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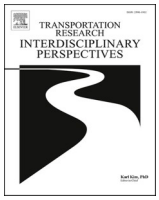

Will air taxis extend public transportation? A scenario-based approach on user acceptance in different urban settings

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ABSTRACT

Increasing urbanization has led to rising mobility and infrastructural challenges for cities and surrounding areas. Electrical vertical takeoff and landing aircrafts, also known as air taxis, enable the use of a new dimension, the skyscape. Air taxis provide a local, emission-free transport option and an infrastructure-conserving solution for the public transportation sector. While the technical implementation has already proved itself, user awareness is not yet widespread. Additionally, essential feasibility factors for public use, such as price, have received scant attention. Since user acceptance is necessary for successful implementation, and willingness to pay is another important indicator for future infrastructure planning, this study aims to investigate different urban transport scenarios. Within the framework of the study, societal acceptance, individual intention to use, and willingness to pay were investigated. Data collection took place in the greater Dresden area in Germany, with a final sample of 1,074 participants. The resulting data suggest an overall limited intention to use and societal acceptance. The scenario analysis revealed a "limousine-like" dial-a-ride scenario as a potential successful path to follow, in which a transitional path with initial dial-a-ride services and growing scheduled services over time is regarded as the most probable. Consumers' willingness to pay was highest for the limousine scenario. Based on this research, governmental authorities and industry stakeholders may consider the findings to develop a human-centered approach for future mobility and ensure successful implementation in the mobility networks of the future.

1. Introduction

Increasing urbanization has led to a dense population in metropolitan areas and increasing challenges regarding mobility and infrastructure (Puppim de Oliveira, 2019). Shared mobility services could provide a suitable solution, requiring lower demand for parking options, no vehicle ownership, and an emission-saving mobility approach (Baptista et al., 2014). Autonomous transportation may offer a safe and comfortable mobility experience, and vehicle manufacturers increasingly focus on such technologies (Bimbraw, 2015). This trend has led to research growth in shared mobility and highlighted a dimension that has received little attention thus far in public transport: the third dimension of space (al Haddad et al., 2020). Urban air mobility (UAM) has emerged as a new category for aerial vehicles and shared mobility concepts.

Electric vertical takeoff and landing (eVTOL) aircrafts, also known as air taxis, are considered the vehicle foundation of UAM, offering a local, emission-free, and infrastructure-conserving mode of transportation (Planing & Pinar, 2019). In recent years, air taxis have demonstrated their growing technical maturity and at least initial capabilities through various demonstration flights. EVTOLs rely on fixed wings for dynamic lift production during horizontal flight segments, leading to higher aerodynamic efficiency and, therefore, a larger achievable range. Multicopter eVTOL concepts are similar to conventional helicopters but feature multiple horizontally mounted rotors. This leads to a far more limited operational range due to lower aerodynamic efficiency, making it a suitable technology for urban areas. (Bruehl et al., 2021).

According to Bruehl et al. (2021), the maximum range of an eVTOL aircraft is approximately 115 km (vectored thrust), including a safety range buffer of 20 %. Electric propulsion leads to specific infrastructure requirements for recharging the battery in due time. Both expected required battery capacity beyond 100 kWh and currently achievable charging speeds up to 350 kW still maintain the charging process on the

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critical time path along an eVTOL turnaround. Physical battery replacement concepts, as speculated in the automotive sector, may become an option to reduce charging times, but these may come with a complex, cost-intensive infrastructure. As such, this excurse is doubtful for the time being.

Despite the technical and operational challenges associated with eVTOL aircraft, the economic success of air taxis will depend on potential users' acceptance of the service (Yedavalli & Mooberry, 2018). To ensure the successful implementation of technologies, taking the perspectives and needs of the public into account is crucial (Venkatesh et al., 2012). Thus far, limited research is available on users' perspectives in different urban scenarios, especially regarding pricing and the willingness to pay for this service (al Haddad et al., 2020). To successfully integrate air taxis into the public transportation network, potential users must be willing to accept the technology and intend to use it regularly. Previous research by Ploetner et al. (2020) demonstrates that air taxi demand depends significantly on the use case and the selling price. While there are approaches simulating air taxi demand using machine learning algorithms and statistical modeling (Rajendran et al., 2021; Winter et al., 2020), little fieldwork has been conducted.

Therefore, the present study aims to investigate the willingness to use and pay for air taxis in various urban scenarios, developed through an interdisciplinary research background, and offers a first approximation for regular trips for each scenario. The implications derived from the present study are intended to point the way for policymakers and future research.

2. Theoretical background

2.1. Intention to use air taxis

Established theories in predicting human behavior, such as the theory of planned behavior, state that behavioral intentions immediately determine behavior (Ajzen, 1985). Thus far, results of previous research on attitudes and intentions toward air taxis have been inconclusive. In a telephone survey by Dannenberger et al. (2020), only 18 % of the participants reported an intention to use air taxis in the future. By contrast, in a survey on the initial reaction of respondents toward air taxis by Yedavalli et al. (2018), 44.5 % of the respondents expressed support or even strong support for air taxis. Similarly, a quantitative survey conducted by the U.S. National Aeronautics and Space Administration (NASA), investigating 2,000 participants from five urban areas, found that approximately half of the respondents would be comfortable adopting air taxis (Hasan S, 2019). This is supported by a virtual reality simulation conducted by Janotta and Hogreve (2021), in which 65 % of the participants reported an intention to use air taxis in the future.

In summary, the research on air taxi acceptance reveals mixed results, which is also reflected in a literature review on UAM by Straubinger et al. (2020). This ambivalence in attitudes and intentions is also known in other areas of transportation, such as autonomous driving. In an empirical investigation of consumers' intention toward autonomous driving, participants showed ambivalence in the intention to use, with perceived usefulness having the strongest impact on their intention (Panagiotopoulos & Dimitrakopoulos, 2018).

Therefore, further research is needed to assess the potential for air taxis better. Especially considering the factor of perceived usefulness, it seems reasonable to investigate different use cases, either as part of public transport in densely populated areas or as dial-a-ride upon request in both urban and rural areas.

2.2. Societal acceptance

An essential factor in the integration of air taxis into a city's public transport system is the impact it has on the city's inhabitants, for example, by installing landing sites close to their homes. This should be desirable, as trip times would be reduced and comfort and attractiveness would be improved. According to research, public acceptance of drones is restricted by worries about visual and acoustic pollution (Boucher, 2016; Eißfeldt et al., 2020). A study conducted by Yedavalli and Mooberry arrived at similar findings, with around half of the participants expressing concerns about the noise generated by drones and the visual pollution caused by their presence in the skyline (Yedavalli & Mooberry, 2018).

Studies on the acceptance of air taxis have also indicated that residents are concerned about factors on a societal level, such as noise levels and visual impact disturbance of the cityscape, regardless of whether manufacturers guarantee low noise levels (Boelens, 2019). Noise levels have been identified in many studies as a fundamental concern of residents (al Haddad et al., 2020; Goyal et al., 2021; Hasan S, 2019; Straubinger et al., 2020). Furthermore, the disturbance of the cityscape by visual pollution is also considered a severe problem, as well as the impact that air taxis may have on the environment (al Haddad et al., 2020; Goyal et al., 2021; Hasan S, 2019). However, contrary to the restricted societal acceptance in aforementioned studies, a field study conducted by Planing and Pinar allows for a more positive perspective, with 84 % of the respondents indicating that they would support the offering of an air taxi service in a German metropolitan area (Planing & Pinar, 2019). These rather contradictory results may be explained by the fact that the study by Planing and Pinar was conducted as part of a field study following a demonstration flight of an air taxi prototype. This consideration is supported by a study by Stolz and Laudien, who found that acceptance and attitudes toward drone flights turned more positive after participants experienced a drone flight (Stolz & Laudien, 2022). The mode of representation of a new technology might influence societal acceptance and the potential use case. In a study on autonomous driving, acceptance was higher for a public transport use case than for individual use (Pakusch & Bossauer, 2017). How the potential acceptance of air taxis differs in potential future scenarios has yet to be investigated.

2.3. Willingness to pay

Next to the intention to use air taxis, the present study investigates the consumer's willingness to pay for this technology. Unlike the expected price of a technology, which is more about external perceptions, the willingness to pay denotes an intrinsic valuation of the product/service (Thaler, 1985). Willingness to pay is utilized in various areas, such as pricing strategy, welfare economics, and cost-benefit analysis (Carson & Groves, 2007).

The users' willingness to pay for air taxi service will be crucial to the success or failure of its integration into today's public transportation network. Thus far, this aspect has been addressed in only a few studies, and a NASA study identified the limited willingness to pay as a major barrier to UAM (Hasan S, 2019). An analysis by Goyal et al. (2021) demonstrated that the demand for UAM is limited by the user's willingness to pay for routes with a journey time of less than 45 min compared to longer journeys. Moreover, Kreimeier et al. (2018) conducted an economic assessment of UAM on-demand concepts in Germany and found that air taxi demand is susceptible to price aspects. In particular, the study found a willingness to pay only €0.50– €0.80 per kilometer traveled, which presents a rather unrealistic price point.

2.4. Study aim

The present study, conducted in a German metropolitan area, integrates diverse research perspectives across different urban transport scenarios: societal acceptance, intention to use, and willingness to pay. This approach addresses the need for more comprehensive studies in the UAM domain by combining divergent research perspectives to illuminate the complex interplay between technological innovation and societal expectations. To date, no studies have examined air taxis' demand and price aspects in different usage scenarios from the user perspective. Since it is still unclear how airtaxis will be integrated into the urban

transport system, comparing scenarios can deliver hands-on insights for a demand-based and feasibility-oriented enhancement of this emerging technology.

Through this exploration, the present paper fills an existing research gap and offers valuable data for potential UAM integration into public transport networks and city infrastructures. By uncovering users' preferred pricing ranges, the present study contributes to shaping sustainable and user-centric UAM models that align with the evolving needs of urban mobility.

3. Method

3.1. Study design

The study was conducted in a quantitative online survey format, aiming for a representative sample of the target population in a German metropolitan area. The study focused on the Dresden area. Therefore, data collection took place in the greater metropolitan area of that city. QR codes leading to the online survey were distributed to passersby at various locations within the city and on the outskirts to ensure that participants from different city areas were queried.

3.2. Scenario development

For the present study, the authors have decided to emphasize external validity over internal validity. Internal validity pertains to the degree to which a study can claim cause-and-effect relationships free from confounding variables. A laboratory setting, while offering greater control over potential confounders, often does so at the expense of external validity (Bo & Galiani, 2021). By staging more contrived scenarios, researchers risk crafting a study so far removed from the textures of real life that its findings become sterile and inapplicable outside the laboratory's confines. By focusing on external validity, we aim to produce results that practitioners, policymakers, and stakeholders can apply in practical contexts.

Consequently, we selected three scenarios meticulously drawn from real-life contexts. These scenarios represent the multifaceted experiences individuals encounter, thereby ensuring the relevance and applicability of our findings. The scenarios were chosen based on the target population's lives, the severity of their implications, and the utility they offer for intervention development. One central factor that was kept constant among the scenarios was that the air taxi covers the distance about 30 % faster than a car, conventional taxi, or bus and that there is less risk of delay due to external influences, such as congestion.

In Scenario 1, we explored the utilization of air taxis as an individual transportation choice for a special occasion. Specifically, we studied the application for a trip to an opera performance ("limousine case"). This scenario was chosen since the Dresden opera is among the most well-known operas in Europa and the most popular tourist location in the area. Scenario 2 examined an individual route from the respondent's home to the Postplatz, a public square in the city center of Dresden ("taxi case"). Since the respondents reported their postal code, approximate distances to the location could be calculated for each scenario. In Scenario 3, the use of an air taxi as part of a fixed-schedule network was presented for a mid-distance flight in the larger city area ("bus case").

3.3. Societal acceptance

To assess societal acceptance, participants were asked whether they would like to see air taxis in Dresden in the future, detached from their individual willingness to use them. As these attitudes are commonly found in technology acceptance and use but are rather difficult to measure directly, they were assessed through 5-point Likert scale agreement statements (Likert, 1932), ranging from 1 = "definitely not" to 5 = "definitely".

3.4. Intention to use

Intention to use was assessed at four points during the survey. First, to test the basal intention to use UAM following Fishbein and Ajzen (2010), participants were asked how likely it is, in general, that they would use an air taxi in the future. A Likert scale from 1 = "not at all likely" to 5 = "extremely likely" was applied. Subsequently, the participants were presented with the above-mentioned scenarios and rated their intention to use them for each specific scenario.

3.5. Willingness to pay

The willingness to pay was determined in all three scenarios using the price sensitivity measurement (PSM) according to Van Westendorp (1976). The PSM is a research method to understand consumers' price perceptions. It generates four price points: the point of marginal cheapness (PMC), the point of marginal expensiveness (PME), the optimum pricing point (OPP), and the indifference pricing point (IPP). This method has two key results: the OPP and an acceptable price range. The OPP is the price at which equal proportions of consumers consider the product good value and too expensive. It is seen as the ideal price for a product, balancing price and perceived value. The acceptable price range is the range between the PMC and the PME and is the spectrum of prices that consumers generally find reasonable.

In essence, the OPP is a single ideal price, while the acceptable price range is a spectrum of generally acceptable prices to consumers. Since the pricing method was applied to all scenarios, only the OPP was determined in the present research to keep the questionnaire an acceptable length.

3.6. Additional variables

Sociodemographic variables included in the questionnaire comprised gender, age, occupation, postal code, and monthly available household budget. Previous research on other emerging technologies has demonstrated that attitudes toward new technologies change significantly when users gather information about them (Momani & Jamous, 2017). Therefore, the survey included an initial question on the current knowledge of air taxis. Prior knowledge was measured on a 5-point Likert scale ranging from "not good at all" to "very good.".

3.7. Data analysis

In the present study, we opted to employ a more descriptive rather than a more complex approach, such as structural equation modeling (SEM). The main reason for this is that we aimed to present our results in a way that is widely recognized across various disciplines, ensuring that our findings are accessible to a broader audience. Additionally, our research objectives primarily focused on understanding direct relationships between predictor variables and the outcome without a strong theoretical underpinning necessitating the assessment of latent constructs or multiple intertwined pathways, which SEM is particularly suited for. Given our dataset characteristics and the scope of our research questions, we determined that a more descriptive, direct analysis of our results would ensure more robust and meaningful insights while also ensuring methodological appropriateness and clarity in interpretation.

3.8. Overall research process

The overall research process is presented in Fig. 1.

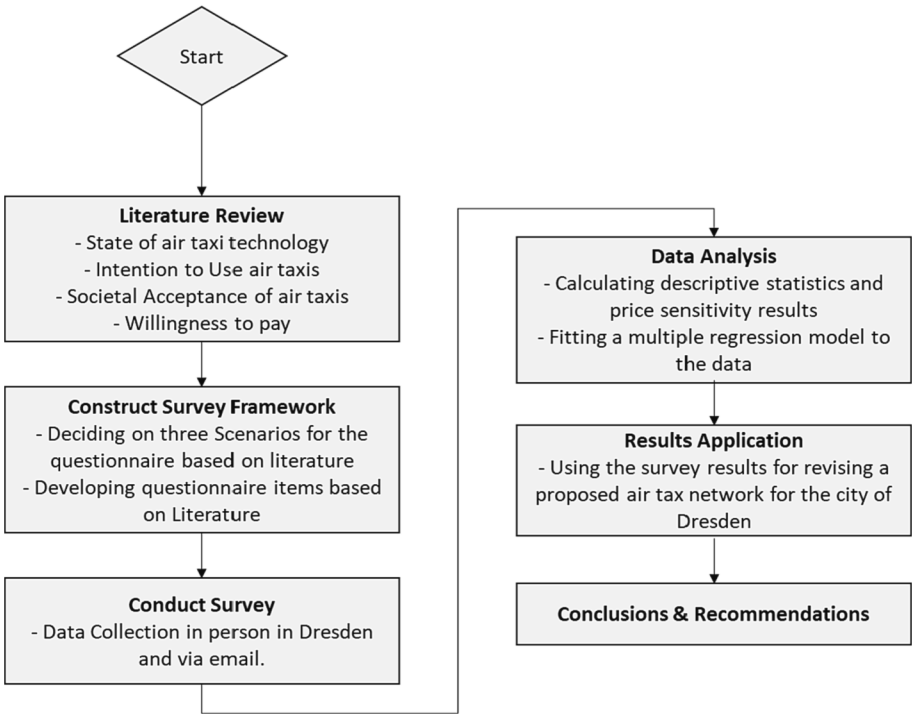

Fig. 1. Research Methodology.

4. Results

4.1. Descriptive analyses

The original sample consisted of 1,123 participants. However, only participants without missing values on the relevant variables were considered in the statistical analyses, resulting in 1,074 participants. Participants' ages ranged from 7 to 74 years ($M_{age} = 38.4$; $SD_{age} = 14.7$) and 59.8 % were male. 73.7 % were employed, and people from a broad range of income levels were interviewed. Compared to the German population, the sample had a higher share of male participants, was slightly younger, and had a notably higher level of employment (Destatis, 2020).Fig. 2.

Knowledge about air taxis was rather limited in the sample, with approximately 45 % of respondents indicating no or very little prior knowledge about air taxis. An overview of the sample characteristics is provided in Table 1.

4.2. Societal acceptance and individual intention to use

4.2.1. Societal acceptance

Results indicated a restrained societal acceptance for air taxis among this sample in the Dresden greater metropolitan area ($M_{\text{societal acceptance}} = 2.6$; $SD_{\text{societal acceptance}} = 1.4$). Approximately half of the respondents indicated they do not want air taxis in Dresden in the future (see Table 2). There was no correlation between the age of the respondents and the societal acceptance of air taxis, and prior knowledge also had no significant influence on the respondents' acceptance (see Table 3).

4.2.2. Intention to use

Results indicated a restrained intention to use air taxis among this sample ($M_{\text{IntentionToUse}} = 2.48$; $SD_{\text{IntentionToUse}} = 1.37$), with most respondents stating that it is not likely they will use air taxis in the future (see Table 4). There was no correlation between the age of the respondents and the intention to use. Prior knowledge also had no significant influence on the respondents' intention to use such a service. However, there was a strong positive correlation between societal acceptance and the individual intention of the respondents to use the

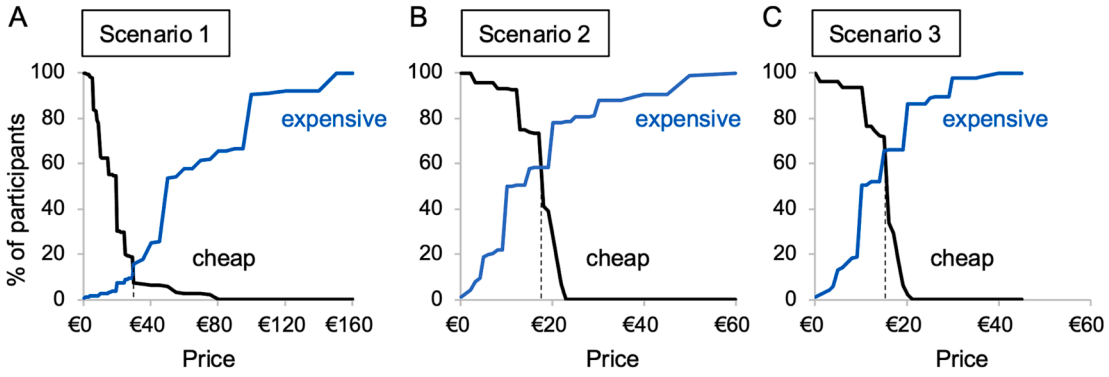

Fig. 2. Willingness to pay per scenario. Note: Dashed vertical lines locate the crossing point of the cumulative functions of cheap and expensive price points, thus representing the Optimal Pricing Point according to the PSM (van Westendorp, 1976).

Table 1
Summary of sample characteristics.

Gender	Female	38.6 %
	Male	59.8 %
	Diverse	01.6 %
Age	≤ 20	03.2 %
	21–30	32.6 %
	31–40	25.5 %
	41–50	15.2 %
	51–60	10.3 %
	61–70	05.0 %
	≥ 70	04.0 %
Monthly budget	≤ €1.500	14.3 %
	€1,501 to €2,500	20.0 %
	€2,501 to €3,500	24.9 %
	€3,501 to €4,500	14.9 %
	€4,501 to €5,500	07.9 %
	≥ €5,501	09.6 %
	No answer	08.3 %
Occupation	Pupil	01.9 %
	Student	13.2 %
	Apprentice	02.9 %
	Employed	73.7 %
	Retired	05.6 %
	Seeking a job	01.4 %
	Other	*01.3 %*
Prior knowledge about air taxis	No knowledge	36.7 %
	Limited knowledge	18.6 %
	Neither	26.3 %
	Good knowledge	12.0 %
	Very good knowledge	6.4 %

Total sample (n = 1,074).

service (see Table 3); in other words, participants who would like to see air taxis in Dresden in the future would also be more likely to use them.

4.3. Scenario analysis

For the following three scenarios, both the intention to use and the willingness to pay were investigated.

4.3.1. Intention to use

The intention to use air taxis in the future was highest in the limousine scenario ($M_{Bu\ s} = 2.56$; $SD_{Bus} = 1.4$), and a similar intention emerged for the bus scenario ($M_{Bus} = 2.44$; $SD_{Bus} = 1.72$). In the taxi scenario, the intention to use was lower ($M_{taxi} = 1.72$; $SD_{taxi} = 1.11$) (see Table 4).

A one-way analysis of variance (ANOVA) was conducted to determine whether there is a significant difference in the intention to use among the three scenarios. Homogeneity of variances between the groups was violated (Levene's test, $p < .001$), therefore, the Welch correction was applied. The one-way ANOVA revealed a statistically significant difference in the intention to use between at least two scenarios, $F(2;1,360) = 98.8$; $p < .001$.

The Games–Howell post hoc analysis revealed a significant difference ($p < .001$) in the intention to use air taxis between the limousine case and the taxi case, as well as between the taxi case and the bus case. No significant difference was found between the limousine and the bus scenarios: The intention to use was lower, on average, in the taxi scenario than in the limousine scenario ($Mean_{Diff} = 0.838$) and the bus scenario ($Mean_{Diff} = 0.726$).

4.3.2. Willingness to pay

In this study, a modified version of the PSM method was employed, focusing on the OPP rather than on the acceptable price range, as described in the methodology section (3.5). Henceforth, the OPP is the participants' willingness to pay for each scenario. To avoid distorting the results, extreme values were identified using an outlier analysis and were excluded from the scenario analysis.

For the limousine case, the computed willingness to pay is €30. In the second scenario, the taxi case, participants' willingness to pay is €15, and for the bus case, it is €18.

5. Application

The outcomes of the investigation are applied in the SmartFly research project (funded by Simul + InnovationHub, contracted to TU Dresden), which studies the basic feasibility of incorporating air taxis in the state of Saxony's mobility system using a minimally invasive approach. This refers to the integration of air taxis into existing transportation infrastructures—airports, parking garages, and parking lots—by retrofitting these spaces with the necessary equipment for air taxi and passenger handling rather than constructing new spaces in urban areas (Bruehl et al., 2022).

Since the SmartFly project focuses on a specific regional area (the Federal State of Saxony), obtaining relevant data about social acceptance is imperative. Consequently, the outcomes of this acceptance study aid in shaping the later application of the SmartFly research project, providing insights into the local population's sentiments regarding this novel transportation technology and providing a baseline for an economic assessment.

6. Discussion

This study aims to gain detailed insights into the intention to use air taxis and their societal acceptance within urban environments under various application scenarios. The research also seeks to identify and compare the users' willingness to pay for such services in various scenarios. In general, the data suggest that air taxis have not yet gained widespread acceptance, as approximately half of the respondents are not open to the idea of using them (see Table 4), and this aligns with the findings of previous studies (Dannenberger et al., 2020; Hasan S, 2019).

The limited experience with air taxis, as they are not yet part of the transportation system, might contribute to the restricted acceptance of participants. This phenomenon is also observed in highly automated driving, where early experience in a driving simulator has significantly increased acceptance rates and trust (Hartwich et al., 2019). In this regard, a field study by Planing and Pinar on air taxi acceptance following a demonstration flight is worth mentioning. The authors reported exceptionally high acceptance rates after participants visually experienced urban air mobility (Planing & Pinar, 2019). Similarly, Stolz and Laudien found decreased concerns and increased acceptance after a

Table 2
Summary of Societal Acceptance.

	1 "Certainly Not"	2	3	4	5 "Definitely"	Mean	SD
Would you like Dresden to have air taxis in the future?	29.3 %	19.9 %	25.2 %	13.3 %	12.4 %	2.6	1.4

Table 3
Variable relations.

	Societal acceptance		Intention to use	
	r	*p*	*r*	*p*
Age	−0.009	> 0.05	−0.055	> 0.05
Prior knowledge	−0.025	> 0.05	0.054	> 0.05
Societal acceptance	–	–	0.791	0.01

virtual reality simulation of urban air mobility (Stolz & Laudien, 2022). It, therefore, appears that personal direct experience with air taxis would likely reduce prejudices and increase acceptance of using air taxis.

Our scenario-based approach also offered a more nuanced analysis. It reveals a greater inclination among respondents to use air taxis for special occasions compared to everyday commuting scenarios, indicating that people are more likely to consider air taxis for unique events rather than as a daily mode of transportation. This finding aligns with a choice modeling approach for urban air mobility by Fu et al., which found that at the market entry stage, potential travelers may favor UAM, particularly for performing non-commuting trips (Fu et al., 2019). Michelmann et al. (2020) also concluded that significant time savings would be necessary for UAM to become attractive for short, daily commutes, particularly when there is direct competition from existing public transport networks.

Our study's findings suggest that prior knowledge does not significantly affect societal acceptance or the intention to use air taxis (see Table 3). This deviates from prior research in this field, which asserts that pre-existing knowledge tends to boost social acceptance and usage intentions (Momani & Jamous, 2017). One possible reason for this discrepancy could be our survey group's inherently low acceptance level of air taxis and the differentiation of prior knowledge and experience.

Furthermore, our study reveals a robust positive correlation between social acceptance and the intention to use air taxis (see Table 3). People are more inclined to welcome the integration of air taxis into their cities if they perceive it as a technology they would use personally in the future. Therefore, it is imperative for stakeholders pushing for the development of air taxi infrastructure to portray this technology as an accessible mobility option for all. Framing air taxis as a viable transportation alternative for the general population will be vital in gaining public support for this emerging mode of travel.

Concerning the willingness to pay, the first scenario (limousine case) saw the highest acceptable price at €30. In contrast, the acceptable price was lowest in the second scenario (taxi case), with an estimate of €15 per flight determined using PSM. The acceptable price for regular use (bus case, Scenario 3) was €18 per flight. These results demonstrate that higher price points will be more achievable for special-occasion flights than regular flights. Interestingly, however, there is little difference in the acceptable price between the taxi and the bus scenarios. This suggests that people may perceive air taxis similarly to conventional taxis, thereby mentally associating them with the typical pricing structure of taxis rather than that of public transport.

An important question remains: Can these prices compete with current market prices for comparable means of transport? A comparable mode of transport for the first scenario, the limousine case for a special occasion, would be a taxi for the route described in the scenario. The current market price here is approximately €160 and, thus, differs significantly from the acceptable price in the first scenario (€30). In the second scenario, the taxi case, routes from the test persons' individual homes to the central post office square in Dresden were investigated. Since the distances vary, a market price comparison is not possible. For the third scenario, the bus case, a comparable route by bus would cost €9 (Dresdner Verkehrsbetriebe, 2023), so the acceptable price among the current sample, €18, exceeds the current market price. However, it is questionable whether the price expectations of potential users for the individual ride scenarios can be met, especially upon market entry, and allow for the cost-covering feasibility of air taxis in public transport scenarios. This finding is also supported by previous research that identifies willingness to pay as a major barrier to the implementation of air taxis in public spaces (Hasan, 2019). While the present sample displayed generally low acceptance and prior knowledge, this might be a possible explanation.

7. Limitations and outlook for future research

The present study is based on data collection at several public places in the greater Dresden area. Although a broad picture of society could thus be addressed, the sample presented here deviates from the overall German population both demographically and psychographically. This limits the external validity of our results. However, due to the collection of data at various highly frequented locations, the expected bias is rather small. Also, the choice of a sample in the German metropolitan might have impacted the results. When taking cultural differences in focus, German culture tends to be high in uncertainty avoidance, which could have influenced the acceptance of a rather unfamiliar technology (Hofstede, 2023).

To capture the opinions of as many respondents as possible, the questionnaire was kept short, allowing only a brief definition and visual representation of air taxis. Respondents also were unable to ask questions about technology. This allowed for a standardized survey process without bias from surveyors but also may have led to ambiguities in understanding the potential of air taxis and, as such, the responses provided. Consequently, future studies should include a realistic demonstration of the technology (e.g., demonstration flight, virtual reality representation). Moreover, further research is necessary to gain a deeper understanding of acceptance and the intention to use. Another limitation is the usage and choice of scenarios. The proximity of these scenarios to the lived experiences of some participants introduces potential confounds, as individual differences may interact with scenario characteristics, influencing responses in ways that are not entirely attributable to the scenarios themselves. Future research should thus extend the scope of the scenarios and could also employ more restricted laboratory settings to isolate the effects more clearly.

Furthermore, the overarching challenge of the generally low WTP across scenarios necessitates a deeper examination of the factors influencing this reluctance. Future studies should investigate the reasons behind the hesitancy to pay higher prices for air taxi services, exploring potential barriers such as perceived value, economic considerations, and competing alternatives. The PSM-light method was used to determine price willingness in this study. Although this is a common and valid

Table 4
Summary of intention to use.

	1 "Not at all likely"	2	3	4	5 "Extremely likely"	Mean	SD
General (prior to scenarios)	33.3 %	21.3 %	20.8 %	13.1 %	11.4 %	2.48	1.37
Scenario 1: limousine case	34.2 %	16.0 %	22.1 %	17.9 %	9.9 %	2.56	1.40
Scenario 2: taxi case	57.4 %	19.8 %	12.2 %	5,7%	4.9 %	1.72	1.11
Scenario 3: bus case	32.6 %	22.1 %	23.8 %	14.8 %	6.8 %	2.44	1.27

method for determining price willingness, it should be noted that it simplifies reality. In a reassessment of the PSM approach, it was found that the approach slightly overestimates the actual price willingness (Kraemer et al., 2017). When interpreting the results, it should be noted that the true acceptable price may be lower than the calculated price willingness.

Nevertheless, we believe the data gathered in this study may be of importance for further research into this rising technology.

8. Conclusion and industry implications

In this study, a survey with a large sample size of 1,074 participants was conducted to examine attitudes and willingness to pay for air taxi services in the Dresden area across three scenarios, including public transport for daily commutes, on-demand taxi services, and a limousine-like concept for special occasions. The survey results indicate that approximately half of the sample has limited intention to use and societal acceptance of air taxis. To address this, targeted awareness campaigns and educational initiatives may be necessary. However, the scenario analysis reveals that intention to use and societal acceptance are higher in the case of the limousine-like concept for special occasions compared to the other scenarios, suggesting a potential niche market. Industry stakeholders may benefit from exploring and capitalizing on this niche by tailoring marketing strategies and service offerings to cater to users seeking air taxi services for unique events. After successfully conquering this niche, air taxis may progress to different scenarios as users gain more experience and thus increasingly accept the idea of air taxis as part of an urban transport system.

Air taxis have the potential to extend to public transport scenarios, unlocking broader possibilities for integration into urban mobility systems. Initially, air taxi operations should be concentrated on individual connections where substantial demand is anticipated rather than on a broader network scale. The WTP for individual limousine-like concepts is also the highest at 30 euros per flight, suggesting a potential niche market despite limited firsthand experience. The disparity in WTP across scenarios raises questions about economic feasibility and highlights the need for careful consideration of user expectations and sustainable service provision by policymakers and industry planners. Future studies should explore barriers to higher prices for air taxi services, such as perceived value and competing alternatives. Also, future research should examine a broader range of participants, possibly taking various countries and cultures into account.

In sum, this study provides insights into individual attitudes and WTP, as well as strategic directions for industry and policymakers to successfully integrate air taxis into urban transport systems. Most importantly, it provides a basic roadmap for the implementation of air taxis.

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CRediT authorship contribution statement

Laura Riza: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Robert Bruehl:** Conceptualization, Funding acquisition, Methodology, Project administration, Resources. **Hartmut Fricke:** Funding acquisition, Project administration, Writing – review & editing. **Patrick Planing:** Conceptualization, Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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