (Mahmoud et al., 2021). For environmental sustainability, alternative fuel sources for eVTOL aircrafts have garnered considerable attention in previous research (e.g., Garrow et al., 2021; Pavel, 2022). In addition to the features of electric propulsion, eVTOL aircraft, along with most UAM aircraft, reduce particulate pollution from rubber tires and brake discs. An overlooked fact is that particulate air pollution from tire wear can be 1000 times worse than pollution from vehicle exhaust (Emissions Analytics, 2020). Alleviating traffic congestion on the ground by relocating road traffic to airspace is an undeniable benefit of UAM. Moreover, the operational features of UAM as a mode of shared mobility can facilitate efficient use of limited resources through high aircraft occupancy. With these features, UAM demonstrates potential as an alternative mode of sustainable transportation that can complement existing road transportation strategies.

Projections suggest that the total UAM market could reach $1.5 trillion by 2040 (Morgan Stanley, 2019), with approximately 100,000 passenger UAM vehicles potentially in operation worldwide by 2050 (Roland Berger, 2018). In the US, an estimated 55,000 daily trips could occur with the early adoption of UAM (Goyal et al., 2021). Research addressing a wide array of topics related to the expansion of UAM capacity has surged over recent years. However, the majority of existing studies are rooted in the aerospace field, concentrating on mechanical development and operations. Given that UAM is an emerging concept, broad conceptual studies have been conducted (e.g., Garrow et al., 2021; Pons-Prats et al., 2022), along with the assessment of technical aspects such as vehicle configuration and design (e.g., Prakasha et al., 2022; Schweiger and Preis, 2022) and operations (e.g., Kopardekar et al., 2016), as well as demand analysis and market studies (e.g., Goyal et al., 2018, 2021).

Despite this strong research interest, a significant fundamental question remains with regard to whether UAM is attractive to travelers. As the widespread adoption of any new transportation service hinges on user demand, public acceptance is crucial for the successful implementation of UAM and the full realization of its societal benefits. Without public acceptance, the primary objectives of using UAM cannot be met, despite its potential to sustainably address environmental issues.

In recent years, several studies have examined individual attitudes toward the perception and adoption of UAM. These studies have identified relevant drivers and barriers to UAM access, as well as the underlying motives influencing adoption decisions in various contexts (Al Haddad et al., 2020; European Union Aviation Safety Agency, 2021; Kwarteng et al., 2023; Shaheen et al., 2018; Winter et al., 2020). Although these studies have contributed to the literature by describing user profiles outside the mode choice context or service-related characteristics, they have not considered the role of initial trust and its interaction with other individual-level factors. To fill this gap, the current study introduces a technology adoption framework integrated with an initial trust model (ITM). The proposed model offers a comprehensive structure that links attitudinal and psychological factors to users' initial trust in UAM and subsequently, usage intention. With such a structure, the proposed model can elucidate how potential travelers form trust and usage intentions during the early diffusion phase of UAM. Drawing on data from eight metropolitan areas in the Republic of Korea (hereafter referred to as Korea), this study aims to answer the following research questions:

1. To what extent will the public consider UAM as an alternative mode of transportation?
2. What are the relevant factors affecting the behavioral intention to use UAM?
3. Which factors contribute to the adoption intention, and which act as barriers?

This paper begins with an overview of the theories of technology adoption and reviews empirical studies on public acceptance of UAM (section 2). Given the limited research available on the attitudinal and psychological determinants, the review focuses on exploratory research concerning market potential and target user groups. Following the review is a discussion of the methods, including data, survey procedures, constructs, and statistical analysis (section 3). Next, the results concerning the measurement and structural models are presented (section 4). Finally, the findings, conclusions, and limitations are discussed in the context of the implementation strategies for UAM (section 5).

2. Literature review and hypotheses development

As Desai et al. (2021) described, UAM involves many uncertainties and challenges not solely related to technology Public acceptance represents a significant challenge and could be the first barrier that needs to be overcome to improve UAM adoption (Straubinger et al., 2020b). Therefore, some scholars have explored potential demand for UAM, primarily focusing on cities in the United States and Europe, with few case studies conducted in developing countries and Asian cities. The range of UAM trip share largely varies according to methodological tools and target sites (e.g., Balać et al., 2019; Rothfeld et al., 2021). For instance, Kreimeier and Stumpf (2017) found that in Germany, the highest mode share of UAM is 19% for intercity trips. Various methodological approaches, such as agent-based transport simulation framework (Balać et al., 2019; Rothfeld et al., 2021), nested logit model (Pukhova et al., 2019), and gravity model (Becker et al., 2018) have been adopted. However, existing studies mainly focus on the changed mode share or market share from existing modes, and thus the influential factors determining public acceptance of UAM have not been detailed extensively. More broadly, few scholars have attempted to identify prevailing factors in the introduction of UAM. For example, Yedavalli and Mooberry (2019) conducted expert interviews and identified safety, noise, inequity, visual pollution, and privacy as key determinants. The European Union Aviation Safety Agency (2021) conducted a societal acceptance study via local market analysis, surveys, and interviews on UAM operations across the European Union, finding safety concerns to be the most influential factor, followed by noise. Below is a review of the empirical research on UAM adoption and theoretical frameworks for modeling societal responses.

2.1. Stated preference for UAM

Several studies have examined user preferences for UAM in the mode choice context. Peeta et al. (2008) used stated choice data to examine travelers' propensity to use air taxi services. Using a binary choice model, the authors found that platform location is significantly associated with the propensity to switch from the usual preferred mode of intercity transportation to air taxis. Location features include site accessibility and connectivity with other modes, thus highlighting the role of air taxis in multimodal transportation systems. The study also identified travel distance and service fare as important determinants of air taxi preference; for instance, UAM was preferred to other modes in long-distance trips because its economic value increases with flight distance. Fu et al. (2019) examined the mode preference for two conventional modes (private cars and public transportation) and two autonomous modes (autonomous taxis and autonomous flying taxis) in the Munich metropolitan area. Multinomial logit models showed that travel time, cost, and safety are significantly associated with the adoption of autonomous transportation services. Of the four transportation modes, autonomous flying taxis garnered the highest willingness to pay from potential users. Moreover, younger and older respondents with above average income expressed a greater preference for flying taxis.

Regarding the civil usage of unmanned drones, several studies have revealed that privacy issues and misuse constitute significant public concerns (Clothier et al., 2015; Wang et al., 2016). A study of 200 drone users and non-users showed that individual responses to drones depend on the factor of expertise, i.e., whether the user possesses knowledge about the technology (Lidynia et al., 2017). Non-users expressed concerns about potential privacy invasions through drone technology (e.g., being filmed using drones without consent), while drone users focused more on risk factors for possible accidents. Boucher (2016) conducted a qualitative study on public attitudes toward civil drones and found that individuals perceive civil drones as a nuisance and a form of surveillance, despite acknowledging the potential benefits of drone technology for the public. Finally, Chamata (2017) proposed a conceptual framework for drone adoption where risk perception mediates the effects of social and economic concerns. This literature is followed by research on public acceptance of transportation technology using the technology acceptance framework, which is detailed below.

2.2. Conceptual framework of technology adoption and acceptance

The major theories used to understand public acceptance of emerging technologies include the theory of reasoned action (TRA), theory of planned behavior (TPB), and innovation diffusion theory (IDT). These theories commonly assume that a person's behavioral intention precedes their consciously intended behaviors (Gücin and Berk, 2015). The TRA assumes that people have volitional control over their behavior and develop certain attitudes and beliefs about whether performing a behavior is beneficial (Fishbein and Ajzen, 1975). An extension of the TRA, the TPB considers perceived behavioral control as an additional determinant of behavioral intention (Ajzen, 1985). The two frameworks constitute the foundations of IDT, indicating that users are willing to adopt innovative technology only if the technology has a comparative advantage over existing solutions (Rogers, 2003). The IDT postulates five antecedents of innovation adoption—compatibility, complexity, relative advantage, trialability, and observability—which collectively determine the actual usage of technology.

The technology acceptance model (TAM) was developed from the TRA and TPB to explain user acceptance of the emerging information technologies. TAM conceptualizes that one's behavioral intention to adopt technology is determined by two attitudinal factors: perceived usefulness and perceived ease of use (Davis, 1989). Perceived usefulness concerns "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). Perceived ease of use refers to "the extent to which a person believes that using a particular technology would be free of efforts" (Davis, 1989, p. 320). Under the TAM, perceived usefulness is assumed to be determined by perceived ease of use; that is, if a technology is easier to use, users are more confident and competent in adopting it. Venkatesh and Davis (2000) proposed an extended version of the TAM, named TAM2, which includes two additional predictors (social influence and cognitive instrumental processes) of technology adoption intention. The TAM has been used in several transportation studies to explain societal responses to innovative transportation services (Thøgersen and Ebsen, 2019; Wang et al., 2020; Zhang et al., 2019).

Al Haddad et al. (2020) applied the TAM to study the individual factors affecting the intention to adopt UAM. The authors suggested exploring factors affecting automation acceptance in transportation, such as how potential travelers respond to autonomous vehicles, to build a conceptual framework for UAM. Reviewing public acceptance research on autonomous vehicles, which share similar service characteristics (Straubinger et al., 2020b), this study conceptualized the behavioral intention to use UAM as a function of perceived reliability of automation, perceived safety, perceived locus of control, previous automation experience, trust, perceived usefulness, social behavior, time value, perceived costs, and data and ethical concerns. Among these potential determinants, the constructs of perceived usefulness, social behavior, time value, and data and ethical concerns were highly significant in predicting the behavioral intention to use UAM. The study also emphasized the moderating role of trust, which could be facilitated by perceived safety, perceived locus of control, perceived reliability of automation, and previous automation experience. Previous crash experience also explained significant variance in the behavioral intention to use UAM. This study suggested that common predictors of transportation technology acceptance can also be highly significant for the societal response toward UAM.

The unified theory of acceptance and use of technology (UTAUT) is based on eight existing theories on technology adoption, which include TRA, TPB, IDT, and TAM (Venkatesh et al., 2003). The UTAUT posits that the perceived likelihood of adopting the technology is jointly determined by four major constructs – performance expectancy, effort expectancy, social influence, and facilitating conditions (Fig. 1). The effects of performance expectancy, effort expectancy, and social influence were assumed to be moderated by behavioral intention. Facilitating conditions was assumed to have a direct impact on intention to use. The four predictors in the UTAUT jointly predicted about 70% of the variation in use intention and 50% of actual usage (Venkatesh et al., 2012). The UTAUT exhibited significantly higher accuracy at predicting user acceptance of emerging technologies, compared to the rest of the models. The rise of information technology led to extension of the UTAUT model to consumer technology use context, emphasizing hedonic value of emerging technology. The revised UTAUT model includes three additional constructs, such as hedonic motive, perceived value, and habit, which is popularly referred as UTAUT2. Given its superior performance and wider generalizability, this study employed UTAUT as the theoretical basis for modeling acceptance of UAM.

Several transportation studies have employed the UTAUT to explore the user adoption of autonomous vehicles (Leicht et al., 2018), autonomous delivery vehicles (Kapser and Abdelrahman, 2020), automated road transport systems (Madigan et al., 2017), and highly automated driving (Hartwich et al., 2019). A survey on the purchase intention of autonomous vehicles revealed that the performance expectancy, effort expectancy, and social influence are positively associated with purchase intention and the preference for innovative technology moderates these associations (Leicht et al., 2018). Hartwich et al. (2019) examined consumer response to a driving simulator and found that trust and experience with the system can significantly influence the acceptance of highly automated driving. Madigan et al. (2017) found a significant association between effort expectancy and the intention to use an automated road transport system and reported a weaker influence of performance expectancy, social influence, and facilitating conditions. Venkatesh et al. (2003) suggested that "future work should attempt to identify and test additional boundary conditions of the model in an attempt to provide an even richer understanding of technology adoption and usage behavior" (p. 470). In the current study, the construct of environmental concerns was considered to expand the boundary conditions of the UAM acceptance model. Environmental concerns are conceptualized as the degree to which a user is concerned about the environmental impact of an emerging mode of transportation. If users perceive that UAM could be a sustainable alternative to personal vehicles, environmental concerns might be positively associated with the behavioral intention to use UAM. Based on the UTAUT and related empirical findings, it is hypothesized that:

H1. Performance expectancy positively affects behavioral intention to use UAM.

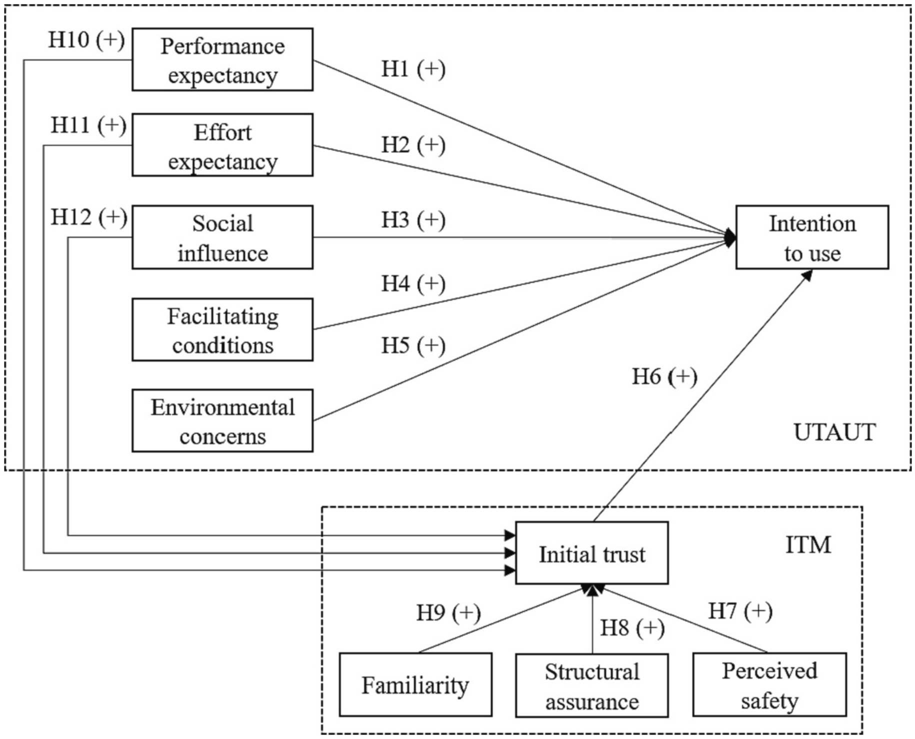

Fig. 1. Research model and hypothesis.

H2. Effort expectancy positively affects behavioral intention to use UAM.

H3. Social influence positively affects behavioral intention to use UAM.

H4. Facilitating conditions positively affect behavioral intention to use UAM.

H5. Environmental concerns positively affect behavioral intention to use UAM.

H6. Initial trust positively affects behavioral intention to use UAM.

2.3. Initial trust in technology

To better explain public acceptance of UAM, the UTAUT is extended with initial trust. Prior research defines initial trust as "an individual's disposition to trust or on institutional cues that enable one person to trust another without firsthand knowledge" (McKnight et al., 1998). In the context of technology adoption, initial trust is conceptualized as the trust a potential user has in a technology when the user has no prior experience with it (McKnight et al., 2002). The early marketization of technology requires that potential users have sufficient trust in the technology to overcome perceived risks and form a positive attitude. This can be particularly important in the transportation context because mode choice decisions are significantly affected by the perceived safety and security of the system (Noland, 1995).

Researchers in transportation studies have integrated initial trust into the acceptance model of emerging technology. For instance, Zhang et al. (2019) suggested a conceptual framework to link the construct of initial trust and perceived usefulness to behavioral intention to use autonomous vehicle, where initial trust is affected by perceived ease of use, perceived safety risk, and perceived privacy risk. The authors highlighted that positive attitudes toward autonomous vehicle affect initial trust, and this link leads to increased intention to use autonomous vehicle. Zhang et al. (2020) explored the initial marketization of autonomous vehicle and demonstrated that social influence and initial trust predict willingness to ride in autonomous vehicle. Xu et al. (2018) highlighted that experience with autonomous vehicle is positively associated with initial trust in autonomous vehicle. Likewise, Khastgir et al. (2018) found that providing information about autonomous vehicle's capabilities and limitations could increase trust and preference for autonomous vehicle. While initial trust is an important determinant of behavioral intention to use emerging transportation technology, it is largely neglected in research on societal response to UAM. Thus, this study proposes to consider initial trust along with other constructs of the UTAUT.

The review of prior research on trust indicates that both individual and institutional attributes determine users' trust in innovative technology (McKnight et al., 1998, 2002). Individual attributes are composed of personality- and cognition-based factors. Institutional attributes include services and guarantees provided by the firm to ensure

Table 1
Demographic and socioeconomic characteristics (*N*=1168).

Category	N	%	Category	N	%
Gender			3000-3999k	225	19.3
Female	585	50.1	4000-4999k	141	12.1
Male	583	49.9	≥ 5000k	185	15.8
Age (in years)					
19–29	245	21.0	Housing		
30–39	234	20.0	Own home	632	54.1
40–49	269	23.0	Long-term rental	229	19.6
50–59	286	24.5	Short-term rental	153	13.1
60–64	134	11.5	Others	154	13.2
Education			City of residence		
< high school	6	0.5	Seoul	503	43.1
high school	259	22.2	Busan	167	14.3
vocational school	149	12.8	Daegu	122	10.5
4-year college	634	54.3	Incheon	153	13.1
Master or PhD	120	10.3	Gwangju	72	6.2
Monthly income*			Daejeon	76	6.5
< 1000k	173	14.8	Ulsan	56	4.8
1000-1999k	149	12.8	Sejong	19	1.6
2000-2999k	295	25.3			

Notes: N, number of observations. * is in South Korean won.

Table 2
Transportation characteristics (N=1168).

Category	N	%	Category	N	%
Monthly travel expenses			Travel modes*		
≤ 50k	242	20.7	Personal vehicle	621	53.2
60-100k	351	30.1	Bus	588	50.3
110-150k	175	15.0	Transit	573	49.1
160-200k	176	9.9	Taxi	169	14.5
210-300k	115	3.8	Car sharing service	15	1.3
> 300k	109	5.6	Motorbike	17	1.5
Driving experiences			Bicycle	79	6.8
No license, no experience	158	13.5	Walk	326	27.9
Licensed but never drove	183	15.7	Others	7	0.6
<1 year	78	6.7	Location		
1–3 years	67	5.7	Public transit within 5 min. of walk	532	45.6
3–5 years	56	4.8	Public transit within 5–10 min. of walk	459	39.3
> 5 years	626	53.6	Public transit within 10–15 min. of walk	143	12.2
Any traffic accident			Public transit outside 10–15 min. of walk	34	2.9
Yes	660	56.5			
No	508	43.5			

Notes: N, number of observations. * could be answered with more than one response items.

trust among potential users. The antecedents of trust in UAM are not yet fully understood because UAM is still at early stage of development. However, the related literature shows that familiarity, structural assurance, perceived safety, and firm reputation are particularly relevant determinants of initial trust (Choi and Ji, 2015; Gefen et al., 2003; Gefen and Straub, 2004; Kim and Prabhakar, 2004). These factors represent cognition, institutional offering, and operator characteristics, which are assumed to increase trust in technology. For technology at the development phase, where the service provider is not known, the literature suggested a simpler version of the ITM that leaves out firm reputation (Afshan and Sharif, 2016). This version of ITM assumes that familiarity, structural assurance, and UTAUT constructs are positively associated with initial trust in technology. Given the importance of perceived safety in initial diffusion of transportation service (Choi and Ji, 2015), this study proposes a conceptual framework in which initial trust is determined by perceived safety, familiarity, structural assurance, and three constructs of the UTAUT (performance expectancy, effort expectancy, and social influence) (Fig. 1). The review of the literature leads to the following hypothesis:

H7. Perceived safety positively affects initial trust in UAM.

H8. Structural assurance positively affects initial trust in UAM.

H9. Familiarity positively affects initial trust in UAM.

H10. Performance expectancy positively affects initial trust in UAM.

H11. Effort expectancy positively affects initial trust in UAM.

H12. Social influence positively affects initial trust in UAM.

3. Methods and data

3.1. Data collection and study sample

A total of 1168 individuals aged 19 to 64 years and living in eight metropolitan areas in Korea (Seoul, Busan, Incheon, Daegu, Daejeon, Gwangju, Ulsan, and Sejong) considering the operational concept of UAM in urban and suburban areas were invited to participate in the online survey. Participants were recruited from the Embrain panel of Macromill-Embrain – a market research firm collecting data on 1,088,408 individuals representing community dwelling citizens in Korea – using quota sampling methods based on age, gender, and region of residence. Sample recruitment was conducted online via email, and the participants were enrolled on a voluntary basis. The average participant spent approximately 15.3 minutes completing the survey. Those who left the survey before completion or refreshed the page without answering any questions were excluded from the sample. Participants who fully completed the survey was rewarded at a rate of 100 KRW per minute to increase the reliability of answers and participation rate. The survey was conducted anonymously between November 24 and 29, 2021. The sample did not include underage minors (age ≤ 18 years) and older adults who qualify for a free subway pass (age ≥ 65 years). Individuals with no access to the local subway system were also excluded. Tables 1 and 2 present the average descriptive statistics for the study sample.

3.2. Survey procedures

Participants were informed that they would be asked about their attitudes toward emerging transportation technologies. The survey began with a series of questions on their demographic and socioeconomic background, including age, gender, education, income, home ownership, and city of residence. They were then guided to the second section of the survey that asked about travel patterns and behaviors (e.g., monthly travel expenses, driving experience, traffic accidents, mode of transportation, vehicle ownership, and proximity to public transportation). The third section surveyed the participants' attitudes toward UAM services using the UTAUT instruments. A short introductory video was first played to help the participants understand the technical and operational features of UAM (Korea Airports Corporation, 2021). The video showed visual images of how a UAM service operates in the city of Seoul and transports people between regional hubs and ports. It was assumed that the service could be called using a smartphone application and was connected to other modes of transportation, including taxis and autonomous public transportation. The video was automatically displayed on the screen and lasted for 2:11. After watching the video, the participants were asked to answer a series of statements concerning the UTAUT constructs (Table A1). The measurement items were presented in the following order: perceived safety, structural assurance, familiarity, performance expectancy, effort expectancy, social influence, facilitating conditions, environmental concerns, initial trust, and intention to use.[3] Responses were recorded on a 7-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (7). The questionnaire was first written in English and then translated into Korean by a native editor. Three doctorate holders in transportation were asked to provide feedback on the conceptual model and related measurement items. The

[3] Note that direct measurements for UAM's urbanicity, such as convenience (Postorino and Sarné, 2020), were not considered in this study. However, another aspect of urban mobility (i.e., compatibility) that UAM also has for intermodal transportation was considered in the measurement item (FC3) under facilitating conditions.

Table 3
Model fit indexes.

Fit statistics	Structural model	Recommended value
RMSEA	0.09 (0.003)	< 0.10 (Browne and Cudeck, 1993)
CFI	0.99	> 0.90 (Bentler and Bonett, 1980)
TLI	0.95	> 0.90 (Byrne, 1994)
SRMR	0.01	between 0 and 0.08 (Hu and Bentler, 1999)
GFI	0.98	> 0.90 (Bagozzi and Yi, 1988)
AGFI	0.94	> 0.80 (Etezadi-Amoli and Farhoomand, 1996)

Notes: RMSEA, root mean square error approximation; AIC, Akaike's information criterion; CFI, comparative fit index; TLI, Tucker-Lewis index; SRMR, standardized root mean square residual; GFI, goodness of fit index; AGFI, adjusted goodness of fit index.

measurement items were further updated according to the feedback and the unique transportation environment of Korea.

3.3. Statistical analysis

Confirmatory factor analysis was conducted to evaluate the reliability and validity of the measurement instruments. The reliability of the instruments was examined using Cronbach's alpha, an indicator of internal consistency. An alpha of 0.7 or higher is considered a minimum acceptable level of internal consistency (Hair et al., 2014). The convergent validity of the instrument was established by examining the factor loading (FL), construct reliability (CR), and average variance extracted (AVE) for each measured variable (Fornell and Larcker, 1981). For adequate reliability and convergent validity, the literature suggests all estimated FLs to exceed 0.6 (Hair et al., 1995), CR values to be above 0.7 (Hair et al., 2014), and AVE values to be higher than 0.5 (Bagozzi and Yi, 1988). In terms of discriminant validity, this study examined the heterotrait–monotrait (HTMT) ratio of the correlation between constructs. The HTMT ratio is a measure of similarity between latent constructs that needs to be lower than 0.85 for acceptable discriminant validity (Kline, 2015).

Structural models can be examined using a covariance-based approach, variance-based approach, or structural equation modeling (SEM). In this study, SEM was employed to evaluate the structural model and path coefficients. SEM is preferred over linear regression analysis because it allows for (a) explanatory and outcome variables to be associated with measurement errors, (b) more accurate estimates of the relationships between latent and observed constructs, and (c) the best fit modeling and theory-driven modeling of data (Hair et al., 2014). The models were estimated using the maximum likelihood procedure in Stata 16.1 software. The model fit was examined using the root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker–Lewis index (TLI), standardized root mean square residual (SRMR), goodness-of-fit index (GFI), and adjusted goodness-of-fit index (AGFI). The critical thresholds for the fit indexes are listed in Table 3.

4. Results

The average descriptive statistics of the study sample showed that approximately 41% were below 40 years old, 64.3% were college graduates, and 55.9% were married (Table 1). In terms of monthly income, 27.6% answered that they earned <2000k KRW, 44.6% reported an income of 2000k to 3999k KRW, and 27.9% indicated earning 4000k KRW or more. More than half of the participants selected "own home" as their primary residence while 32.7% indicated that they lived in long- or short-term rental houses. Compared with the nationally representative figures obtained from the 2021 National Survey of Tax and Benefit, the study sample includes a higher proportion of educated respondents, males, and homeowners.

Table 2 shows the transportation-related characteristics of the study sample. The statistics showed that 20.7% of the study sample spends 50k KRW or less on transportation per month, 29.2% had no driver's license

Table 4
Confirmatory factor analysis for construct validity.

Constructs	Items	M (SD)	Alpha	SFL	CR	AVE
Performance expectancy	PE1	5.09 (1.29)	0.89	0.81	0.88	0.66
	PE2	4.66 (1.42)		0.86		
	PE3	5.01 (1.38)		0.84		
	PE4	4.74 (1.42)		0.72		
Effort expectancy	EE1	3.78 (1.48)	0.80	0.60	0.80	0.57
	EE2	4.76 (1.31)		0.80		
	EE3	4.61 (1.31)		0.85		
Social influence	SI1	4.82 (1.28)	0.90	0.76	0.90	0.68
	SI2	4.22 (1.43)		0.91		
	SI3	4.15 (1.43)		0.88		
	SI4	4.81 (1.36)		0.75		
Facilitating conditions	FC1	3.88 (1.41)	0.79	0.74	0.76	0.52
	FC2	3.83 (1.43)		0.76		
	FC3	4.58 (1.35)		0.64		
Environmental concerns	EC1	5.10 (1.25)	0.84	0.65	0.82	0.61
	EC2	4.40 (1.44)		0.85		
	EC3	4.21 (1.35)		0.84		
Perceived safety	PS1	3.55 (1.23)	0.91	0.80	0.90	0.75
	PS2	3.33 (1.24)		0.90		
	PS3	3.28 (1.28)		0.90		
Structural assurance	SA1	3.83 (1.40)	0.86	0.67	0.84	0.64
	SA2	4.14 (1.51)		0.88		
	SA3	4.43 (1.45)		0.84		
Familiarity	FM1	3.58 (1.65)	0.93	0.87	0.92	0.79
	FM2	3.27 (1.61)		0.91		
	FM3	3.10 (1.62)		0.88		
Initial trust	IT1	4.05 (1.34)	0.94	0.89	0.93	0.81
	IT2	3.94 (1.40)		0.90		
	IT3	4.11 (1.34)		0.91		
Intention to use	IU1	4.65 (1.33)	0.88	0.92	0.88	0.71
	IU2	4.71 (1.36)		0.90		
	IU3	3.96 (1.51)		0.70		

Notes: M, mean; SD, standard deviation; Alpha, Cronbach's α; SFL, standardized factor loading; CR, composite reliability; AVE, average variance explained.

Table 5
Heterotrait-monotrait ratios for discriminant validity.

	PE	EE	SI	FC	EC	PS	SA	FM	IT	IU
PE										
EE	0.71									
SI	0.88	0.77								
FC	0.68	0.80	0.75							
EC	0.79	0.66	0.81	0.63						
PS	0.08	0.04	0.10	0.04	0.09					
SA	0.60	0.65	0.64	0.63	0.68	0.19				
FM	0.35	0.45	0.44	0.63	0.47	0.09	0.49			
IT	0.68	0.70	0.75	0.73	0.73	0.23	0.86	0.54		
IU	0.79	0.70	0.84	0.78	0.73	0.08	0.68	0.47	0.82	

Table 6
Hypothesis testing.

	Hypothesized path			Beta	SE	95 % CI Lower	95 % CI Upper	*p* value	Decision
H1	PE	→	IU	0.19	0.03	0.13	0.24	<0.001	Supported
H2	EE	→	IU	−0.03	0.03	−0.08	0.02	0.267	Not supported
H3	SI	→	IU	0.28	0.03	0.22	0.35	<0.001	Supported
H4	FC	→	IU	0.19	0.03	0.14	0.24	<0.001	Supported
H5	EC	→	IU	0.02	0.03	−0.04	0.07	0.550	Not supported
H6	IT	→	IU	0.34	0.02	0.29	0.39	<0.001	Supported
H7	PS	→	IT	0.15	0.02	0.11	0.18	<0.001	Supported
H8	SA	→	IT	0.45	0.02	0.41	0.49	<0.001	Supported
H9	FM	→	IT	0.14	0.01	0.11	0.17	<0.001	Supported
H10	PE	→	IT	0.12	0.03	0.07	0.18	<0.001	Supported
H11	EE	→	IT	0.10	0.02	0.06	0.15	<0.001	Supported
H12	SI	→	IT	0.22	0.03	0.16	0.28	<0.001	Supported
Model									*R*-squared
Intention to use									0.69
Initial trust									0.73

Notes: CI, confidence interval; SE, standard error.

or had never driven a car, and 56.5% reported experiencing a traffic accident. The most frequently used mode of transportation was personal vehicle (53.2%), followed by bus (50.3%), transit (49.1%), and walking (27.9%). The majority of the participants lived in the vicinity of a public transit facility (97% lived within 10–15 minutes of walking distance).

Table 4 presents the estimated indicators of reliability and convergent validity, including the alpha, FL, CR, and AVE values. All constructs were found to have satisfactory inter-item reliability, with the standardized FLs exceeding the minimum threshold of 0.6. The AVE values were >0.5, which indicated an adequate level of convergent validity (Bagozzi and Yi, 1988). The CR scores were higher than the critical threshold of 0.7. Finally, the alpha values of internal consistency were above the 0.7 threshold suggested by Hair et al. (2014). Therefore, all the measured variables in the model had a satisfactory degree of reliability and convergent validity. This result establishes that the constructs were suitable for evaluating the structural model and hypothesized paths.

Table 5 presents the results regarding the discriminant validity of the constructs. Discriminant validity ensures that an instrument is not overlapping with other instruments from which it should differ. One measure of discriminant validity is the HTMT ratio, which must be lower than 0.85 (Kline, 2015). The estimation results showed that most HTMT ratios were <0.85, and some were close to zero. The HTMT ratio for SI-PE was slightly higher than the critical threshold but not far from the acceptable level. Overall, the results from confirmatory factor analysis suggest that the measurement model is appropriate for evaluating the path coefficients in the structural model.

The next step in SEM is to examine the goodness of fit of the structural model (Table 3). Overall, the hypothesized model fit the data well. The RMSEA value of <0.10 indicated that the estimated structural model had an acceptable model fit. The CFI and TLI values were greater than the corresponding thresholds, suggesting that the structural model was significantly better than the null model in explaining the data. The GFI and AGFI values also showed that a large fraction of the variance in the behavioral intention variable was explained by the estimated model. The SRMR value was approximately 0.01, which was well below the benchmark of 0.08. Given the satisfactory model fit indexes, the path coefficients of the structural model were assessed.

Table 6 presents the results of the estimated structural model. The table consists of hypothesized paths, beta coefficients, standard errors, 95% confidence intervals, *p* values, and remarks of the hypothesis. Hypotheses H1–H6 concern the UTAUT, and the subsequent hypotheses correspond to the ITM. The results from the UTAUT showed that performance expectancy (β=0.19; $p < 0.001$), social influence (β=0.28; $p < 0.001$), facilitating conditions (β=0.19; $p < 0.001$), and initial trust (β=0.34; $p < 0.001$) are positively associated with intention to use UAM. These estimates confirm hypotheses H1, H3, H4, and H6. However, effort expectancy ($\beta = -0.03$; $p = 0.267$) and environmental concerns (β=0.02; $p = 0.550$) are not associated with intention to use at the 5% level, rejecting hypotheses H2 and H5. The constructs with the largest influence on intention to use were initial trust, followed by social influence, performance expectancy, and facilitating conditions in order. For instance, it was estimated that the intention to use rises by 0.34 standardized units for one standardized unit increase in initial trust. Also, the intention to use increases by 0.28 standardized units for one standardized unit increase in social influence.

The results from the ITM suggest the positive impact of perceived safety (β=0.15; $p < 0.001$), structural assurance (β=0.45; p<0.001), familiarity (β=0.14; $p < 0.001$), performance expectancy (β=0.12; $p < 0.001$), effort expectancy (β=0.10; $p < 0.001$), and social influence (β=0.22; $p < 0.001$) on initial trust in UAM. All hypothesized paths leading to initial trust were statistically significant at the 1% level, confirming hypotheses H7–H12. Among the six constructs constituting the ITM, structural assurance and social influence were relatively more

Table 7
Multi-group analysis by transportation characteristics.

Panel A: By traffic accident				Beta (*p*-value)		
				Accident (N = 660)	No accident (N = 508)	*p* value for Δ
H1	PE	→	IU	0.16 (0.04)***	0.20 (0.05)***	0.550
H2	EE	→	IU	−0.06 (0.03)*	0.02 (0.04)	0.124
H3	SI	→	IU	0.29 (0.04)***	0.28 (0.05)***	0.922
H4	FC	→	IU	0.23 (0.03)***	0.14 (0.04)***	0.056
H5	EC	→	IU	−0.01 (0.03)	0.07 (0.04)	0.142
H6	IT	→	IU	0.38 (0.03)***	0.27 (0.04)***	0.022
H7	PS	→	IT	0.14 (0.02)***	0.16 (0.03)***	0.519
H8	SA	→	IT	0.47 (0.03)***	0.42 (0.03)***	0.231
H9	FM	→	IT	0.14 (0.02)***	0.15 (0.02)***	0.695
H10	PE	→	IT	0.13 (0.04)***	0.11 (0.04)***	0.683
H11	EE	→	IT	0.11 (0.03)***	0.10 (0.04)***	0.862
H12	SI	→	IT	0.21 (0.04)***	0.24 (0.04)***	0.629
Panel B: By travel mode				Beta (*p*-value)		
				Personal vehicle (*N* = 621)	Others (*N* = 547)	*p* value for Δ
H1	PE	→	IU	0.21 (0.04)***	0.15 (0.05)***	0.333
H2	EE	→	IU	−0.04 (0.03)	−0.01 (0.04)	0.568
H3	SI	→	IU	0.29 (0.04)***	0.27 (0.05)***	0.666
H4	FC	→	IU	0.20 (0.03)***	0.20 (0.04)***	0.928
H5	EC	→	IU	−0.06 (0.03)	0.10 (0.04)**	0.003
H6	IT	→	IU	0.39 (0.03)***	0.27 (0.04)***	0.011
H7	PS	→	IT	0.12 (0.02)***	0.17 (0.03)***	0.153
H8	SA	→	IT	0.45 (0.03)***	0.46 (0.03)***	0.946
H9	FM	→	IT	0.15 (0.02)***	0.13 (0.02)***	0.444
H10	PE	→	IT	0.12 (0.04)***	0.12 (0.04)***	0.936
H11	EE	→	IT	0.10 (0.03)***	0.11 (0.04)***	0.889
H12	SI	→	IT	0.27 (0.04)***	0.17 (0.04)***	0.078
Panel C: By proximity to public transit				Beta (*p*-value)		
				within 5 mins. (*N* = 532)	outside 5 mins. (*N* = 636)	*p* value for Δ
H1	PE	→	IU	0.27 (0.04) ***	0.12 (0.04)***	0.014
H2	EE	→	IU	−0.04 (0.04)	−0.01 (0.03)	0.479
H3	SI	→	IU	0.25 (0.05) ***	0.31 (0.04)***	0.341
H4	FC	→	IU	0.18 (0.04) ***	0.20 (0.03)***	0.625
H5	EC	→	IU	0.05 (0.04)	−0.01 (0.04)	0.304
H6	IT	→	IU	0.32 (0.04) ***	0.36 (0.03)***	0.456
H7	PS	→	IT	0.18 (0.03) ***	0.12 (0.02)***	0.125
H8	SA	→	IT	0.42 (0.03) ***	0.48 (0.03)***	0.095
H9	FM	→	IT	0.15 (0.02) ***	0.13 (0.02)***	0.380
H10	PE	→	IT	0.13 (0.04) ***	0.13 (0.04)***	0.925
H11	EE	→	IT	0.15 (0.04) ***	0.06 (0.03)*	0.047
H12	SI	→	IT	0.20 (0.05) ***	0.23 (0.04)***	0.633

Notes: CI, confidence interval; SE, standard error. Significance levels are indicated by *, **, and *** for 10, 5, and 1% significance level, respectively.

influential in explaining initial trust in UAM. For instance, when structural assurance was increased by one standardized unit, initial trust was expected to rise by 0.45 standardized units. Similarly, when social influence was raised by one standardized unit, initial trust was expected to increase by 0.22 standardized units. The impact of the other constructs was approximately 0.10 to 0.15 standardized unit increase in initial trust for one standardized unit increase in each construct.

A multigroup analysis was conducted to examine the potential moderating effects of transportation-related experiences on travelers' responses to UAM (Table 7). Particularly, this study explored whether the path relationships between the UTAUT constructs and the intention to use UAM differed according to the participants' transportation characteristics. The sample was split by traffic accident (whether a respondent experienced a traffic accident or not), mode of travel (whether a respondent used a personal vehicle or other modes of transportation, including bus, subway, taxi, car sharing service, motorbike, bicycle, and walking), and proximity to public transit (whether public transit was within 5 minutes of walking distance or not). The same structural model was estimated using each subsample, and the path coefficients across the groups were compared.

Panel A shows the estimated structural models based on the participants who had experienced a traffic accident (N=660) and those who did not (N=508). The associations between the UTAUT constructs and the intention to use UAM were similar across the two groups. In both models, effort expectancy and environmental concerns were not related to intention to use at the 5% level. The other constructs were significantly associated with initial trust and intention to use. Comparing the equality of the path coefficients revealed that the coefficients were significantly different for IT → IU across the two groups. The path coefficient for IT → IU was 0.38 for the participants who experienced a traffic accident; the coefficient was reduced to 0.27 for those with no experience of traffic accident.

Panel B splits the structural model by transportation mode. Among those who commuted using personal vehicles, effort expectancy and environmental concerns were not associated with intention to use at the 5% level. Among those who used other modes of transportation, only effort expectancy was not associated with intention to use. The tests for the equality of the path coefficients showed that the coefficients associated with IT → IU and EC → IU differed significantly according to the travel mode. Path IT → IU was more pronounced for personal vehicle users while path EC → IU was significant only for those who used other modes of transportation. Panel C splits the structural model based on proximity to public transit. The comparison of the path coefficients showed that the estimates associated with EE → IT and PE → IU were significantly larger for the participants near public transit. Among those outside 5 minutes of walking distance from public transit, effort expectancy was not associated with initial trust at the 5% level.

5. Discussion

UAM is an emerging transportation system comprising aerial vehicles that can maneuver in low-altitude airspace above urban landscapes (Hamilton, 2018). Its innovative value as an alternative transportation system has attracted increasing interest from researchers and policymakers aiming to realize sustainable transportation. Growing policy and planning efforts to advance UAM have prompted the need to explore the factors that determine travelers' acceptance of this technology and highlight the individual-level determinants of its initial diffusion (Al Haddad et al., 2020; Kwarteng et al., 2023; Winter et al., 2020). Despite the existence of various relevant studies, the answer to the basic research question regarding the public acceptance of UAM is still unclear (Straubinger et al., 2020a). In the context of Korea, limited knowledge exists about how potential travelers would respond to the concept of short-haul mobility through airspace. To fill this gap, this study investigated the antecedents that can lead to the initial adoption of UAM among Korean travelers. This study aims to deepen our understanding of societal attitudes and responses to UAM and identify implications for developing an effective initial implementation strategy. The results will eventually contribute to a wider deployment of UAM as an alternative to existing modes of sustainable transportation.

For this purpose, this study extended the UTAUT model to build a theoretical foundation for analyzing the latent variables of initial trust and usage intention. The empirical analyses showed that initial trust and the three UTAUT constructs (performance expectancy, social influence, and facilitating conditions) positively influenced the intention to use UAM. Moreover, initial trust in UAM was determined by perceived safety, structural assurance, familiarity, performance expectancy, effort expectancy, and social influence. Multiplying the path coefficients along the paths allowed us to estimate the compound effects of each construct and establish a ranking of the factors that influence usage intention (Table A2). Among the nine factors considered in this study, including a latent construct of initial trust, the strongest predictors of usage intention were social influence and initial trust. The next most influential factors were performance expectancy, facilitating conditions, and structural assurance. Perceived safety and familiarity had relatively weak but significant positive effects. Overall, the estimated models demonstrated good predictive power and identified the key determinants of usage intention for UAM services.

The findings from this study justify the proposed conceptual framework involving initial trust as potential travelers have indicated that the trustworthiness of UAM is an important antecedent of usage intention. In prior research, initial trust was not considered an important mechanism linking attitudinal factors to usage intention and was treated as one of the external determinants. Filling this gap in the literature, this study demonstrated the moderating role of initial trust and its underlying connection to other variables, that is, how it is influenced by attitudes toward UAM and leads to the behavioral intention to use. It appears that initial trust serves as a major pathway through which underlying attitudes are translated into the usage intention for UAM. For consumers who hold a positive predisposition toward UAM, it is likely that they find the concept of flying taxis more attractive, leading to the formation of trust. As UAM continues to evolve, there is a clear need to guide initial implementation in a way that fosters initial trust in UAM.

This study further illustrates that trust formation could be facilitated by augmenting structural assurance. As noted earlier, structural assurance is the degree to which potential users believe that institutional safety nets, "like guarantees, regulations, promises, legal resources, or other procedures, are in place to promote" the efficient use of the system (McKnight et al., 2002, p. 339). It is often denoted as "institution-based trust" or "technology trust" to emphasize institutional structures and mechanisms that provide protection against the potential failure of the system (Pavlou and Gefen, 2004). Within the UAM context, it pertains to the safety net that assures UAM will operate safely according to regulations and that any loss or damage incurred by UAM will be compensated by the service operator. Facilitating structural assurance necessitates a framework of regulation, legislation, and specific rules concerning UAM, which should be managed by national and local governments. As UAM is developed and integrated into the existing transportation system, the government and transportation authorities need to assume an active role in ensuring the safe operation of UAM (Al Haddad et al., 2020; Pons-Prats et al., 2022; Straubinger et al., 2020b).

Social influence is another vital construct that influences UAM usage intention. This concept assumes that potential users are more likely to use an emerging technology when it is recommended by their peers, parents, and others who are important to them. Social pressure on adoption intention has been demonstrated in information technology research, which has emphasized the likelihood of users to use mobile services in a public context (Nysveen et al., 2005). When people observe the wide adoption of emerging technology, they feel confident that the technology is socially acceptable and that it is becoming the norm in society. In the transportation context, a large user community may indicate public confidence in the system and the integration of the new transportation mode into the existing transportation network. The UAM industry may exploit the image of early adopters to promote their systems and services to potential travelers who are more likely to switch. This strategy may be particularly efficient when targeting relatively young individuals who care about their social image, such as those who frequently use social media (Curtale et al., 2021).

This study revealed that environmental concerns did not positively influence the intention to use. Despite UAM being an eco-friendly solution (Kasliwal et al., 2019; Rothfeld et al., 2021; Zhao et al., 2022), potential users might not factor this into their usage decisions. One plausible explanation is that concerns related to the operation of flying aircraft might counterbalance the anticipated environmental benefits of UAM. A report from the European Union enumerates several risk factors linked to UAM, including noise, visual disturbance, downward wind generated by rotors, inner-city occupation of landing pads, and the utilization of public money for financing ground infrastructure (European Union Aviation Safety Agency, 2021). For those unfamiliar with UAM, the concept might appear akin to a series of helicopters buzzing through the inner city, which could potentially be bothersome. Collectively, these findings underscore the necessity to highlight the environmental benefits of UAM while allaying concerns over possible environmental damage.

Finally, split sample analyses were conducted to examine whether the determinants of usage intention varied across individual predispositions toward mobility and transportation infrastructure. The results revealed differences in the determinants of usage intention based on traffic accident experience, travel mode, and proximity to public transit. For instance, initial trust was a significant predictor of behavioral intention to use UAM in the accident and no-accident groups. However, its effect was more pronounced for individuals with a history of traffic accidents, indicating that those injured in traffic accidents care more about the trustworthiness of UAM (Al Haddad et al., 2020). A comparison of the samples by travel mode showed that initial trust exerted a considerable influence on usage intention among personal vehicle users. Initial trust was still related to intention to use UAM among shared mobility users, but the association was relatively weak. Moreover, shared mobility users appeared to take the environment into account when deciding to use UAM. The results indicated that environmental concerns were a significant predictor of the intention to use UAM among shared mobility users, whereas their effect was negligible for personal vehicle users. Lastly, the effects of effort expectancy and performance expectancy were stronger for the sample living within a 5-minute walking distance from public transit compared to those living >5 minutes away. This outcome could be ascribed to the likelihood that those residing near public transit are more prone than their counterparts to consider UAM as a feasible alternative to existing public transportation, and therefore care more about its performance and ease of use once it becomes available.

5.1. Limitations and future research

There are several limitations that can be considered in future research. First, this study does not account for the affordability of UAM. Consulting firms estimate that a typical air taxi concept or eVTOL might cost as little as $30 per trip, with prices potentially rising to several hundred dollars depending on service characteristics such as shared, on-demand, or intraurban operations (Goyal et al., 2018). The proposed UAM concept ranges from business-oriented, on-demand aviation services to semi-scheduled and scheduled services, which could appeal to a broad range of travelers (Cohen and Shaheen, 2021). Given the uncertainty surrounding the development and implementation of UAM, future research should investigate the varied public responses to different UAM concepts and scenarios. Second, this study could not consider how individuals might respond to potential interventions designed to address the acceptance challenges of UAM. Service providers and regulatory authorities may consider a range of interventions to ensure safety and operational security while minimizing environmental and land use impacts (Cohen et al., 2021). Anticipated interventions could effectively alleviate barriers to societal acceptance of UAM and accelerate its initial diffusion among the public. Identifying efficient intervention strategies will significantly enhance our understanding of how governments can support disruptive transportation technologies in gaining broader community acceptance. Third, the conceptual framework could be further enriched by incorporating contextual factors critical to promoting UAM. Scaled UAM operations may require physical infrastructure, such as a network of vertiports and fueling stations, and information technology to facilitate communication with potential travelers and other transportation modes. As UAM evolves and expands, the services will become more integrated into the existing transportation system and encounter new challenges related to the broader built environment. While the current study identified several facilitating conditions, they were limited to psychological aspects of individual travelers and failed to reflect the built environment they inhabit. Future research can contribute to the literature by considering the role of societal infrastructure in UAM usage intention.

Methodologically, this study could not consider how attitudes and preferences for UAM change over time. Longitudinal research would reveal time-varying associations between attitudinal factors and intention to use and provide a clearer picture of how individuals respond to the initial concept of UAM. Also noteworthy is that the regional scope of this study was confined to urban environments. Although this study included a measurement item to represent UAM's compatibility with other urban mobility modes, it did not delve into the specific aspects of UAM as urban transportation. Subsequent research needs to emphasize the urban context of UAM to clarify its operational concept as low-altitude air mobility in urban and suburban areas. Lastly, there might be unobserved factors influencing the intention to use UAM. While the selection of predictors was thoughtfully guided by theory and literature, it is possible that certain predictors of adoption intention were unobserved and left out of the model (e.g., personality, propensity to trust). Future research should identify these unobserved confounders and confirm the robustness of the findings.

5.2. Conclusions

The objective of this study was to identify psychological and attitudinal factors predicting behavioral intention to adopt UAM. Using data from 1168 Korean adults living in metropolitan areas, an integrated framework of technology adoption and initial trust was estimated and validated. Results showed that social influence and initial trust were significantly related to usage intention, which, along with performance expectancy, facilitating conditions, and structural assurance, leads to positive attitudes toward UAM. Initial trust was dependent on all six constructs considered, but most strongly on structural assurance. These findings highlight the role of institutional safety nets, such as regulations and legal resources, in increasing initial trust and promoting the initial diffusion of UAM. They also provide guidance for designing interventions to improve public acceptance of UAM.

Table A1
Measurement items.

Constructs	Items	Measure	References	M	SD
Performance expectancy	PE1	UAM would help me reach my destination in an efficient manner	Kopplin et al. (2021)	5.09	1.29
	PE2	I would comfortably take rides on an UAM for my daily trip	Kopplin et al. (2021)	4.66	1.42
	PE3	UAM would help increase my personal mobility	Kopplin et al. (2021)	5.01	1.38
	PE4	Using UAM would improve road safety	Leicht et al. (2018)	4.74	1.42
Effort expectancy	EE1	EE1. Learning to ride UAM will not require any prerequisite	Kopplin et al. (2021)	3.78	1.48
	EE2	EE2. Learning to ride UAM will be easy for me	Kopplin et al. (2021)	4.76	1.31
	EE3	EE3. Using UAM will be clear and understandable	Kopplin et al. (2021)	4.61	1.31
Social influence	SI1	Using UAM will be perceived in a positive manner	Kopplin et al. (2021)	4.82	1.28
	SI2	People who are important to me would think that I should use UAM	Zhang et al. (2020), Kopplin et al. (2021)	4.22	1.43
	SI3	People whose opinion I value would think that I should use UAM	Zhang et al. (2020), Kopplin et al. (2021)	4.15	1.43
	SI4	I think I am more likely to use UAM if my friends or family used it	Zhang et al. (2020)	4.81	1.36
Facilitating conditions	FC1	I have the economic resources necessary to use UAM	Venkatesh et al. (2003)	3.88	1.41
	FC2	I have the knowledge necessary to use UAM	Venkatesh et al. (2003)	3.83	1.43
	FC3	UAM will be compatible with other transportations modes I use	Venkatesh et al. (2003)	4.58	1.35
Environmental concerns	EC1	UAM will help reducing traffic congestion	Kopplin et al. (2021)	5.10	1.25
	EC2	UAM will help protect the environment	Kopplin et al. (2021)	4.40	1.44
	EC3	Using UAM would fit my environmental concerns	Kopplin et al. (2021)	4.21	1.35
Perceived safety	PS1	I believe that using UAM is dangerous*	Kopplin et al. (2021)	3.55	1.23
	PS2	I am anxious of the potential safety issue associated with UAM*	Kopplin et al. (2021)	3.33	1.24
	PS3	I am afraid of having an accident when using UAM*	Kopplin et al. (2021)	3.28	1.28
Structural assurance	SA1	I would feel safe using UAM because the service provider will ensure its safety	Afshan and Sharif (2016)	3.83	1.40
	SA2	The UAM operator would guarantee against any losses that might occur during the use of UAM	Kim and Prabhakar (2004)	4.14	1.51
	SA3	The UAM operator would develop clearly stated accident handling and compensation policies	Kim and Prabhakar (2004)	4.43	1.45
Familiarity	FM1	I am familiar with UAM through magazines, newspaper, TV, or social media	Afshan and Sharif (2016)	3.58	1.65
	FM2	I am familiar with UAM through its website	Afshan and Sharif (2016)	3.27	1.61
	FM3	I am familiar with UAM through personal interactions	Afshan and Sharif (2016)	3.10	1.62
Initial trust	IT1	UAM seems dependable	Afshan and Sharif (2016)	4.05	1.34
	IT2	UAM seems secure	Afshan and Sharif (2016)	3.94	1.40
	IT3	UAM seems reliable	Afshan and Sharif (2016)	4.11	1.34
Intention to use	IU1	I predict I would use UAM in the future	Zhang et al. (2020)	4.65	1.33
	IU2	I intend to use UAM in the future	Venkatesh et al. (2003), Zhang et al. (2020)	4.71	1.36
	IU3	I would pay more for an UAM than for a conventional mode of transportation	Leicht et al. (2018)	3.96	1.51

Notes: M, mean; SD, standard deviation. * is reverse coded.

Table A2
Total effects.

Factor	Total effect on intention to use
Performance expectancy	0.23[a]
Effort expectancy	0.004[a]
Social influence	0.35[a]
Facilitating conditions	0.19
Environmental concerns	0.02
Initial trust	0.34
Perceived safety	0.05[a]
Structural assurance	0.15[a]
Familiarity	0.05[a]

Note: [a] denotes the sum of direct and indirect effects.

CRediT authorship contribution statement

Changju Lee: Conceptualization, Methodology, Validation, Investigation, Resources, Writing – original draft, Writing – review & editing, Supervision. **Bumjoon Bae:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing – original draft, Writing – review & editing, Project administration. **Yu Lim Lee:** Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – review & editing. **Tae-Young Pak:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Project administration.

Data availability

The data that has been used is confidential.

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