



Original Article

The Impact of Drone Delivery Innovation on Customer Intention: An Empirical Study in Vietnam

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Abstract: Since e-commerce in the world is becoming increasingly popular, it leads to an increase in demand for a more efficient delivery system. Drone delivery innovation, with its distinct attributes, is contributing several advantages for delivery services. This paper studies the impact of drone delivery services on customers' intention in Vietnam. The research uses correlation analysis and structural equation modeling (SEM) to analyze the data of 405 valid observations collected in a structured questionnaire survey in Vietnam. The paper reveals that convenience, speed, and compatibility affect customers' attitude while convenience and compatibility have no negative effects on costs. Convenience has the highest impact on customers' attitude, while speed concern has the lowest impact. In regard to customers' intention to use drone delivery services, attitude has a strongly positive impact, while costs have a negative influence.

Keywords: Drone delivery service, customer intention, costs, customer attitude, speed concern, compatibility, online retailing.

1. Introduction

The Impact of Drone Delivery Innovation on Customers' According to Hwang et al. (2021), in the fourth industrial revolution, drones play a critical role in different fields (i.e.: agriculture, fire detection, distribution). Nowadays, drone adoption has been expanded following its innovation with regard to high-quality video, wide accessibility, and respectable speed (Shavarani et al., 2018). This kind of technology

supports firms in shipping products at lower costs and in shorter time, satisfying customers' expectation (Yoo et al., 2018). Consequently, this paper investigates the impact of drone delivery services on customers' intention in an emerging economy.

Investigation of the impact of drone convenience, speed, and compatibility on customers' attitude and intention in an emerging economy has not been conducted. Yoo et al. (2018) studied drones in a developed country

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(U.S.) by a national survey among U.S. citizens above 18 years old. Hwang et al. (2021) continuously examined the impact of drone delivery services in South Korea through a survey among restaurant customers. They investigated drones under the internal environmental locus of control and anticipated emotions of customers. Unfortunately, there is no research investigating the relationship between drone delivery services and their impact on customers' intention.

This study examines the influence of drone delivery services on customers' intention in the context of Vietnam. E-commerce is also on a strong growth path and is gradually becoming a popular shopping channel with a significant portion of consumers in Vietnam (VECOM, 2022). Currently in Vietnam, drones have not yet been applied in the field of delivery; however, drones have been presented in many other fields such as agriculture, digital survey, artistic videography, and forest ranger work (Hao & Dung, 2021). For example, some Vietnamese farmers are using agricultural drones to monitor the growth of crops to help find ways to fertilize to increase production. On the other hand, Vietnamese people are familiar with drones being used to take photos, record memories or produce movies. Drones in Vietnam have a wide range of prices from low to mid-range to high cost, which are suitable for different market segmentations (100 USD to several thousand dollars) (Hao & Dung, 2021). From these aspects, Vietnamese people are quite familiar with drones in many different activities, except in delivery. Moreover, the drone market in Vietnam is not as diverse as abroad for many reasons, namely: infrastructure (interlaced wires), and regulations related to aviation safety and national security. Therefore, research on drones in the field of delivery, approached from the perspective of consumers, will provide answers for Vietnamese retail businesses as well as the government in expanding the application of drones in delivery services.

In conclusion, it is extremely necessary to study methodically the impact of drone delivery services on the intention of Vietnamese consumers in order to solve the above questions.

Moreover, for businesses when planning to use a new technology like a drone, it is important to understand what value it can bring. One way to gauge the quality of technology is to look at customers' attitude and also evaluate its effectiveness in customers' intention compared with a traditional delivery method (Albayati et al., 2020). Stemming from the above practical problem and research gap, this study analyzes the impact of drone delivery services on customers' intention to use drones in an online shopping context with theoretical and practical contributions.

2. Theoretical framework

2.1. Drone delivery innovation

According to Chaurasia and Mohindru (2021), "a drone is a type of flying vehicle or unmanned aircraft with remote control and without the presence of humans inside the cockpit, and it can come in many different shapes, sizes, and roles". Relating to innovation and following the suggestion of Rogers (1983), "relative advantage, compatibility, complexity, speed, and observability as attributes of innovations" while the finding of Choudhury and Karahanna' (2008), noted "one more of the relative advantage of electronic channels, namely convenience". Therefore, this study is also based on the suggestion of Rogers (1983) and Choudhury and Karahanna (2008) to investigate the impact of drones on Customer intention towards delivery services under three attributes, including convenience, speed and compatibility. The convenience of a service is its ease of accessibility (Najmi, 2017). In the case of self-service technology, convenience is expressed through three main aspects: geography, time (such as opening times) and effort (such as ease of use) (Duarte et al., 2018). Speed concern is defined as a service attribute that is incorporated into the design of drone services to improve customers' control over personal or financial information when using the service (Sun et al., 2021). Compatibility is defined as the uniformity and accuracy of drone services. Compatibility is measured through four criteria in the ability to provide the correct

service: (1) in terms of logistics, (2) in technical terms (Ali et al., 2021), (3) the ability to guarantee goods management, and (4) overall assessment when compared with delivery operations performed by humans (Hwang & Kim, 2021).

In Vietnam, the Ministry of National Defense grants flight permission to Vietnamese and foreign military aircraft operating civil flights in Vietnam and to unmanned aircraft. According to the Civil Aviation Authority of Vietnam (CAAV), flying a drone is legal in Vietnam. Every drone flight conducted in Vietnam requires a special flight license that should be submitted to the Department of Defense at least 14 days before the flight (Bina & Francis, 2020). Recently, the Ministry of National Defense required all drone flyers to have a license to take flight for personal or commercial use. Since 2019, the drone issue has been included in the announcements and directives of the Vietnamese government related to aviation safety and security. In 2020, there is a direction on enhancing management and supervision measures for driven and super-small flight vehicles. In 2022, drones started to be employed in monitoring the growth of crops to help find ways to fertilize to increase production. In these regulatory corridors, since the content supports the flight operations of drones, drones are allowed to operate in many areas (Tran & Nguyen, 2020). According to the registration specification, the operator has the right to decide the model of drone management in the allowed area (Chi et al., 2023). There have not been any classifications or specifications for drones from the government. These conditions have made drone application in Vietnam have an impressive development (Tran & Nguyen, 2020). Therefore, it is necessary to study the intention to use drones in delivery from the customer's perspective.

Based on the diffusion of innovation theory (Rogers, 1983) and the technical acceptance model (Davis, 1989), this study develops a theoretical model of the relationships between three attributes of drones and customer intention to use.

2.2. Diffusion of innovation theory and technical acceptance model

Rogers (1983) stated that “diffusion of innovation theory has been frequently used in

communication and information systems research to assist in understanding why consumers adopt innovative technology”. Several studies have found that only three of these - relative advantages (speed and convenience), compatibility, and complexity - are related to innovation (Kang et al., 2015). Relative advantages are considered as “the degree to which (it is) an innovation” and “perceived as being better than its competitors” (Rogers, 1983). Moreover, Yoo et al. (2018) identified that drone speed and convenience advantages and compatibility significantly impact customers' attitude, while Lee and Lee (2020) proposed that consumers require not only service quality and convenience, but also the “type of service they prefer”, and “speed of service became important”. Therefore, this study investigates three attributes of new technology innovation in delivery services (drones), which are, convenience, speed, and compatibility. On the other hand, several studies on the diffusion of innovation theory focused on how perceptions of innovation characteristics affect customers' adoption. Moon and Kim (2001) argued that the Technology Acceptance Model (TAM) is used to explain and predict the acceptance of technology. Relative advantages and compatibility in the diffusion of innovation theory are similar to perceived usefulness and ease of use in the TAM (Wu & Wang, 2005).

Costs are defined as the opportunity costs encountered as a result of using a drone. Costs are measured across three factors: search, learning, and effort costs associated with using a drone (Lv et al., 2021) or measured by three items (operation, maintenance, and transaction) under the suggestion of Nayal et al. (2021). Economic/financial factors are removed from the scale because according to the current operating mechanism of drones, customers will not be charged when choosing this method.

Behavioral intention refers to an individual's ability to engage in a particular behavior (Oliver et al., 1997). It has been measured using various secondary dimensions, such as intent to use, word of mouth, and willingness to pay above the selling price (Han et al., 2018). Customers' intention to adopt technology applications has been widely investigated (Chi & Vu, 2023).

2.3. Hypothesis development

Geographically, a drone delivery station or cabinet is located near a place of residence, work or intersection will be suitable for individuals who often have to move (Hwang & Kim, 2021). In terms of time, instead of having to wait at home to receive goods, customers can pick up the goods from the cabinet whenever it is convenient (Wiastuti et al., 2022). Finally, in terms of effort, in today's digital age, it is often easier for customers to accept, support and become interested in new technologies related to their mobile phones (Osakwe et al., 2022). Since these drones are automated and need to be connected to a mobile phone in order to deliver items, the effort required to learn how to use this relatively new service is relatively low. Based on the above arguments, the study proposes that convenience can increase customers' perceived value in terms of functionality (saving waiting time and reducing effort in general related to using service usage) and emotion (creating excitement when interacting with cabinets). This study also suggests that convenience can reduce users' costs. Firstly, if a drone delivery station is located near a customer's place of residence or where they perform daily activities, the time and cost of commuting will be reduced, thereby reducing costs (Yaprak et al., 2021). Second, drones eliminate the opportunity cost of unnecessary waiting time for home deliveries. Finally, thanks to their smart and user-friendly design, drones reduce the costs associated with learning about them and using them (Jiang & Ren, 2020). The hypotheses propose that:

H1a: Convenience of a drone has a positive impact on customer attitude.

H1b: Convenience of a drone has a negative impact on costs.

Compared with home delivery, a drone delivering to a station is more reliable as it reduces the risk of late delivery (Miranda et al., 2022). Customers only receive a notification from the shipping provider when the item is ready for pickup. In addition, a drone reduces failed deliveries in case the recipient is not at home. Even if shippers can have someone else pick them up for them, they still run the risk of their goods being stolen, damaged or lost.

Besides, humans cannot completely avoid errors in knowledge, operation or evaluation, so fully automatic drones will make the receiving process more reliable (Hamdi et al., 2020). All of the above characteristics of the service will enhance perceived value in terms of functionality (shown through a process free from technical or human error).

Thanks to its speed, a drone can reduce unwanted opportunity costs caused by late deliveries or failed deliveries (Euchi, 2021). These costs include the time and effort spent waiting, delaying deliveries, or having someone else (neighbor or family member) pick up the goods for you. In addition, costs related to correcting errors delivered to the wrong address, contacting customer service or rescheduled delivery can be kept to a minimum. The hypotheses are the following:

H2a: Speed concern of drones has a positive impact on customer attitude.

H2b: Speed concern of drones has a negative impact on costs.

Compatibility is becoming one of the biggest concerns of customers in the digital age (Ganguly & Barua, 2021). One of the benefits of drones compared to home delivery is that the delivery is made to a centralized pick-up point. This protects the privacy of the customer, as personal information (address, phone number, etc.) will not be disclosed to the staff of the transportation service. Finally, information security policies, whose primary function is to inform customers of how the company uses their information, often indirectly tell about the data security system that the company uses (Campi et al., 2016). This policy can help build customer trust and reduce concerns about invasion of privacy (Wu et al., 2012). Many companies operating on online platforms are often transparent about their information security policies to eliminate worries about personal information being disclosed or misused (Chua et al., 2021). From the above arguments, the compatibility of drone services enhances perceived value in terms of functionality (for example, through value co-creating behavior or through users' assessment of security capabilities), emotionally (coming from a feeling of greater control, especially for

individuals who value privacy) and socially (through conforming to social norms) and recommendations on information security (Kang et al., 2015). Several studies demonstrated that compatibility influences customers' attitude towards the innovative system (Yoo et al., 2018; Shim et al., 2016).

While compatibility functions can make transactions complicated (e.g. steps like scanning a QR code, entering passwords, signing a confirmation or entering an ID/ID card number, etc.) (Wang et al., 2017). First, direct costs from identity and financial information theft, tampering, theft of goods, or unattended user access activities can be avoided if the system is sufficiently resilient. Second, indirect costs include additional time and formula spent on finding, researching, and evaluating deficiencies in security systems or taking measures to prevent invasion of privacy can be reduced (Ali et al., 2021). Moreover, according to Yoo et al. (2018), "attitude indicates consumers' favorable or unfavorable intention to use a particular innovation. In this study, customers' attitudes refer to their evaluation towards drone delivery services". The literature shows that attitude impacts an individual's behavior (Sharma et al., 2021; Dhir et al., 2021, Chi et al., 2023). Consequently, hypotheses are proposed that:

H3a: Compatibility of drone services has a positive impact on customer attitude.

H3b: Compatibility of drone services has a negative impact on costs.

H4: Customer attitude has a positive impact on customer intention to use drone services.

According to Oliva et al. (1992), the costs occurring during the use of the service will have an influence on a customer's behaviors. Many empirical studies have supported this argument (Li & Fang, 2022; Chang et al., 2022). A customer considering purchasing a product is likely to assess the product's value and buy it if the value of the product match the customer's expectations, and product evaluation cost positively mediates reuse intention (Zhang et al., 2011). Masri et al. (2020) demonstrated that monetary value, product evaluation cost, and customer enjoyment have a relationship with the intention to purchase and to reuse the products or

services as influenced by trust in the online vendor. Specifically, if customers have to spend less time and cost to use the service, they will intend to use this service. Hence, we hypothesize that:

H5: Costs have a negative impact on customer intention to use drone services.

The proposed framework is suggested in Figure 1.

3. Methodology

3.1. Measurement

To operationalize latent constructs in the study, scales have been taken from prior literature with relevant modification in item wordings to fit the context. Three items of drone convenience are respectively in conformity with the studies of Hwang et al. (2021). Meanwhile, three items of speed concern are captured from Tan and Teo (2000). Compatibility is captured using three items from the study of Yoo et al. (2018). Costs have three components and are adapted from Nayal et al. (2021). Customer attitude has three components from Yoo et al. (2018) and Lee (2009). Finally, customers' intention to use drone services has three items from Yoo et al. (2018) (Table 1).

3.2. Sample and data collection

Based on the rule of thumb in the multivariate analysis literature of Comrey and Lee (1992), the sample size is identified by at least 300 observations. Therefore, 700 questionnaires were distributed to obtain at least 350 observations. To validate participants, they were kindly asked whether they experienced online purchasing on the first page of the online form. If they had experienced online purchasing, they continued to fill out the questionnaire. Otherwise, an introductory brief was made for each participant in order to make sure that they fully understood the survey context and technical terms. Further, after each participant completed the questionnaire, they received a small financial incentive from the research project (approximately USD 2.12). This study follows proper ethical procedure, by ensuring that the answers of participants are kept confidential. In addition, questionnaires are anonymous. The questionnaires that contain

incomplete or disengaged responses are discarded. Only complete questionnaires are used. As a result, 405 responses were recorded for the analysis, which represents a retrieval rate of 57.9 percent.

Regarding the data analysis method, this study firstly employed “Exploratory Factor

Analysis”-EFA and “Confirmatory Factor Analysis”- CFA to check the validity and reliability of all items in the scale. Secondly, this study conducted SEM using SPSS AMOS 22.0 for testing the proposed hypotheses (Hair et al., 2010).

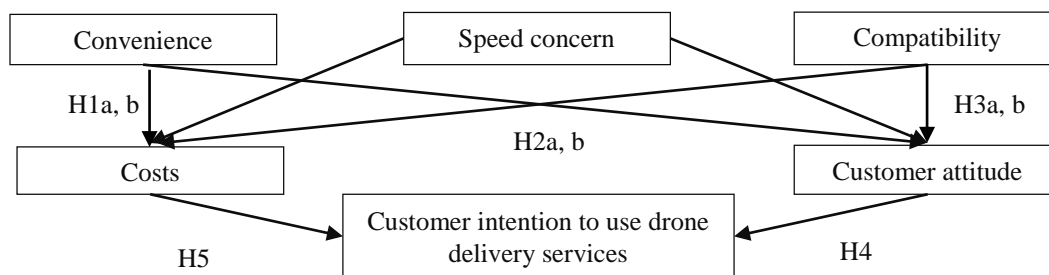


Figure 1: The proposed framework
Source: Authors’ compilation.

Table 1: The measurement scale of proposed constructs

Constructs	Items	Source
Convenience	Drone services allow users to pick up goods at different times	Hwang et al. (2021)
	Customers can easily manipulate a drone to pick up goods	
	Drone delivers products anywhere customers require	
	Customers find it easy to use drone services	
Speed concern	Drone delivery allows me to receive a fast package	Tan & Teo (2000)
	Drone delivery is a quick way to get a package delivered	
	Drone delivery for quick package pickup is useful	
Compatibility	Using drone delivery is compatible with all aspects of my work	Yoo et al. (2018)
	I think that using drone delivery is very much in line with my expectations	
	Using drone delivery suits my lifestyle	
Costs	Maintenance cost	Nayal et al. (2021)
	Operational cost	
	Transaction Cost	
Customer Attitude	In my opinion, using drone delivery would be a wise idea	Yoo et al. (2018), Lee (2009)
	In my opinion, using drone delivery to pick up a package would be a wise idea	
	I think I find it easy to use drone delivery	
Customer intention to use Drone service	I will use drone delivery to receive my order	Yoo et al. (2018)
	I will use drone delivery to pick up products	
	I can see myself using drone delivery to pick up a package	

Source: Authors’ compilation.

4. Results

The research sample consists of 405 valid observations of online customers. In the research sample, males account for 43.2% and females 56.8%. The group of respondents aged 18 - 29

accounts for 57.5%, while the group aged 30-40 years accounts for 42.5%. Of the research sample, people with academic qualifications of undergraduate and master's degree account for 75% (Table 2).

Table 2: The respondents' information

		Percentage (%)
Gender	Female	43.2
	Male	56.8
Age	18-29	57.5
	30-40	42.5
Education	Sub-degree	20.3
	Undergraduate degree	54.7
	Master degree	19.0
	Doctoral degree	8.0

Source: Authors' compilation.

4.1. The validity and reliability analysis

In this study, we followed the suggestion of Hair et al. (2010) in using CFA-confirmatory factor analysis. The reliability of the indicators is confirmed by capturing standard factor loadings ($\lambda > 0.70$). Composite reliability for the latent constructs remained significantly high (greater than 0.70) following the research of Fornell and Larcker (1981). Further, Cronbach's Alpha (α) known as the reliability coefficient, was found to be above the designated cutoff value of 0.70 (Table 3). Regarding validity, items loading highly significantly onto corresponding constructs confirm convergent validity that is further vetted by finding the average variance extracted score above 0.60.

4.2. Hypotheses testing

Causal relationships among the latent constructs have been examined through the SEM model and modeled on AMOS 26. The measurement model confirmed in the previous step was subjected to structural theory testing by estimating paths and overall model fit. The

proposed hypotheses (H1a, H2a, H2b, H3a, H4, and H5) are accepted, H1b and H3b are not supported (Table 4).

Drone convenience, speed, and compatibility all affect customers' attitude toward drone delivery services while convenience and compatibility do not have a negative impact on costs. Drone convenience has the highest impact (0.451) on customers' attitude while speed concern has the lowest impact. In regard to customers' intention to use drone delivery services, customers' attitude has a strongly positive impact while costs have a negative influence.

5. Discussion

The empirical investigation of this paper discovered customers' potential attitudes towards drone usage and delivery intentions. The empirical results of this paper indicate that drone delivery services have significantly impacted customers' attitude and their intention to use drone delivery services.

The findings of this study show that drone convenience, speed, and compatibility are the key factors of customers' attitudes. Moreover, "positive attitude" created the high level in intention to adopt drone delivery services, which is in line with the findings of Yoo et al. (2018). The results about the relationship between drone convenience and customers' attitude are similar to the study of Sun et al. (2021). However, drone convenience does not generate higher costs. This finding is somewhat similar to the results of Yoo et al. (2018). They argued that drones reduce delivery costs and satisfy customer expectation.

Table 3: The test-validity and reliability

Constructs	Range of loadings (CFA)	Cronbach's Alpha	Composite reliability	Average variance extracted
Convenience	0.720 - 0.811	0.827	0.828	58%
Speed concern	0.715-0.803	0.785	0.782	53%
Compatibility	0.699-0.789	0.834	0.866	56%
Costs	0.687-0.795	0.772	0.769	52%
Customer attitude	0.713-0.831	0.843	0.891	55%
Customer intention	0.741-0.896	0.852	0.897	62%
Chi-square/df = 2.347; CFI = 0.911; TLI = 0.912; IFI = 0.918, RMSEA = 0.056				

Source: Authors' compilation.

Table 4: Path analysis results of the baseline model

	Relationships	Path coefficient	P	Test result
H1a: Convenience	→ Customer attitude	0.451	***	Supported
H2a: Speed concern	→ Customer attitude	0.116	0.032	Supported
H3a: Compatibility	→ Customer attitude	0.318	**	Supported
H1b: Convenience	→ Costs	0.016	0.058	Not supported
H2b: Speed concern	→ Costs	-0.007	0.018	Supported
H3b: Compatibility	→ Costs	0.022	0.072	Not Supported
H4: Customer attitude	→ Customer intention to use Drone	0.602	***	Supported
H5: Costs	→ Customer intention to use Drone	-0.074	0.043	Supported

Note: *** < 0.001.

Source: Authors' compilation.

The second critical finding reveals that a drone's speed increases the positive attitude of customers toward drone delivery services. This finding is in accordance with the suggestion of Hamdi et al. (2020). They suggested that "drones offer low-cost, safe operations to monitor locations inaccessible to humans". This is also a reason to explain why the speed attribute of drones has a negligible impact on costs. It also can be concluded that costs in this study are related to customers' effort in monitoring, searching, and comparing the products or sellers.

The third finding shows that drone compatibility has significantly influenced customers' attitudes. This result is somewhat similar to the work of Kang et al. (2015), which confirmed the compatibility is a key determinant in satisfying customers' needs and demands. Unfortunately, compatibility has no impact on costs. This finding is different from the results of the Wang et al. (2017) study. The final result suggests that costs reduce the customer intention to use drone delivery services. This finding is in line with the argument of Li and Fang (2022) and Chang et al. (2022) about the cost in using drones.

6. Implications

6.1. Theoretical implications

The current paper brings several significant contributions to the literature. Firstly, this research provides a relatively comprehensive model to evaluate the adoption of drone delivery services in online retailing. Although there have been several research studies on the impact of drones in this field, they did not mostly focus on providing a complete measure to evaluate drones

in an emerging economy but only picked out a few outstanding features for analysis. Therefore, it can be said that this study is novel as it gives a different view on how to evaluate customer behaviors toward drone services in e-tailing. Secondly, positive attitudes to drone delivery generated higher intention to use it. Unlike previous studies using the TAM, this study defined relative advantage as a multidimensional construct and divided it into speed, compatibility and convenience. Three variables positively affected attitudes toward drone delivery. Thus, people who perceive that drone delivery might be faster and more environmentally friendly than traditional delivery modes are more likely to adopt it. Thirdly, this study also reveals that the convenience and compatibility of drones do not relate to the increase in costs. This contribution promises the successful adoption and application of drones in an emerging economy. To reduce delivery costs and satisfy customer expectations for delivery service quality, many firms are considering drone delivery as an innovative technology. However, it is unknown whether customers are willing to adopt it in spite of its advantages such as delivery speed, compatibility, and its convenience over traditional delivery systems. This empirical study explored potential customers' attitude toward drone delivery and adoption intention.

6.2. Practical implications

Several implications in the real-world context need to be noted regarding this study. Firstly, in order to promote and create conditions for drone delivery services to develop in an emerging economy, the role of Government and

policy-makers is very important in communicating information about drones to consumers and related stakeholders. Drone delivery service targets three groups of stakeholders: one is the consumers who buys goods online - the group of direct users; second, e-commerce companies who have their own delivery teams; third are logistics companies - this group has the ability to self-deploy drone services to delivery methods. The communication needs to be done clearly and specifically for each of the above target groups to achieve the best effect. Secondly, this study has managerial implications for firms preparing to offer drone delivery. The study showed that the determinants of positive attitudes can differ depending on the customer's area of residence. Therefore, firms should emphasize different drone delivery characteristics depending on the characteristics of the customer and of the customer's location. For urban customers, companies should highlight drones' advanced technologies and the safety of their delivery in order to reduce customers' anxieties about performance risks. For rural customers, companies should emphasize their privacy policy to reduce privacy concerns. For applying drones in delivery, firms may advertise drone services via a new media channel such as the social network to increase the likelihood of drone service exposure.

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