
Management of Consumers Embraces Drone Delivery

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Abstract: Over the past few years, significant progress has been made in the field of drone technology, leading to its implementation and transformation in various industries. As technology has improved, drones have become increasingly adaptable to numerous tasks, such as delivering packages right to customers' front doors. As the need for swift and reliable delivery options increases, drone delivery is an option that businesses and consumers alike should consider. This paper studies the underlying factors that influence consumers' intentions to adopt drone delivery services in Portugal. A quantitative methodology was used, and 155 responses were collected from Portuguese citizens. The findings indicate that perceived usefulness, perceived privacy risk, and attitudes serve as key predictors of user behavioural intentions among individuals in Portugal. Moreover, they highlight that perceived usefulness and perceived privacy risks exert an indirect influence on behavioural intentions through attitudes. Consequently, the comprehensive analysis underscores the significant impact of perceived usefulness on behavioural intentions, with attitudes and perceived privacy risks closely behind. The study uncovers new insights into consumer adoption of drone delivery services. This finding suggests that promoting the advantages of drone technology, emphasising its usefulness, efficiency, and convenience in advertising, can positively impact consumer perception and willingness to adopt. Furthermore, this study indicates that addressing potential consumer concerns about drone delivery, such as privacy, safety, and reliability, is essential. Clear communication about the measures taken to ensure these aspects can mitigate apprehensions and enhance acceptance. Governments play a crucial role in regulating drones to increase trust, protect users, and promote a favourable environment for adoption. Public awareness campaigns led by governments can educate citizens about the benefits and safe use of drones. Transparent communication about regulatory measures, safety features, and the positive impacts of drone technology on society can demystify drones and build public trust.

Keywords: service marketing; consumer intention; strategy; drone delivery service; technology acceptance model.

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1. Introduction. In the digital age and with globalisation, most people are aware of both environmental sustainability and the emergence of new technologies (Gajanova & Michulek, 2023; Kita et al., 2022; 2023). In recent years, considerable advancements have been made in drone technology, which is revolutionising various industries. Thus, with technological advancements, drones have become increasingly capable of performing multiple tasks, including delivering parcels to customers' doorsteps (Raivi et al., 2023). The concept of using drones for delivery purposes has been gaining momentum because of their potential to revolutionise the logistics industry and contribute to more sustainable logistics (Borghetti et al., 2022; Dzwigol et al., 2021). As the demand for faster and more efficient delivery options continues to grow, drone delivery has become a solution for both businesses and consumers to consider.

Recent studies have revealed various hypotheses that underscore the complexity of consumer intentions to adopt drone delivery services. One controversial hypothesis posits that the perceived ease of using drone delivery services directly influences the perceived usefulness of these services (Waris et al., 2022). This hypothesis suggests that consumers are more likely to adopt drone delivery if they find it easy to use, as ease of use enhances their perception of its utility. However, this proposition has met with scepticism from some researchers who argue that ease of use alone cannot drive adoption intentions without addressing broader concerns, such as privacy and security (Manana & Otieno, 2022; Mathew et al., 2021).

Another conflicting hypothesis revolves around the efficiency and security of drone delivery services as determinants of consumer adoption. Merkert et al. (2022) and Kim (2020) emphasise that operational efficiency and secure handling of information are paramount for consumers. Proponents argue that when consumers are assured of timely deliveries and the secure management of their data, their intention to adopt drone delivery increases significantly. Conversely, critics of this hypothesis argue that consumer trust might be more deeply rooted in cultural and social factors (Chen et al., 2024). For example, Chen et al. (2024) explored culturally different groups and reported that trust in technology and societal norms heavily influence adoption intentions, challenging the notion that efficiency and security alone are sufficient. However, Yoo et al. (2018) argue that universal factors such as perceived benefits and ease of use are more influential than cultural differences. They contend that while cultural factors may play a role, they do not overshadow the fundamental determinants of consumer behaviour, such as convenience and efficiency. This ongoing debate underscores the need for more nuanced research to reconcile these divergent perspectives.

Businesses and consumers must consider several points before using drone delivery services. The logistics efficiency can be greatly improved with drones, as they can swiftly deliver packages without traffic congestion (Chi et al., 2023; Smith et al., 2022). Additionally, logistics costs can be reduced since drones eliminate the need for human workers and complex transportation infrastructure (Kwilinski et al., 2022). Nonetheless, it also presents potential drawbacks that should be taken into account. Minimising the risk of accidents and injuries linked to conventional delivery methods, drone delivery promotes safety (Eskandaripour & Boldsai Khan, 2023; Li et al., 2023; Stephan et al., 2022). Nevertheless, challenges and worries about this new system exist, including regulatory issues, high drone device costs, and security concerns regarding customer data privacy (Chi et al., 2023; Eskandaripour & Boldsai Khan, 2023).

According to recent research, consumer attitudes and intentions toward drone delivery services are influenced by various factors (Valencia-Arias et al., 2022; Yoo et al., 2018). These include task characteristics such as delivery distance and pick-up time, as well as technology characteristics such as reliability and safety, all of which significantly impact adoption rates (Valencia-Arias et al., 2022). To understand the drivers behind technology adoption, studies have employed the technology acceptance model (TAM), which also sheds light on how drone delivery services are perceived (Yaprak et al., 2021). In identifying influences on consumer attitudes and intentions towards their service, the TAM provides valuable insight for developers, such as determining perceived ease of use (POU) and perceived usefulness (USF) (Valencia-Arias et al., 2022). Additionally, privacy concerns and perceived privacy risks are contributors to these attitudes and intentions, as emphasised in studies (Koh et al., 2023; Lee et al., 2022). Several privacy implications exist with drone delivery that consumers cite, including data collection and surveillance (Koh et al., 2023; Yaprak et al., 2021), issues that Tu & Piramuthu (2023) and Yaprak et al. (2021) note as impacting perceived privacy risks towards drone delivery, and ultimately, consumers' attitudes towards the service. Thus, addressing privacy issues and ensuring consumer data protection are crucial to building trust and increasing consumers' intention to adopt drone delivery services (Leon et al., 2023; Osakwe et al., 2022).

The literature on the underlying factors that influence consumers' intention to adopt drone delivery services presents some notable gaps. One of the gaps is the lack of research on the specific factors that contribute to consumer innovation in the context of drone delivery services (Xie et al., 2022) and their impact on adoption

intentions (Chen et al., 2023; Osakwe et al., 2022). Furthermore, there is a need for more studies on TAM, task characteristics (TACs), technology characteristics (TECHCs), privacy concerns (PCNs), perceived privacy risks (PRSs), and attitudes (ATDs) in the context of drone delivery services (Valencia-Arias et al., 2022), as these factors play crucial roles in shaping consumers' attitudes and intentions toward adopting new technologies. That said, two important research questions arise:

- RQ1: What are consumers' perceptions of drone delivery services?
- RQ2: What are the factors that influence consumers' intentions to adopt drone delivery services?

Filling these gaps can provide valuable information for service providers, policymakers and researchers in understanding and promoting the adoption of drone delivery services. This paper aims to study the underlying factors influencing consumers' intentions to adopt drone delivery services in Portugal.

This paper contributes to the field of technology adoption by elucidating the specific predictors of BI among users in Portugal, highlighting the roles of the USF, PRS, and ATD. This research stands out for its detailed examination of how these factors collectively influence BI. The study's originality is particularly evident in its exploration of the indirect effects of the USF and PRS on BI through ATD. Specifically, the findings demonstrate that USF mediates the impact of technology-related variables on BI, indicating that the perceived usefulness of a technology significantly shapes user intentions. Additionally, the PRS is shown to mediate the influence of privacy concerns and perceived risks, suggesting that these factors affect BI through their impact on users' attitudes toward technology. Furthermore, the comprehensive analysis reveals a hierarchy of effects, with USF exerting the strongest influence on BI, followed by ATD and PRS. This ranking of predictors not only enhances the understanding of the determinants of technology acceptance but also provides actionable insights for increasing user adoption rates. By emphasising the importance of perceived usefulness and addressing privacy concerns through positive attitude formation, this study offers a strategic framework for fostering favourable user intentions. The regional focus on Portugal adds another layer of originality, providing context-specific insights that can inform localised strategies for technology adoption. Governments are essential in regulating drones to build trust, safeguard users, and create a supportive environment for their adoption. By leading public awareness campaigns, governments can inform citizens about the benefits and safe operation of drones. Clear and transparent communication regarding regulatory measures, safety protocols, and the societal advantages of drone technology can help demystify drones, thereby fostering public confidence and acceptance. Overall, the article's in-depth analysis of these interrelated factors and their impacts on BI marks a significant advancement in the field, offering both theoretical and practical contributions.

2. Literature review

2.1. Entrepreneurial and employability opportunities in drone delivery services

The analysis of market demand and growth potential in drone delivery services reveals a burgeoning interest and significant opportunities for entrepreneurial ventures. Statistics on drone delivery highlight its potential for growth and widespread adoption. The drone delivery market is projected to grow considerably, reaching a value of \$0.69 billion in 2024 and \$1.75 billion by 2029 (Mordor Intelligence, 2023). Moreover, the global drone parcel delivery market size is projected to grow from approximately \$530.2 million in 2022 and is expected to grow at a compound annual growth rate (CAGR) of 42.6% from 2023-2030 (Grand View Research, 2023). These figures indicate the growing interest in and investment in drone delivery services, highlighting their potential for future expansion. Jazairy et al. (2024) highlighted the increasing consumer preference for faster and more efficient delivery methods, with drones being a leading contender in meeting these demands. This preference is driven by the ability of drones to bypass conventional traffic and deliver goods directly to consumers' doorsteps, increasing convenience and satisfaction. Moreover, technological advancements in unmanned aerial systems have significantly reduced operational costs, making drone delivery financially viable for many businesses (Cıkmak et al., 2023). These factors collectively contribute to a promising market outlook, with projections indicating substantial growth in the coming years.

Current market trends and projections underscore the potential of drone delivery to revolutionise the logistics and delivery sectors. According to Tokosh & Chen (2022), the integration of drone technology into delivery services is not only feasible but also poised for widespread adoption. Industry leaders such as Amazon, Google, UPS, and Domino's Pizza have already started projects to test and refine their drone delivery systems, aiming to scale up their operations in the near future (Tokosh & Chen, 2022). Additionally, market analysis indicates a steady increase in investments and innovations within the drone delivery space, suggesting a growing confidence among stakeholders in its long-term viability (Benarbia & Kyamakya, 2022; Chen et al., 2021).

Key industries adopting drone delivery include retail, healthcare, and logistics, each leveraging the unique advantages offered by this innovative technology. The retail sector, for example, is increasingly utilising drones for the rapid delivery of small packages, enhancing customer experience and operational efficiency (Cikmak et al., 2023). In healthcare, drones are employed to transport medical supplies, blood samples, and even emergency medications to remote or inaccessible areas, significantly improving healthcare delivery (Li et al., 2023). The logistics industry also stands to benefit immensely, with drones streamlining the supply chain and reducing delivery times (Li et al., 2023). As these industries continue to explore and implement drone delivery solutions, the demand for skilled professionals and entrepreneurs in this domain is expected to rise, creating numerous employability opportunities.

2.2. *Technology acceptance model*

The technology acceptance model (TAM) is a theoretical framework widely used in the field of technology acceptance research. Waris et al. (2022) believe that comprehending why people welcome or decline novel technologies, such as drone delivery, is enlightening. TAM, a theoretical framework popular in technology acceptance research, has proven successful in analysing consumer behaviour towards technological advancements such as drone delivery. Consequently, businesses and policymakers can use the TAM's insights to develop efficacious strategies for adopting drone delivery services (Chi et al., 2023).

Individuals' acceptance of technology relies on a variety of factors that make up the TAM. One crucial aspect is USF, which gauges how much people believe technology can improve their performance or simplify tasks (Dhagarra et al., 2020). Additionally, POU—another facet of the TAM—evaluates the ease of operating technology (Yaprak et al., 2021). Nonetheless, other factors, such as perceived compatibility with existing systems or technologies, social influence, and perceived risk, also impact the adoption of drone delivery services (Shapira & Cauchard, 2022).

The application of the TAM in the context of drone delivery services has been an area of interest for researchers. Some studies have explored the factors influencing the acceptance of drone delivery services via the TAM framework (Koh et al., 2023; Mathew et al., 2021). For example, Koh et al. (2023) investigated the underlying factors that influence consumer acceptance of drone delivery in urban cities, particularly during the COVID-19 pandemic. Mathew et al. (2021) focused on the impact of various factors on consumer acceptance of drone food delivery services. Similarly, Edwards et al. (2023) analysed the impact of factors affecting the adoption of delivery drones by logistics service providers for humanitarian operations. Waris et al. (2022) used the extended TAM to assess customer behaviour, considering factors such as product processing innovation and information processing. Chi et al. (2023) studied the critical determinants of drone delivery services, including personal innovativeness, outcome expectancy, and anticipated positive emotions. Furthermore, the importance of USF and POU in shaping consumers' attitudes and intentions toward the adoption of drone delivery services is recognised.

Edwards et al. (2023) claim that ease of use is a crucial factor in drone delivery service adoption. According to their research, individuals are more inclined to find the service helpful if it is perceived as easy to use in fulfilling their needs and requirements. Moreover, Chen et al. (2022) reported that POU greatly affects users' willingness to utilise drone delivery services, whereas USF does not impact their intended behavior. If consumers view drone delivery services as helpful tools in their day-to-day routine, they are more inclined to adopt it, as indicated by Yaprak et al. (2021), who reported that the USF is positively correlated with behavioural intentions. Thus, the greater the perception of usefulness and convenience is, the stronger the intention to use the service.

According to research conducted by Gupta et al. (2021), customers' adoption of drone delivery services is influenced by their perceived advantages and the USF. The literature emphasises that this creates a clear connection between the POU and the USF in the decision-making process.

H₁. Perceived ease of use is positively related to perceived usefulness in the adoption of the drone delivery service.

H_{2a}. The greater the perceived usefulness is, the greater the behavioural intention of consumers to adopt the drone delivery service.

H_{2b}. A higher perceived usefulness corresponds to a better attitude of consumers to adopt the drone delivery service.

2.3. *Task characteristics*

The proficiency of drone delivery services relies heavily on task characteristics (TACs). In simple terms, the TAC refers to the features specific to the tasks undertaken during the delivery process, as defined by Benarbia & Kyamakya (2022). Defining and grasping these unique TACs is crucial in streamlining the

efficiency and effectiveness of drone delivery systems Chi et al. (2023). Identifying the unique attributes of each task and analysing how they fit into the delivery process is crucial. In the TAC, various facets of the delivery service are affected, including task complexity, service quality, and overall consumer perception. The magnitude of the TAC cannot be underestimated, as it holds the power to impact multiple aspects of the delivery process.

Delivering packages by drones requires tackling the TAC's task complexity. Complexity in this scenario presents the delivery's difficulty level and complexity. Obstacles such as regulatory airspace, weather conditions, and geographical terrain contribute to the complexity drones face when making deliveries (Mohsan et al., 2023). Effectively managing these challenges necessitates the use of advanced technology and operational strategies to guarantee secure and timely deliveries.

When consumers see drones as reliable, efficient, and convenient, they are considered valuable and beneficial. Perceived usefulness is increased by factors such as accurate delivery, quick speed, and ease of use in reaching the desired location (Yaprak et al., 2021). Therefore, considering task characteristics and optimising them to meet consumer expectations can increase the acceptance and adoption of drone delivery services.

H₃. Task characteristics are positively associated with consumers' perceived usefulness of the drone delivery service.

2.4. Technology characteristics

Technology characteristics (TECHC) refer to the specific features and capabilities of the technology used in drone delivery systems. Understanding and considering the TECHC is essential for optimising the efficiency, reliability, and user experience of drone delivery services. Benarbia & Kyamakya (2022) highlighted the importance of the TECHC in the context of drone delivery systems.

In drone delivery services, technology compatibility is important to the TECHC. It refers to the degree of compatibility between existing infrastructure and processes with technology used in drone delivery. To ensure delivery efficiency, seamless integration between drones and transportation and logistics systems is paramount. In their study, Mohsan et al. (2023) explored the attributes that set different UAVs apart when employed for drone delivery tasks. They highlighted the importance of compatibility with features such as payload capacity and flight range, as stated by Koh et al. (2023) and Raghunatha et al. (2023).

In this framework, it has been observed that TECHCs are positively associated with consumers' perceived usefulness of drone delivery services. Mathew et al. (2021) recently researched consumer thoughts and plans regarding the implementation of unorthodox technologies, namely, drone transportation for meals. The findings revealed that consumers regarded drone delivery as an ingenious and expedient tactic, significantly increasing their acceptance of the idea. This indicates that the service's technical components and abilities can augment the worth and utility that the public assigns to these services.

H₄. Technological characteristics are positively associated with consumers' perceived usefulness of drone delivery services.

2.5. Privacy Concern

The consumers' privacy concern (PCN) is a vital consideration in the widespread integration and acceptance of drone delivery options. The PCN delineates people's fears, concerns, and worries about potential encroachment on their privacy when drone delivery options are used (Yaprak et al., 2021). As the drone industry advances and drone deliveries gain more traction, it is essential to assess and address PCN concerns among consumers. Mathew et al. (2021) and Rath & Kumar (2021) presented misgivings about drone delivery services, including the interception of private data, monitoring potential and the possibility of confidential information being accessed without consent. There is also a trepidation with regard to the safety aspect of the delivery process. Studies establish a meaningful correlation between the PCN for Drones, perceived privacy risk (PRS), and attitudes towards drone delivery services. Yoo et al. (2018) discovered a significant link between the PCN for Drones, the PRS, and attitudes towards drone delivery services. Their research revealed that heightened concerns over privacy were connected to increased perceptions of privacy risks. Additionally, Yaprak et al. (2021) reported that the use of drones for online ordering resulted in negative attitudes toward drone delivery services because of the PRS felt by consumers. Alleviating consumer concerns regarding drone delivery services is vital in ensuring their successful adoption and uptake, as researchers have found (Yaprak et al., 2021). Promoting positive attitudes toward drone delivery can be achieved by implementing robust privacy protection measures and addressing privacy issues. This strategy is backed by Koh et al. (2023) and Tu & Piramuthu (2023).

H₅. The greater the degree of privacy concern is, the greater the perceived privacy risk of consumers in adopting drone delivery services.

2.6. *Perceived privacy risks*

Individuals' perceived privacy risk (PRS) in drone delivery services is influenced by various factors that create a unique array of concerns. Among these factors is the type of PRS connected to drone delivery, encompassing privacy and data security apprehensions, potential surveillance, and misuse of personal information (Mathew et al., 2021). Moreover, the perceived attributes of drone delivery, performance risk, and the impact of COVID-19 have also been shown to impact individuals' perceived privacy risks regarding drone delivery services (Leong & Koay, 2023; Valencia-Arias et al., 2022).

Given their significant impact, PRSs in drone delivery services, as noted in the literature, affect individuals' attitudes towards embracing this technology (Yoo et al., 2018). Studies have shown that the higher the PRS is, the less favourable consumers' attitudes are toward the adoption of drone delivery services (Mathew et al., 2021). PRS, along with other factors such as green image and protection motivation, negatively affects consumers' attitudes toward drone delivery (Yaprak et al., 2021).

In addition to influencing attitudes, perceived privacy risk affects individuals' intentions to adopt drone delivery services. A study conducted in the United States revealed that the higher the PRS is, the lower the individuals' intentions to adopt drone delivery services (Chi et al., 2023; Mathew et al., 2021). Privacy and security concerns are among the top public concerns in regard to drone delivery (Tu & Piramuthu, 2023). Therefore, companies and policymakers must address these concerns and establish trust by implementing robust privacy measures and ensuring the safe and responsible use of drones in delivery services (Yoo et al., 2018). By doing so, they can increase individuals' intentions to adopt drone delivery services and facilitate their widespread uptake (Yaprak et al., 2021).

H_{6a}. The greater the perceived privacy risk is, the less favourable the consumers' attitude toward adopting drone delivery services.

H_{6b}. The greater the perception of privacy risk is, the lower the consumers' intentions to adopt the drone delivery service.

2.7. *Attitudes*

In consumer behaviour, ATD refers to individuals' general evaluations or feelings towards a particular object, person, or service. This could result in a consumer's willingness, or lack thereof, to consider adopting a new technology or service (Hwang et al., 2020). Understanding attitudes toward drone delivery services is highly important because of the growing popularity and potential of drone technology in the delivery industry (Waris et al., 2022). Waris et al. (2022) reported that consumers' willingness to recommend and use drone delivery services is positively affected by their attitudes.

The adoption of drone delivery services is influenced not only by consumer attitudes but also by changes in food delivery culture and consumption practices (Poon & Tung, 2022). Crucial in determining whether consumers will use new delivery methods are their attitudes towards these methods, including drone delivery, as their reliance on food delivery services grows (Mathew et al., 2021). According to a study by Waris et al. (2022), positive attitudes towards drone technology and the potential benefits of faster and more efficient deliveries significantly impact consumer intentions to adopt drone delivery services. Additionally, convenience and reliability, among other perceived attributes of drone delivery, can shape the attitudes and intentions of consumers (Hwang et al., 2020).

Consumer attitudes and intentions toward drone delivery services have been the subject of several studies (Leong & Koay, 2023; Mathew et al., 2021). Mathew et al. (2021) reported that a favourable attitude toward drone delivery is linked to increased intention to use. The perceived usefulness of drone delivery during pandemics is another factor that has a positive influence on consumer attitudes and intentions (Leong & Koay, 2023). In addition to the impact of external and adverse events, performance risk is another key factor that has been shown to shape consumer attitudes toward drone delivery services (Mathew et al., 2021). By understanding consumer attitudes and intentions, firms can develop targeted strategies to address consumer concerns and promote the adoption of drone delivery services (Yaprak et al., 2021).

H₇. Attitude is positively related to consumers' intentions to adopt drone delivery services.

Figure 1 shows the research model.

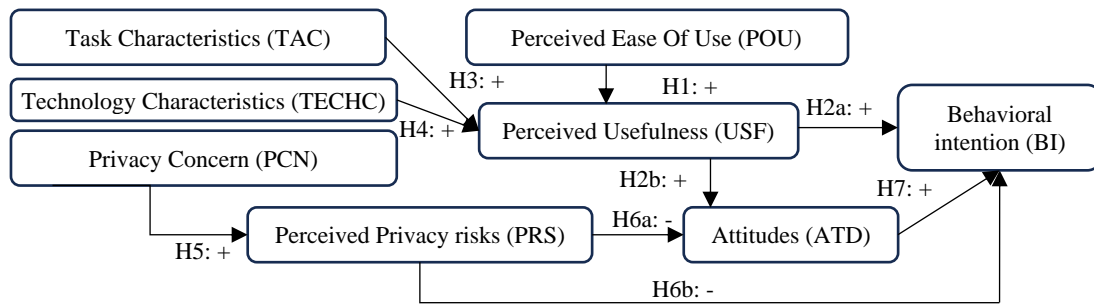


Figure 1. Research model.
Sources: developed by the authors.

3. Methodology and research methods.

3.1. Method and measures of the constructs

On the basis of the studies of Zhou et al. (2010), Manis & Choi (2019), Wang et al. (2021), Cai et al. (2021) and Koh et al. (2023), a self-response instrument was adapted and disseminated on social networks (Instagram and WhatsApp). The study link was disseminated via social media via the Google Form platform. A preliminary test was conducted on a sample of 20 Portuguese citizens to evaluate the items’ clarity and comprehensibility. Data collection (snowball sampling procedure) took place between February 2023 and April 2023. Sample comprising 155 participants. Written informed consent was obtained from all participants to ensure their authorisation and confidentiality regarding their answers.

This questionnaire is closed-ended and consists of three sections. The first section related to the frequency with which participants make online purchases, as well as their preferences regarding how orders are delivered. In the second section, forty-three questions (items) (Table 1) were designed to measure eight constructs (variables) (Table 1).

Table 1. Authors who have previously addressed the variables under study.

Variables	Definitions	Items	Authors	Variables	Definitions	Items	Authors
Perceived Ease of Use (POU)	An individual's perception of how easy it will be to use a technology.	POU1	Davis (1985), Lee et al., (2013)	Privacy Concern (PCN)	Individuals' concerns about information privacy practices.	PCN1	Zhu & Bao (2018); Al-Jabri et al. (2019); Koh et al. (2023)
		POU2				PCN2	
		POU3				PCN3	
		POU4				PCN4	
		POU5				PCN5	
Perceived Usefulness (USF)	An individual's perception of how advantageous it would be to adopt a new technology.	USF1	Abdullah et al. (2016), Barkhi & Wallace (2007)	Perceived Privacy Risks (PRS)	Potential loss in the pursuit of a desired outcome from the use of a technological service.	PRS1	Kwon et al. (2022); Yoo et al. (2018); Del-Real and Díaz-Fernández (2021)
		USF2				PRS2	
		USF3				PRS3	
		USF4				PRS4	
		USF5				PRS5	
Task Characteristics (TAC)	Attributes of activities performed by individuals	TAC1	Goodhue and Thompson (1995); Yoo et al. (2018)	Attitudes (ATD)	Consumers' intention to use a particular innovation	ATD1	Koh et al. (2023); Waris et al. (2022)
		TAC2				ATD2	
		TAC3				ATD3	
		TAC4				ATD4	
		TAC5				ATD5	
Technology Characteristics (TECHC)	Individuals use the current system to complete their tasks	TECHC1	Goodhue and Thompson (1995); Yen & Abdous (2011); Koh et al. (2023)	Behavioural intention (BI)	Probability of an individual engaging in a behaviour	B11	Hwang et al. (2019); Mathew et al. (2021); Holzmann et al. (2021)
		TECHC2				B12	
		TECHC3				B13	
		TECHC4				B14	
		TECHC5				B15	
						B16	

Sources: developed by the authors.

These items are rated on a 5-point Likert scale ranging from (1) "strongly disagree" to "strongly agree" (5). Perceived ease of use (POU), perceived usefulness (USF), task characteristics (TAC), technology characteristics (TECH), perceived privacy risk (PRS) and attitudes (ATD) are measured with five items each.

Behavioural intentions (BIs) are assessed by six items, and privacy concerns (PCNs) are evaluated by seven items. The third section of the questionnaire describes the participants' demographic characteristics: gender, age, education, employment status, residence, and net monthly income. Table 1 presents a summary description of the authors who previously used the variables under study.

3.2. Sample profile

Table 2 presents the participants' demographic characteristics.

Table 2. Sample characterisation.

Variables	Frequencies	Percentage (%)	Variables	Frequencies	Percentage (%)
Gender			Employee	41	26.5
Male	65	41.9	Retired	3	1.9
Female	90	58.1	Unemployed	4	2.6
Age			Residence in Portugal		
[17-19]	20	12.9	Norte	12	7.7
[20-59]	132	84.3	Lisbon	3	1.9
> 60	3	1.8	Centro	130	83.9
Education			Alentejo	3	1.9
4th year	2	1.3	Algarve	4	2.6
6th grade	0	0.0	Madeira	2	1.3
9th grade	6	3.9	Acores	1	0.6
12th grade	59	38.1	Monthly net income		
Graduation	68	43.9	0	53	34.2
Master's degree	19	12.3	€1 - €760	43	27.7
PhD	1	0.6	€761 - €850	12	7.7
Professional situation			€851 -€1000	18	11.6
Students	80	51.6	€1001 - €1500	15	9.7
Student worker	20	12.9	€1501 - €2000	9	5.8
Independent worker	7	4.5	+ than €2000	5	3.2

Sources: developed by the authors.

Of the 155 answers obtained, 65 (41.9%) were male, and 90 (58.1%) were female, indicating that it was the female gender that adhered more. The age of the respondents ranged from 17--70 years ($M = 26.5$ years; $SD = 10.98$), and the mode was 20 years. Regarding the level of education, approximately 43.9% of the respondents were college graduates, 38.1% had a 12th-grade degree, and 12.3% had a master's degree. With a lower representation of schooling, we found individuals in the 4th year (1.3%), 9th year (3.9%), and PhD (0.6%). With respect to professional status, approximately 51.6% reported being students, 26.5% were employees, and 12.9% were working students. The geographical distribution of the answers included all the regions of Portugal, with the following results by region: Centre with an absolute majority of 83.9%, North China with 7.7%, Algarve with 2.6%, and the remaining regions with a less significant expression.

3.3. Statistical analysis

Data analysis was performed via the Statistical Package for the Social Sciences (SPSS, v. 27) statistical software. Sociodemographic characteristics were characterised on the basis of frequency and percentage analysis. The mode, mean, and standard deviation were calculated for the age variable. A confirmatory factor analysis (CFA) was conducted to test the theoretical model of the data collection instrument composed of eight dimensions. The following goodness-of-fit indices were used to assess the model fit: chi-square statistic (X^2/df) values between 2 and 5, which indicate good fit; the comparative fit index (CFI) and Tucker and Lewis index (TLI), which indicate adequate model fit, with values ranging from 0.90 to 0.95; and the standardised root mean square residual (SRMR), which shows an acceptable fit, with values lower than 0.08 (Hu & Bentler, 1999). Additionally, the root mean square error of approximation (RMSEA) was computed ($CI = 90\%$; values between 0.05 and 0.08 suggest an acceptable fit (Kline, 2005). The reliability of each dimension was calculated via Cronbach's alpha (Brown, 2015; Harrington, 2009). For hypothesis testing, Pearson correlation coefficients were calculated. The interpretation criteria followed were those defined by Dancey & Reidy (2007). Thus, Pearson correlation coefficients with values ranging between 0.10 and 0.39 are considered weak, those between 0.40 and 0.69 are moderate, and those above 0.70 are considered strong. The significance level used was $p < 0.05$.

4. Results. Confirmatory factor analysis was conducted to verify the model's fit to the original questionnaire, which consisted of eight dimensions. Thus, the model proved to be similar to that of the original study. $X^2/df = 1.87$; $p < 0.001$; CFI = 0.89; TLI = 0.88; RMSEA = 0.07 [0.06 - 0.08]; SRMR = 0.08.

The internal consistency of each of the eight dimensions studied, which was calculated via Cronbach's alpha, revealed good and very good reliability. Thus, for each dimension, the α values were as follows: POU = 0.93; USF = 0.86; TAC = 0.85; THEC = 0.79; PCN = 0.94; PRS = 0.94; ATD = 0.97; and BI = 0.96.

Given the objectives of the study and the need to test the formulated hypotheses, Pearson's correlation coefficient was used. Thus, as shown in Table 3, all the correlations are highly significant with the variables intended to test the postulated hypotheses ($p < 0.001$ and $p = 0.02$).

Table 3. Correlations between the dimensions.

	POU	USF	TAC	THEC	PCN	PRS	ATD
USF	0.725**						
TAC	0.595**	0.655**					
THEC	0.246**	0.342**	0.440**				
PCN	-0.271**	-0.139	-0.005	0.288**			
PRS	-0.313**	-0.186*	-0.126	0.184*	0.709**		
ATD	0.728**	0.798**	0.584**	0.313**	-0.197*	-0.240**	
BI	0.686**	0.824**	0.608**	0.266**	-0.178*	-0.208**	0.851**

Note: * $p = 0.02$, ** $p < 0.001$

Sources: developed by the authors.

Thus, the variables perceived ease of use (POU) and perceived usefulness (USF) are positively related ($r = 0.725$; $r^2 = 0.53$). When USF is associated with behavioural intention (BI) and consumer attitudes (ATD), the variables are highly correlated ($r = 0.824$; $r^2 = 0.68$ and $r = 0.798$; $r^2 = 0.64$). Equally significant were task characteristics (TAC) and technological characteristics (TECH) with the USF ($r = 0.655$; $r^2 = 0.43$ and $r = 0.342$; $r^2 = 0.12$). Privacy concern (PCN) and perceived privacy risk (PRS) were significantly positively correlated ($r = 0.709$; $r^2 = 0.50$). The results of the correlations between PRS and ATD, as well as PRS and BI, revealed that an increase in perceived risk corresponds to less favourable consumer attitudes and intentions ($r = -0.240$; $r^2 = 0.06$ and $r = -0.06$; $r^2 = 0.04$). Finally, the association between ATD and consumers' behavioural intentions (BIs) to adopt the drone delivery service also proved positive and significant ($r = 0.851$; $r^2 = 0.72$). As shown in Table 4, all the hypotheses of the study were confirmed.

Table 4. Summary of the statistical decision.

Hypotheses	p-value	Results	Hypotheses	p-value	Results
H1	< 0.001	Accepted	H5	< 0.001	Accepted
H2a	< 0.001	Accepted	H6a	0.02	Accepted
H2b	< 0.001	Accepted	H6b	0.009	Accepted
H3	< 0.001	Accepted	H7	< 0.001	Accepted
H4	< 0.001	Accepted			

Sources: developed by the authors.

5. Discussion. This study aimed to determine the influence of Portuguese consumers' behavioural intentions regarding drone delivery services. The proposed model includes a set of variables to infer the predictors of behavioural intention (BI), such as perceived usefulness (USF), perceived ease of use (POU), task characteristics (TAC), technology characteristics (TECH), perceived privacy risks (PRS), privacy concerns (PCN), and attitudes (ATD). This study is relevant because it presents a systematic approach to the interaction between high-technology concepts and their associated services. Otherwise, this approach is beneficial to companies because it infers the consumers' preferences about the total offer (products and services) and to consumers because it helps them understand the motives that leverage the behavioural intention to adopt technological services.

First, this study demonstrated that the USF is positively influenced by POU, so Hypothesis H1 is validated. These results are in accordance with other studies (Chen et al., 2022; Edwards et al., 2023), indicating that the convenience of drone delivery services can improve the usefulness of drone technologies (Yaprak et al., 2021). In general, users quickly adopt innovations (Valencia-Arias et al., 2022) that are more useful according to their needs (Edwards et al., 2023). Consequently, the easier the use of technology is, the more useful it is for

users. Thus, implementors of drone delivery services must identify the task needs of users and their impact on their lives to perceive their usefulness, contributing to the development of easy-of-use and alternative technologies that solve people's problems, as Valencia-Arias et al. (2022) demonstrated in their study performed in Colombia in the context of the COVID-19 pandemic.

The tested model shows that H2a is validated, meaning that the USF is a predictor of BI. This evidence is supported by the studies of Gupta et al. (2021) about logistics and services in future transportation and Yaprak et al. (2021) about Turkish consumers, demonstrating the greater importance of the USF in promoting drone delivery technologies in different realities and applications. This result supported the TAM regarding one of its crucial elements (USF). Additionally, our results complement the findings of Chen et al. (2022) concerning Thai users, demonstrating the positive significant impact of the USF on the BI of Portuguese respondents. Therefore, implementors of drone delivery services should develop useful and highly connected systems that facilitate the tasks of their users to stimulate their acceptance. In this context, marketers play a key role in determining local users' needs, especially with respect to their USF, which can contribute to (better) technology acceptance.

Another significant relationship verified by the results is the positive influence of the USF on ATD, which validates H2b. Thus, more USF improves the positive evaluation and feelings of users to take up drone delivery services. These findings, which are relatively similar to those of prior studies (Valencia-Arias et al., 2022; Yaprak et al., 2021) performed in different regions and in the context of emergency scenarios, showed that drone delivery technologies should be developed according to the consumption practices and needs of users to facilitate their lives and solve emergent problems, which implies a positive evaluation of drone technologies by users.

The results revealed the influence of the TAC on the USF, so Hypothesis H3 was validated. These results, similar to those obtained by Chi et al. (2023), Mohsan et al. (2023), and Yaprak et al. (2021), suggest that the unique characteristics, complexity, and performance of tasks affect the motivation and useful perception of users to use drone delivery services. These similar results allow us to infer that implementors of drone delivery services should develop technologies in addition to an "ease-to-use" service (Valencia-Arias et al., 2022; Yaprak et al., 2021). Moreover, companies that provide drone delivery services should identify the tasks that motivate the uptake of drone delivery technologies. The perception of the lower complexity of drone delivery services and their compatibility with other platforms may influence the usefulness and adoption of this delivery service. Additionally, the performance of drone delivery tasks can result in positive judgments by users according to their expectations. In this context, marketing promotion can improve the acceptance of drone delivery technologies by comparing their (high) usefulness and task benefits with those of other conventional delivery methods.

The TECHC positively influences the USF, which validated hypothesis H4. This evidence is consistent with other prior studies (Koh et al., 2023; Raghunatha et al., 2023) and demonstrates that drone delivery technologies must be perceived by users as helpful, efficient, and reliable. Accordingly, our results confirmed the important role of innovation and drone capability in improving acceptance by users and the compatibility between drone delivery technologies and other platforms, as previous studies have reported on drone service capacity and abilities in drone food delivery services and UAVs applied in several drone delivery tasks (Mathew et al., 2021; Mohsan et al., 2023). Therefore, the implementation of drone delivery technologies should maximise drone technology to ensure high connectivity with other network systems and develop cargo and transportation abilities to ensure delivery efficiency (Mohsan et al., 2023), which may augment the public assignment of these services.

The findings demonstrated that the PCN predicts PRS, which is confirmed by hypothesis H5. Thus, the higher the PCN is, the higher the PRS of consumers to adopt drone delivery services. These results agree with other studies (Mathew et al., 2021; Yoo et al., 2018) and prove that privacy issues are a matter of great concern to companies because most users do not like the invasion of their privacy. Hence, security, surveillance, and data protection promote positive Portuguese users' attitudes toward drone delivery services, which is consistent with the outcomes of previous studies about drone delivery services in urban cities, digital data-based information, and last-mile drone delivery services (Koh et al., 2023; Rath & Kumar, 2021; Tu & Piramuthu, 2023). Thus, the excessive exposure of users' individual information and fears about insecurity regarding drone delivery technology can negatively influence their BI. This consensus extended to several scenarios and highlighted the importance of developing cybersecurity mechanisms to prevent risks in communications and infrastructure systems. However, the PRS can be mitigated if the user's willingness to use drone delivery technology is influenced by their utility, system robustness, and low-cost benefits.

The PRS affects ATD and BI, which supports Hypothesis H6a and Hypothesis H6b, meaning that the PRS has a direct and indirect influence on BI. First, the PRS has a significant effect on attitudes toward adopting drone delivery services; a higher PRS reduces consumers' attitudes toward the adoption of drone delivery services, which is in line with the findings of prior studies on the use of drone delivery services within cities (Koh et al., 2023; Mathew et al., 2021; Yoo et al., 2018). The comparison between our findings and the outcomes of past studies reveals that PRSs can affect individuals' attitudes towards embracing drone delivery services in different realities. However, companies can mitigate some risks of drone delivery services by providing clear information about the efficiency and guarantee of this technology and increasing safety regarding the data privacy of users (Leong & Koay, 2023; Tu & Piramuthu, 2023; Valencia-Arias et al., 2022; Yoo et al., 2018). Quality should be a concern with respect to the requirements of drone delivery services to increase customer satisfaction/evaluation and, consequently, customer trust. Companies can develop marketing campaigns with valuable information about the advantages of drone delivery services, compared with traditional delivery services, which are based on persuasive information about convenience, faster time-delivery, costs, and "less exposition" of users in shops to increase users' intentions to use this delivery technology (Hwang et al., 2020; Waris et al., 2022).

Consumer attitudes positively influence BI toward drone delivery services, which confirms Hypothesis H7. Therefore, users' positive feelings are determinants in promoting BI about new technologies (Hwang et al., 2020). To increase BI about drone delivery technologies, companies can provide clear information about their benefits and impact (e.g., efficient delivery services, impact on consumers' commodity, safety service) (Li et al., 2023; Mathew et al., 2021; Stephan et al., 2022; Waris et al., 2022), which promotes the users' intention to adopt this technology in the long term. Thus, the promotion of drone delivery technologies is crucial for allowing users to adopt them. In this vein, companies must monitor users' attitudes toward drone delivery services to analyse the "positive feelings" of users toward drone technologies and the high possibility of recommending them. However, a comparative analysis with other studies reveals that culture, consumption practices and perceived usefulness also influence consumer attitudes and intentions regarding the uptake of drone delivery services (Poon & Tung, 2022). By understanding these different approaches to the factors that influence consumer attitudes, the implementors of drone technologies should understand which attributes of drone delivery positively influence consumer attitudes to promote the adoption of drone delivery services.

Finally, our results showed that USF mediates the impact of the technology feature variables on BI, whereas PRS mediates the effect of technology acceptance on BI. Additionally, both the USF and PRS variables have direct and indirect influences on BI. Hence, the high usefulness of drone delivery technology can be used by decision-makers to mitigate the (possible) negative effect of PRSs on BI; advantages can outweigh the disadvantages through the highest effect of USF on BI, resulting from an assertive promotion. This evidence adds a systematised perspective to the literature concerning BI influencers, showing the importance of a set of variables that leverage BI and those that represent resistance regarding the uptake of drone delivery services.

6. Conclusions.

Regarding the trend of technology advances, this study is supported by a proposed model based on the TAM to determine the influence of BI on drone delivery services. All the hypotheses tested are accepted and have a significant influence on the BI, which indicates the relevance of the proposed model.

The results demonstrated that the USF, PRS, and ATD are predictors of BI for users located in Portugal and that the USF and PRS have indirect effects on BI through ATD. Specifically, USF mediated the effect of the technology feature variables, and PRS mediated the effect of privacy/risks in technology acceptance on BI. Hence, the total analysis revealed that the USF has a strong effect on BI, followed by ATD and PRS. In this regard, we find that the BI toward drone delivery services is determined by the USF, which in turn is influenced by the POU, TAC, and TECHC. This suggests that implementors of drone delivery services must research and develop compatible and ease-of-use technologies according to the delivery task needs of users. Additionally, we found that ATD influences the use of drone delivery services by the BI. Thus, consumers are willing to use these delivery services if they feel and evaluate them as beneficial and convenient compared with conventional delivery services. On the other hand, recommendations and the growing adoption of drone delivery services in several industries influence users' attitudes. Thus, personal evaluation and market trends can positively influence users' attitudes toward new (drone) delivery methods.

In summary, the outcomes of this study lead to the conclusion that Portuguese users are willing to accept drone delivery services if they are useful (performant, easy, efficient) and if the associated risks are low. PRS had a strong influence on ATD and BI, which means that privacy issues and data security are key influencers

of users towards drone delivery services. Consequently, implementors of drone delivery services must care about the security of systems. On the other hand, governments play an important role in the regulation of drone technologies by determining norms that contribute to protecting both implementors and users against fraud and creating a "trust environment" in the drone technologies industry, which will certainly increase their BI and adoption.

This study has theoretical implications related to the acceptance of new technologies. First, this study complements the literature with a systematised perspective on the principal influencers of BI towards drone technologies, such as POU, TAC, TECHC, USF, PCN, PRS, and ATD, incorporating two approaches of analysis—the set of technology feature variables and the set of technology acceptance variables. This perspective contributes to expanding the knowledge about the TAM model (Koh et al., 2023; Kwon et al., 2022; Valencia-Arias et al., 2022; Yaprak et al., 2021) through the analysis of the variables that influence (positively/negatively) the uptake of drone delivery services and provides a multivariable perspective for future research on technology acceptance. Second, this research confirms the findings of several prior studies (Edwards et al., 2023; Mathew et al., 2021; Yaprak et al., 2021; Yoo et al., 2018) but also complements the literature concerning the relevant role of USF in positive attitudes and BI toward the adoption of drone delivery services (Chen et al., 2022). Additionally, it highlights a set of theoretical technology feature variables—POU, TAC, and TECHC—that positively influence ATD and BI through the effect of USF, demonstrating the important role of USF as a mediator of those variables. Otherwise, this study pointed to the PRS factors that could negatively affect ATD and BI towards drone delivery technologies, as referred to in prior studies (Chi et al., 2023; Leong & Koay, 2023; Yaprak et al., 2021)—risks, surveillance, privacy, and data protection—and suggested insights into the theoretical concepts of safety and regulations to mitigate the PRS effect. The results showed that ATD is an important predictor of BI—a greater attitude (feelings and evaluations) toward drone delivery services positively influences BI to adopt this technology (Hwang et al., 2020; Mathew et al., 2021; Waris et al., 2022). Thus, this study includes a perspective related to consumer behaviour theories that can be explored better in future studies.

With respect to practical implications, this paper can provide inputs for drone technology acceptance and the promotion of drone delivery services to companies that intend to adopt this technology for business. Hence, technology implementors can consider the factors that affect users' attitudes and intentions in the development of strategies to encourage the uptake of drone delivery services (Chi et al., 2023; Mathew et al., 2021; Valencia-Arias et al., 2022). Additionally, implementors of drone delivery technologies could identify consumers' task needs (Mathew et al., 2021) and develop compatibility technologies (Mohsan et al., 2023) to positively influence users' attitudes.

According to our results, companies and governments can promote drone delivery services to encourage customers to use them as innovative, safe, convenient, and environmentally friendly services. This can contribute to attracting a large number of customers and, consequently, developing the industry of drone delivery services that can be extended across other industries of the supply chain. Consequently, the growth of the market in drone delivery services can represent a significant opportunity for entrepreneurial ventures. Moreover, technological advances in the aerial systems industry have made drone delivery services more efficient, faster, reliable, and financially viable for several businesses in terms of cost reduction (Cıkmak et al., 2023). However, as drone technologies continue to evolve, their impact on business is also growing, making it crucial that implementors stay informed about new technical developments. On the other hand, the market trend of technological delivery services indicates an increase in investments and innovations in the drone industry. (Chen et al., 2021). Thus, the greater efficiency and speed in commercial exchanges provided by the use of drone delivery may have a leverage effect on the global economy through the maximisation of commercial exchanges. Researchers could explore the economic impact of drone delivery services on different industries and regions. The insights of this study have implications for society regarding changes in consumption practices. Drone delivery services promote faster processes with less time-to-delivery and lower costs. Additionally, useful drone technologies can solve several problems and facilitate consumers' lives (Koh et al., 2023). From another point of view, this study highlights consumer attitudes toward the uptake of drone delivery services derived from (more) "ecological consumption" and its positive impact on the environment. Moreover, drone delivery services can solve problems related to traffic management (Chi et al., 2023), which can contribute to changing consumer practices regarding delivery services. In this vein, governments must formulate norms to protect the privacy of drone delivery users and mitigate the negative impact of the PRS on BI (Yaprak et al., 2021; Yoo et al., 2018). This helps implementors increase the security of systems against sophisticated attacks (Chi et al., 2023) and increases trust in the technology applied to delivery services.

There are several limitations in this study. First, the results of this study cannot be generalised because the data only referred to Portuguese citizens. Thus, other studies could verify whether these results can be replicated in other regions/countries and contribute to developing a comparative study through cross-cultural analysis of influencers and their role in BI towards drone delivery services.

Furthermore, this study only analyses the perspective of the end-users via upstream analysis. Hence, future studies could extend the perspective of analysis downstream, which can contribute to understanding both perspectives in the supply chain. This study uses the TAM to analyse the predictors of users' intentions related to drone delivery technology. However, future research could extend the analyses of users' acceptance of drone delivery technologies by incorporating other theories (e.g., innovation, consumer behaviour, sustainability). Finally, future (comparative) studies could be performed in several industries, contributing to determining the influence of BI on drone delivery services per industry.

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Управління споживачами у контексті доставки дронами

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Останніми роками досягнуто значного прогресу в технологіях дронів, що сприяло їх впровадженню та трансформації у різних галузях. Із розвитком технологій дрони стають дедалі більш універсальними та придатними для виконання різноманітних завдань, зокрема доставки посилок прямо до дверей клієнтів. Зі зростанням попиту на швидкі та надійні варіанти доставки дрони стають перспективним рішенням як для бізнесу, так і для споживачів. У цій статті досліджуються ключові фактори, які впливають на наміри споживачів у Португалії використовувати послуги доставки дронами. Для дослідження застосовано кількісну методологію, і зібрано 155 відповідей від громадян Португалії. Результати свідчать про те, що сприйнята корисність, ризики приватності та загальне ставлення є ключовими факторами, що впливають на поведінкові наміри користувачів у Португалії. Крім того, авторами виявлено, що сприйнята корисність та ризики приватності мають опосередкований вплив на поведінкові наміри. Таким чином, результати дослідження підкреслюють вагомий вплив сприйнятої корисності на поведінкові наміри, з урахуванням таких факторів, як ставлення та ризики приватності. Це дослідження розкриває нові аспекти прийняття споживачами послуг доставки дронами. Зокрема, результати вказують на те, що просування переваг дронів, таких як корисність, ефективність та зручність, у рекламних кампаніях може позитивно вплинути на сприйняття споживачів і підвищити їхню готовність використовувати ці послуги. Окрім того, вирішення потенційних побоювань споживачів щодо доставки дронами, зокрема питань приватності, безпеки та надійності, є вкрай важливим. Чітка комунікація про заходи безпеки та захист приватності може зменшити побоювання і сприяти більшій довірі з боку споживачів. Уряди відіграють ключову роль у регулюванні використання дронів для підвищення рівня довіри, захисту прав користувачів та створення сприятливих умов для впровадження технологій. Підвищення обізнаності громадян через урядові інформаційні кампанії може допомогти розкрити переваги та безпечність використання дронів. Прозоре інформування про регулятивні заходи, функції безпеки та позитивний досвід використання дронів сприятиме зниженню занепокоєння та зміцненню довіри до технологій.

Ключові слова: маркетинг послуг; наміри споживачів; стратегія; послуги доставки дронами; модель прийняття технологій.