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Article

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Cogent Business & Management

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Suggested Citation: Chen, Charlie; Nakayama, Makoto; Ractham, Peter (2023) : Increasing the intention of Gen Zers to adopt drone delivery services based on a three-step decision-making process, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 10, Iss. 1, pp. 1-21,
<https://doi.org/10.1080/23311975.2023.2188987>

This Version is available at:

<https://hdl.handle.net/10419/294329>

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To cite this article: Charlie Chen, Makoto Nakayama & Peter Ractham (2023) Increasing the intention of Gen Zers to adopt drone delivery services based on a three-step decision-making process, Cogent Business & Management, 10:1, 2188987, DOI: [10.1080/23311975.2023.2188987](https://doi.org/10.1080/23311975.2023.2188987)

To link to this article: <https://doi.org/10.1080/23311975.2023.2188987>



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Received: 28 September 2022
Accepted: 06 March 2023

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Reviewing editor: Balan Sundarakani, University of Wollongong Faculty of Business, United Arab Emirates

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OPERATIONS, INFORMATION & TECHNOLOGY | RESEARCH ARTICLE

Increasing the intention of Gen Zers to adopt drone delivery services based on a three-step decision-making process

Charlie Chen¹, Makoto Nakayama² and Peter Ractham^{3*}

Abstract: Generation Zers are digital natives who may be early adopters of drone delivery services for e-commerce. Therefore, e-commerce vendors must understand what causes Gen Zers to believe, desire, and intend to adopt drone delivery services. Gen Zers were surveyed regarding their decision-making processes using the DITTO research framework (Diversity, Individualism, Teamwork, Technology, and Organizational Support) and belief-desire-intention theory. A survey was conducted with 83 Gen Zers from the United States, and data was analyzed using multilinear regression analysis. Many important implications can be drawn from the analysis results. Before Gen Zers adopt drone delivery services, the “seeing is believing” moment appears to be essential, according to the analysis. Moreover, e-commerce vendors should emphasize drone delivery’s relative advantages in terms of speed and environmental protection. Based on our findings, Gen Zers are rational decision-makers when it comes to adopting drone delivery services. To motivate Gen Zers to use drone delivery services, it is imperative to help them develop the belief and increase their desire.

Subjects: Management of Technology & Innovation; Marketing; Information Technology

Keywords: Drone Delivery; E-Commerce; Generation Z; Last Mile Delivery

1. Introduction

The global Covid-19 pandemic, Ukraine war, and high inflation have intensified environmental uncertainties and disrupted global and local supply chains. Retailers are struggling to fulfil and deliver orders to customers on time because of the growing number of unpredictable events. The uncertainty of receiving orders has increased anxiety and dissatisfaction among customers (Yaprak et al., 2021). Gen Zers, especially, could feel the most impact during uncertain times because they are active users of e-commerce (Wood, 2013). A study conducted in the USA found 87% of Gen Zers have been Amazon Prime members (Statista. (2022). Share of online consumers in the United States who are Amazon Prime members in, 2019). This finding indicates that Gen Zers are time and cost-sensitive regarding the delivery of online orders. Having online orders delivered faster and cheaper could be imperative to Gen Zers during times of uncertainty. Gen Zers could be early adopters of innovative delivery services because they expect faster delivery of online orders. Also, the outbreak of Covid-19 has accelerated the demand for contactless delivery such as drone delivery due to national lockdowns and Covid-related movement restrictions (Chamola et al., 2020). The global pandemic provides business opportunities for traditional retailers to leverage new and innovative deliver services to customers during the lockdown and beyond due to the increased demand in contactless delivery post pandemic (Wang et al., 2021.) Thus, drone delivery could provide an innovative service which is fast, contactless, affordable and

environmentally friendly for the Gen Zers to adopt for their e-commerce purchases (Xie et al., 2022.)

A growing number of businesses, such as Zipline, have started experimenting with drone delivery services to overcome the current challenges in last-mile delivery (Euchi, 2021). Leading companies, such as Amazon, UPS, and DHL have publicized their future plan of using drones to deliver packages to customers' premises (Iranmanesh & Raad, 2019). Amazon's Prime Air is one of the most well-known drone delivery services despite its current market unavailability. By 2030, drone delivery services are predicted to save the online merchants close to 50 million U.S. dollars in delivery charges and increase e-commerce revenues by 25% (Born Techies, 2022). Research shows that 47% of American customers are interested in using last-mile drone delivery services (Statista, 2017). In 2019, the U.S. market size of the drone delivery services reached 266 million U.S. dollars and is expected to reach 9 billion U.S. dollars by 2030 (Statista, 2022). Share of online consumers in the United States who are Amazon Prime members in, 2019).

However, most Gen Zers are not familiar with drone technology and its applications in the retailing business. Gen Zers can be receptive to the novelty concept. They are most likely to adopt drone delivery services that are fast and affordable. Thus, drone delivery services can have a considerable effect on the future of e-commerce. Traditional retailers can offer drone delivery services to overcome environmental uncertainty and pandemic-related challenges. However, commercial drone delivery is still at the inception stage. For example, regulations and customer acceptance are two significant barriers to the general public's adoption of drone delivery services in developing countries (Chen et al., 2022). The global pandemic also forced many countries to make regulatory changes to reap the commercial benefits of drone delivery services. As such, local Chinese businesses and customers have started to explore the business values of drone delivery services (Hsu, 2022). Therefore, it is vital to investigate e-commerce customers perceptions of last-mile drone delivery services in order to predict the mass acceptance of the innovative delivery method.

In developed countries, companies like Amazon, UPS, and Domino's have announced plans to use drones to deliver packages to customers' premises quickly (Iranmanesh & Raad, 2019). Developing countries, however, use drones primarily to assist displaced and vulnerable populations or smart farming activities (Srivetbodee & Igel, 2021). India, for example, has used drones to deliver emergency medical supplies to remote areas (Laksham, 2019). A number of African countries have employed drones in disaster relief operations (Naidoo et al., 2011). Specifically, this study examines how Gen Zers perceive drone delivery services in the context of e-commerce in developed countries.

The extent studies on drone delivery adoption examine factors influencing behavioral intention to use drones. Those factors identified include: desire, outcome expectancy, and lifestyle expectancy (Osakwe et al., 2022); awareness of consequences (Hwang, Kim, Gulzar et al., 2020); sense of obligation to take pro-environmental actions (Hwang, Kim, Gulzar et al., 2020); attitude driven by functional, hedonic and social motivations (Hwang et al., 2019); the advantages of decrease in delivery time, environmental friendliness, complexity, performance risk, and privacy risk (Yoo et al., 2018); and characteristics of innovation, relative advantage, compatibility and trialability (Yuen et al., 2018). The above mentioned studies implicitly assume that consumers can form their intention solely based on media reports and second-hand knowledge. One important aspect underconsidered is how the actual experience of seeing drone use influence the intention to adopt drone delivery.

Gen Zers are digital natives and open to new ideas and technologies adoption. Gen Zers could potentially be receptive to the novelty idea of drone delivery services. However, their intention to adopt drone delivery services may remain purely hypothetical without having some first-hand knowledge. This study aims to understand the role of Gen Zers' drone experience to adopt last-

mile drone delivery services using belief-desire-intention (BDI) theory. The research questions are as follows: First, what factors are critical to the increased desire of Gen Zers to use drone delivery services? Second, what relative advantages can drones provide that would promote Gen Zers' intention to switch to drone delivery services? The research objective is to inform e-commerce businesses about how to increase the desire and intention to use last mile drone delivery service for Gen Zers based on the insights learned from the study. The findings of this study can help accelerate the adoption of drone delivery services by learning how to penetrate the demographic cohort because they are potential pioneers and early adopters.

The remainder of the paper is organized as follows. We will first review the literature on drone adoption, belief-desire-intention (BDI) theory, Gen Zers' characteristics, and the propensity of Gen Zers to adopt drone delivery services. A hypotheses will be proposed at the end of the literature review, followed by the research methodology and data analysis. Analysis results will be reported to validate our proposed hypotheses. Theoretical and practical implications will be drawn based on the analysis results. This study concludes with limitations and future research directions.

2. Conceptual formation

2.1. Drone adoption related theories

The current literature on drone delivery services primarily builds upon technology adoption, privacy calculus, and diffusion of innovation theories. Technology adoption theory allows researchers to examine the predictors for the intention of users to adopt drone delivery services. The Technology Acceptance Model (TAM), developed by Davis et al. (1989), suggests that users' acceptance and use of a technology originate from behavioral intention. External factors, such as attitudes, and perceptions of usefulness and ease of use, can affect the behavior intention toward adopting new technology. The theory of reasoned action is fundamental to developing TAM because it establishes a strong correlation between attitudes, behavioral intentions, and behaviors (Ajzen & Fishbein, 1969).

A vast body of research builds upon the TAM model. It demonstrates that the determinants of perceived usefulness (PU) and perceived ease of use (PEOU) can influence attitudes and behavioral intentions. Many studies have extended the use of TAM to more precisely predict the use of emerging technologies by incorporating additional constructs (Venkatesh & Bala, 2008). For instance, studies on e-commerce, electronic healthcare records, and autonomous driving have shown that the behavioral intention of users also needs to consider trust and perceived risks (Egea & González, 2011; Featherman & Pavlou, 2003; Kesharwani & Singh Bisht, 2012; Lee, 2009; Y.-H. Li & Huang, 2009; Lu et al., 2005; Suh & Han, 2002; Zhang et al., 2019). Recent studies have recognized the general applicability of the TAM model and used it to explain the behavioral intention of adopting drone delivery services by users (Chen et al., 2019) and organizations (Ali et al., 2021). Research from Choe et al. (2021), Ramadan et al. (2017), and Dejonghe (2019) has also employed TAM to explain the effects of the perceived ease of use and usefulness on the consumer's attitudes and behavioral intentions to use drone food delivery services.

In contrast, privacy calculus theory examines drone delivery adoption behaviors from the dual lens of perceived risks and benefits. Users decide to disclose information by weighing anticipated benefits and perceived risks before deciding how much information to disclose to others (Laufer & Wolfe, 1977). Drone delivery could pose more risks than benefits. Privacy calculus theory offers a balanced view of drone adoption behaviors. Drone delivery services heavily rely on location-based technologies, such as GPS and sensors. Previous research has shown that privacy calculus theory can help to understand various location-based technologies. These technologies include e-commerce, social networking services, mobile applications, and healthcare wearable devices (Dienlin & Metzger, 2016; Dinev & Hart, 2006; Li et al., 2016; Xu et al., 2009). Thus, a few studies also use privacy calculus theory to explain the behavioral intention of users to adopt drone delivery services (Leon et al., 2021; Xie et al., 2022).

Many drone studies have found that diffusion of innovation (DOI) theory applies to understanding the adoption behaviors of drone delivery services. For example, Demuyakor (2020) studied the use of drone delivery for medical supplies in Ghana and found it had a positive impact on the emergency health delivery system. Sharmar et al. (2018) demonstrated that the advantages of environmental friendliness, speed, complexity, performance risk, and privacy risk, affect drone delivery adoption. DOI theory asserts that the characteristics of the adopters and four key elements: the innovation, the communication channels, time, and the social system, can affect the innovation diffusion process (Rogers, 1962). The successful diffusion of innovations also contains four elements: significant relative advantage, compatibility, trialability, observability, and less complexity (Rogers, 1962). Relative advantage refers to the degree to which an innovation is better than its predecessor and its complexity (Rogers, 1962). DOI is often used to complement TAM because of its complementary nature. For instance, DOI's relative advantages and complexity constructs are surrogates used to measure the PU and PEOU constructs of TAM (Vijayarathy, 2004; Yoo et al., 2018).

The current literature has primarily used TAM, DOI, and privacy calculus theories to understand behavioral intention. However, the current study did not consider practical reasoning processes and divided the process into three phases: belief, desire, and intention. Drone delivery services are still in the introductory phase. Helping users form a strong belief and increase their desire to try drone delivery services could be even more critical than understanding users' intentions. Furthermore, very few studies have specially targeted Gen Zers as the pioneers and early adopters of drone delivery services. This study looks closely at the active e-business user segments from the BDI perspective.

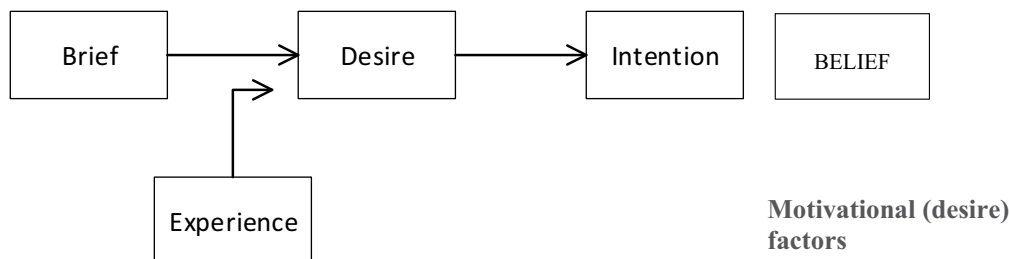
This study adopts BDI theory to propose a conceptual model (Figure 1) to guide the research. The research model examines the intricate and sequential influence of essential factors across three stages of the reasoning process within the context of Gen Zers adopting drone delivery services.

2.2. Belief desire intention theory (BDI)

The original purpose of the BDI model was to understand practical reasoning processes (Bratman, 1987). For instance, a recent study applies the BDI model to design autonomous vehicles to capture human values and minimize potential risks caused by artificial intelligence (Umbrello & Yampolskiy, 2022). Belief and desire are pro-attitudes toward taking action. Beliefs represent an agent's informational state or model of the world, whereas desires represent the agent's motivational state or goal(s; Vitek & Peer, 2020). In comparison, intention is an action choice or a conduct-controlling pro-attitude toward the deliberate state of the agent. Commitment is the major difference between desire and intention (Bratman, 1999). An increased desire level can thus lead to temporal persistence in executing sequences of actions to achieve one's desired goals (Cohen & Levesque, 1991).

The BDI model can assist in understanding how users form beliefs and desires before they intend to adopt new technology and use it to achieve their desired goals. Many studies have adopted the BDI model to understand the adoption behaviors of numerous technologies. For instance, Shen et al. (2011) investigated antecedents of the desire of users to embrace instant messaging

Figure 1. Conceptual models.



technology. They found that subjective norms, group norms, and social identity are key antecedents. An information systems security study also used the BDI model to improve the performance of security applications (Shajari & Ghorbani, 2004). The design of social robots can incorporate the BDI framework to improve the “act like a human” feature for proactive behaviors (KC & Chodorowski, 2019). These studies show that the BDI model helps to understand how users form beliefs about using new technology to achieve their desired goals. An increased desire level can help predict whether users will adopt new technology.

2.3. Gen Zers propensity to switch to drone delivery services

Gen Zers are people born between 1997 and 2012. Gen Zers account for 24% of the U.S. (Pichler et al., 2021) and 32% of the global population (Mondres, 2019). Gen Zers represent most of the incoming workforce. This new generation has grown up in a technology-driven business environment. Consequently, they possess some unique characteristics. Pichler et al. (2021) proposed the DITTO (Diversity, Individualism, Teamwork, Technology, and Organizational supports) framework to help managers and organizations effectively understand and manage Gen Zers in the workplace. They also posit that the framework can serve as a tool to improve the understanding of Gen Zers beyond workplace management. Businesses can try to improve their understanding of Gen Zers by developing mutually reinforcing policies and practices for their businesses. Gen Zers are more open to individuality, diversity and innovative technology. Thus, studying how Gen Zers adopt new technology such as drone delivery services and investigating what factors can help Gen Zers form a positive belief toward drone delivery services, could be useful for e-commerce companies. We elaborate on the five common characteristics from the DITTO framework and provide rationale for their relationships with the belief, desire, and intention to switch to drone delivery services (Table 1).

Table 1 shows that Gen Zers could potentially be more receptive to drone delivery services because these services can add diversity to their lifestyle. Gen Zers pursue an individualized lifestyle and want to improve their life’s meaningfulness. Drone delivery services empower Gen Zers to have a more individualized lifestyle because of their mobility. These services can further help Gen Zers make the Earth more sustainable. Therefore, Gen Zers are more likely to adopt drone delivery services.

The key factors that will change the belief, desire, and intention of Gen Zers to switch to drone delivery services remains unknown. This study is interested in understanding whether drone delivery services are compatible with Gen Zers lifestyles and whether the proximity or experiences can increase their desire to accept the service. After forming desires, Gen Zers can increase their intention to use drone delivery services when seeing its relative advantages. The following discussion will center on the relationships between Gen Zers’ desire and intention to switch to drone delivery services and propose hypotheses to assess these relationships.

2.4. Research models and hypotheses

This study uses the BDI model and derives constructs related to three phases of drone delivery adoption. We proposed experience as a critical lever to drive the desire to adopt drones in the context of our conceptual model (Figure 1). The following hypotheses are proposed to understand motivation and intentional factors conducive to the switching intention of Gen Zers for drone delivery services.

3. Motivational (desire) factors

3.1. The improved lifestyle compatibility can increase the desire to try drone delivery services

Lifestyle compatibility is one of the significant reasons for Gen Zers to embrace new technologies or services. Many studies have shown that Gen Zers are receptive to mobile banking (Ruangkanjanases & Wongprasopchai, 2017) and social media (Dobre et al., 2021) for online shopping because they enable a seamless online transactional process. Purchasing recycled

Table 1. The belief, desire, and intention of Gen Zers to switch to drone delivery services based on their common characteristics

DIITTO framework	Common characteristics (DIITTO)	Belief in the usefulness of delivery drones	Desire to use delivery drones in their daily life	Intention to switch to delivery drones	Sources
Diversity	Gen Z is one of the most diverse generations. Gen Z is more open to diversity than other generations. Promoting diversity can increase firm performance.	Drone delivery represents an innovative and new delivery mode. Drone delivery increases the diversity of delivery methods for online shopping.			Yoo et al., 2018
Individualism	Gen Z is used to learning and working individually. Gen Z is more individualistic than other generations.		Delivery drones can provide contactless delivery for online orders. Drones provide a faster delivery time. n.		W. Kim et al., 2020
Teamwork (meaningfulness of life)	Meaningfulness can improve individual performance.	Delivery drones are eco-friendly and emit no carbon dioxide.	Delivery drones can help save time for all involved parties. Delivery drones can help make the Earth more sustainable.	Gen Zers are more likely to embrace delivery drones if they can help save time and protect the environment.	Chiang et al., 2019
Technology	Technology is a way of life for Gen Z. Gen Z is used to communicating through technology. Gen Z leverages technology for social interaction.	Drone delivery services are a new way of life for online ordering delivery.		Delivery drones enable Gen Z to have more social interactions without waiting for their orders to be delivered to them.	Tan et al., 2018, May
Organizational supports	Gen Z grew up in a financially precarious time. Gen Z needs to feel socially supported by others. Perceptions of support improve well-being.	Drone delivery allows Gen Zers to save time and support each other to help the Earth become a better place.			Chiang et al., 2019

clothing is also compatible with the lifestyle of Gen Zers, who are concerned with the environment (Chaturvedi et al., 2020). Gen Zers can multitask using emerging technologies (e.g., social media, YouTube) to improve their job productivity and efficiency (Dewi et al., 2021).

Drone delivery services are an addition to the current online shopping experience. Gen Zers will likely employ novelty services to enrich their current lifestyle. Moreover, Gen Zers can use social media to seek and share information with others (Entina et al., 2021). When Gen Zers have the chance to see delivery drones or use the technology, they are likely to share their new experience with friends via social media. Thus, compatibility to use drones (Cpat) and the experience of being near an e-commerce flying drone (DroneProxi) are significant predictors of trialability: desire to try drones (Tb). Thus, we propose:

H1: The improved lifestyle compatibility can increase the desire of Gen Zers to try drone delivery services.

3.2. The close contact with e-commerce delivery drones can increase the desire to try drone delivery services

Generational cohort theory can help gain insights into customer characteristics of different market segments (Howe & Strauss, 2000). The theory asserts that generational cohorts could help better understand customer characteristics than age because they consider the shared experiences of a group of peers with common values and goals (Eastman et al., 2012). The same generational cohort usually shares common beliefs and behaviors because they experience the same changes in social norms, historical events, innovations, technological breakthroughs, new celebrities, and cultural icons (Goldring & Azab, 2021). The unique beliefs and behaviors exhibited by a generational cohort are closely tied to critical historical events, leading to a unique generational identity (Lissitsa & Kol, 2016).

Drone delivery will become a new option offered to consumers in the near future. It is essential to know whether generational cohort's positive beliefs or experiences will trigger their desire and intention to adopt this delivery option. The historical event of Apple's iPhone launch in 2007 formed the shared nomadic identity of Gen Zers during their formative years (Dimock, 2019). Drone delivery services could be the next historical event transforming today's e-commerce landscape. Gen Zers could play a decisive role in driving the mass adoption of innovative services. Suppose Gen Zers have experience using the service and enjoy its promised benefits, including fast delivery and environmental friendliness. In that case, they could utilize social media and other communication tools to influence online purchasing patterns and decisions (Rindfleisch, 1994).

Gen Zers have some shared online shopping characteristics. First, they engage in daily activities online, including maintaining and building social relationships, information searching, and shopping (Smith, 2019). Gen Zers form particular online shopping behaviors to reflect their current or aspirational self-identity, such as purchasing certain brands. Second, Gen Zers are independent-minded but also easily influenced by others' opinions because they have had a deep relationship with digital technology since they were born (Bassiouni & Hackley, 2014). Third, Gen Zers are less concerned about high-end luxury brands but always have an urgent need for uniqueness, such as having unusual hobbies or wearing clothes with a unique style. Fourth, Gen Zers grew up with social media and have engaged with brands throughout the media, such as learning and sharing brand stories with each other through online channels.

Drone delivery services match the online shopping characteristics shared by Gen Zers. Drone delivery is unique because it is faster and more environmentally friendly than traditional services. The services could also allow Gen Zers to learn about the online delivery journey after ordering goods. However, Gen Zers can only appreciate the potential value of drone delivery services when they socialize with others through information sharing and exchanging on social media. Gen Zers

are more likely to increase their desire to try drone delivery services if they are in close contact with e-commerce delivery drones and observe their usefulness. Thus, we propose:

H2: Being in close contact with e-commerce delivery drones can increase the desire of Gen Zers to try drone delivery services.

3.3. The impact of Gen Zers' desire to innovate on their desire to try drone delivery services

Gen Zers quickly search for information from multiple sources to solve their problems (Szymkowiak et al., 2021). For instance, they love to obtain coupons from different information sources (e.g., friends and shopping channels) and use them to get the best deal for each shopping experience. In addition, users of this generation are receptive to the self-service kiosks in fast food restaurants (Yang et al., 2019). Drone delivery empowers Gen Zers with another technology to automate their online shopping experience. This novelty service gives Gen Zers the autonomy to pick up orders from the delivery drone anytime and anywhere. For instance, drones can deliver packages to users wherever they are within 30 minutes to one hour. Gen Zers do not need to wait at home until they receive a package before running errands. Instead, Gen Zers can stick to their original schedule and receive their package anywhere. For instance, if someone wants to go hiking or camping, they could have a package delivered to them on the mountain. This novelty technology can automate the online shopping process and give gratification to Gen Zers within a much shorter time frame than traditional shopping tools. Thus, we propose:

H3: The increased desire of Gen Zers to innovate has a positive impact on their desire to try drone delivery services.

3.4. Intentional (conduct-controlling pro-attitude) factors

Drone delivery services are compatible with Gen Zers' lifestyles. Gen Zers favor individualized, diverse, sustainable, and technology-driven businesses. Drone delivery enables Gen Zers to use the novelty service as another tool to complete online shopping. More importantly, drones are an eco-friendly technology and help Gen Zers improve environmental sustainability. Drone delivery services are an addition to the current online shopping experience. Gen Zers will likely employ the novelty service to enrich their current lifestyle.

Moreover, Gen Zers can use social media to seek and share information with others (Entina et al., 2021). When Gen Zers have the chance to see delivery drones or use the technology, they are likely to share this new experience with a friend via social media. Thus, we propose:

H4: The improved lifestyle compatibility can increase the intention of Gen Zers to switch to drone delivery services.

Gen Zers are proponents of environmental sustainability. They believe that drone delivery is more environmentally friendly than alternative delivery methods, such as trucks or motorcycles. Truck delivery results in about 1 kg of greenhouse gas emissions. In comparison, drone delivery has about 0.42 kg (Smithsonian Magazine, 2018). The positive environmental impact of drones is much more significant than motorcycle delivery which is commonly used in emerging countries. The Global Warming Potential (GWP) is a measure of energy absorbed by the emissions of 1 ton of gas in comparison to the emissions of 1 ton of carbon dioxide (CO₂; United States Environmental Protection Agency, 2022). The larger GWP indicates that a given gas warms the Earth more than CO₂ over the same period. Park et al. (2018) found that the GWP per 1 km of drone delivery is only one-sixth of motorcycle delivery. They also found that the environmental impact reduction is 13 times higher in a rural area than in an urban area. These studies indicate that drone delivery has

a relatively more positive environmental impact than the current truck and motorcycle delivery services. The higher the relative advantage in environmental protection, the more likely Gen Zers will switch to drone delivery services. Thus, we propose:

H5: The perceived relative advantage of environmental protection can increase the intention of Gen Zers to switch to drone delivery services.

The causal effect of desire on intention is part of the decision-making core for users when deciding what new technologies to adopt. The desire and intention could be related to goal and action. Users must first desire to achieve goal intention, followed by action desire and action intention (Bagozzi, 2007). The self-regulation mechanism is critical to understanding the intention of users to adopt innovative ideas or technologies. It is imperative to increase their desire to try innovative services to increase the intention of Gen Zers to adopt drone delivery services. Lack of desire can thus result in the decreased intention of Gen Zers to adopt drone delivery services. Thus, we propose:

H6: The increased desire to try drone delivery positively impacts the intention of Gen Zers to adopt drone delivery services.

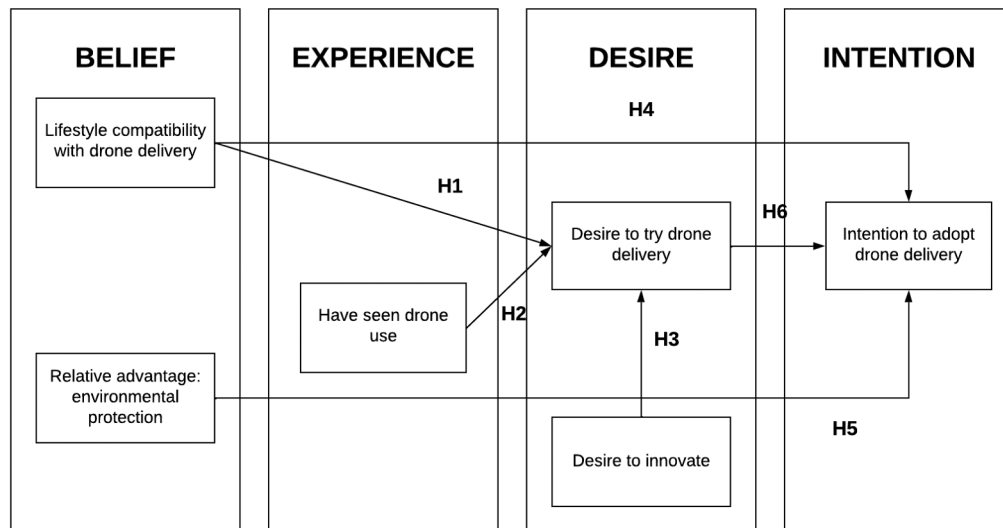
Our research models (Figure 2) depict the hypothesized relationships in four phases of adopting drone delivery services for Gen Zers.

4. Research methodology

4.1. Data Collection Procedure

The primary objective of this study was to investigate what factors contribute to the increased desire of Gen Zers and their intention to use drone delivery services. These factors were categorized into motivational and intentional factors that are likely to move Gen Zers across three sequential phases: belief, desire, and intention. Motivational factors that can increase the desire of Gen Zers to use drone delivery services include lifestyle compatibility and proximity to drones. Factors that can motivate users to take deliberate actions are intentional factors, including lifestyle compatibility, relative advantages of faster delivery time, and environmental protection.

Figure 2. Research model.



Respondents were asked to watch a video about drone delivery to ensure they understood drone delivery services similarly. This scenario was used to describe a possible future situation, including the path of development leading to that situation (Kosow & Gabner, 2008). The scenario approach does not intend to represent a complete description of the future but rather highlight possible elements. Subjects were provided with a scenario and asked to step into the situation where researchers wanted them to be and answer the question, “what are you going to do in it” (Bishop et al., 2007).

This study conducted a pilot test with a group of six graduate and four undergraduate students to review and improve the adapted survey questions. Wording and organization were revised based on the initial feedback. Next, an online pilot survey collected 50 responses. The survey was fine-tuned further based on the online pilot survey results. The 37-item survey questionnaire was then finalized and used to collect 83 responses. We collected our survey data from 83 undergraduate students in a regional business school in the USA. Responses were mainly recorded using a 7-point strongly disagree (1)—strongly agree (7) Likert scale. Multi-item semantic-differential scales were used to measure the switching intention construct. Different scales within the same survey questionnaire help lower common method bias (Podsakoff et al., 2003). In addition, manipulation questions such as speeder trap and attention filter were used to eliminate bias (Bassiouni & Hackley, 2014; Oppenheimer et al., 2009; Meade & Craig, 2012). Table 2 shows the demographic snapshot of the 83 respondents and Figure 3 outlines the data collection procedure.

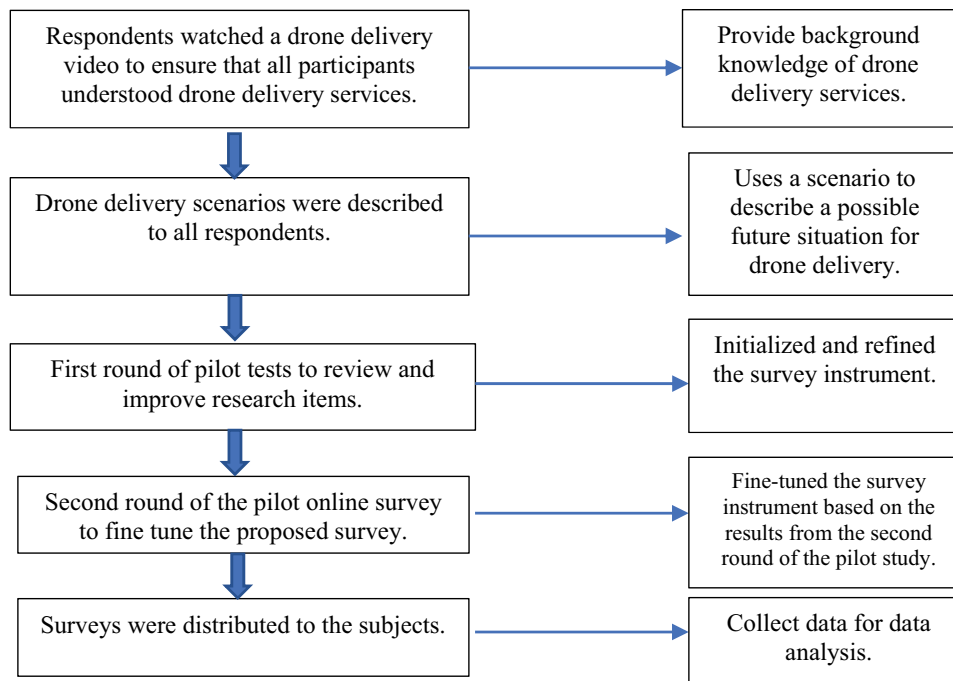
4.2. Measurement of Survey Instruments

The constructs in this study were measured using items adapted from previously validated studies. We adopt three semantic items from Bansal et al. (2005) to gauge the dependent variable switching intention to drone delivery (Table 1). For example, respondents were asked to rate the chance of switching to drone delivery, such as “the likelihood that you would switch from truck delivery to drone delivery.” There were four items to measure the attitude of respondents towards the advantages of speed and the environmental protection offered by drone delivery. These items were initially designed to test the emerging technology diffusion process (Moore & Benbasat, 1991). Extant research has applied them to various technology-enabled service contexts, such as mobile banking (e.g., Al-Jabri & Sohail, 2012).

All variables have clear operational definitions. The environmental advantage of drones was determined by their superiority over alternative delivery methods (e.g., trucks). Compatibility was

Table 2. Demographics	
Demographics	Statistics
Gender	Female = 28 Male = 55
Transportation	Yes = 78 No = 5
Drone proximity	Yes = 5 No = 78
Amazon Prime membership	No = 6 Had = 14 Yes = 63
Neighborhood type	Tight = 27 Close = 30 Moderately close = 23 Distanced = 3
Delivery frequency	Average = 1.8/per month
Shopping distance proximity	Average = 7.13 minutes/per month

Figure 3. Data Collection Procedure.



determined by how well drones aligned with the values, needs, and previous experiences of potential users. The desire to try drones was a measure of trialability, that is, the ability to experiment with drone delivery before it becomes popular. Gen Zers' desire for innovation refers to their intention to adopt drone delivery services when they become available. Intention to adopt drones refers to the probability that users will switch from alternative delivery methods to drone delivery services. We modified the original questions to reflect the context of drone delivery services. Table 3 shows the measurement items and adapted literature.

4.3. Regression models and hypothesis testing results

We ran two regression models with Desire to Try Drones (DTD) and Intention to Adopt Drones (IAD) each as the dependent variables. First, the regression model was significant with $F_{79,3} = 20.561$ ($p = 0.000$) and Adjusted- $R^2 = 0.417$. Table 4 and Figure 4 show the summary of regression results. Because the sample size is less than 100, we estimated the possible bias using 10,000 Bootstrap samples. The bias estimates were small, with 1.6% as the maximum for INNV. The collinearity indicators, or variance inflation factors (VIFs), were below 5 (Everitt & Skrondal, 2010) for the three independent variables.

Drone compatibility (COMP) was significant as expected with $\beta = 0.330$ and $p = 0.001$. This supports H1 (the improved lifestyle compatibility can increase the desire of Gen Zers to try drone delivery services). Having Seen Drone Use (PROX) and Desire to Innovate (INNV) were also significant each with $\beta = 0.218$ and $p = 0.000$ as well as $\beta = 0.393$ and $p = 0.000$. They affirm H2 (being in close contact with e-commerce delivery drones can increase the desire of Gen Zers to try drone delivery services) and H3 (the increased desire of Gen Zers to innovate has a positive impact on their desire to try drone delivery services).

Second, the regression model for switching intention to use drones was significant with $F_{79,3} = 15.777$ ($p = 0.000$) and Adjusted- $R^2 = 0.351$. Table 5 and Figure 5 show the summary of regression results. The bootstrap simulation with 10,000 samples shows the maximum bias estimate was -3.6% for COMP. The VIFs were all well below 5 (Everitt & Skrondal, 2010), indicating collinearity was not an issue for the regression model. As hypothesized, desire to try drone (DTD)

Table 3. Measurement Items

Construct	Code	Items	Reference
Relative advantage in environment protection $\alpha = 0.874$	AdvEn1	Drone delivery is a green way to deliver orders.	Al-Jabri and Sohail (2012) Moore and Benbasat (1991)
	AdvEn2	Drone delivery allows me to receive orders in a more environmentally friendly way.	
	AdvEn3	Drone delivery is a less carbon dioxide emitting delivery method.	
	AdvEn4	Drone delivery gives me greater control to protect the climate.	
Drone Compatibility $\alpha = 0.800$	Cpat1	Drone delivery fits well with the way I like to manage my online order delivery.	Al-Jabri and Sohail (2012) Moore and Benbasat (1991)
	Cpat4	Drone delivery is compatible with my lifestyle.	
	Cpat5	Using drone delivery fits into my online shopping style.	
Desire to Innovate $\alpha = 0.935$	Cpat2	I like to try new drone delivery technology.	Al-Jabri and Sohail (2012) Moore and Benbasat (1991)
	Cpat3	I like to adopt a new drone delivery innovation.	
Desire to Try Drones $\alpha = 0.828$	Tb1	I want to try drone delivery for at least one month.	Al-Jabri and Sohail (2012) Moore and Benbasat (1991)
	Tb2	I want to use drone delivery on a trial basis to see what it can do for me.	
	Tb3	Before deciding whether to use drone delivery, I want to try it out.	
	Tb4	I am able to experiment with drone delivery if necessary.	
Intention to Adopt Drones $\alpha = 0.949$	Si1	Rate the probability that you would switch from truck delivery to drone delivery: unlikely—likely.	Bansal et al. (2005)
	Si2	Rate the probability that you would switch from truck delivery to drone delivery: improbable—probable.	
	Si3	Rate the probability that you would switch from truck delivery to drone delivery: No chance—Certain	
Having Seen Drone Use	DroneProxi	Have you ever been in close proximity to an e-commerce flying drone? (Yes, No)	Self-developed by authors.

Table 4. Summary of the first regression model (DTD as the DV)

	B	BootBias	BootSE	β	t	p	VIF
COMP	0.393	-1.3%	0.111	0.330	3.438	0.001	1.298
PROX	4.258	0.2%	1.215	0.218	2.589	0.000	1.000
INNV	0.770	1.6%	0.201	0.393	4.094	0.000	1.298

Dependent Variable: DTD Adjusted-R²: 0.417

BootBias: Percentage of the estimated bias over the regression coefficient based on 10,000 bootstrap samples

BootSE: Standard error of bootstrap estimate

p: Estimates based on 10,000 bootstrap samples

was a significant factor with $\beta = 0.267$ and $p = 0.040$. This supports H4 (the improved lifestyle compatibility can increase the intention of Gen Zers to switch to drone delivery services). Furthermore, drone compatibility (COMP) had a significant strong influence ($\beta = 0.314$ and $p = 0.002$) on drone adoption, affirming H5 (the perceived relative advantage of environmental protection can increase the intention of Gen Zers to switch to drone delivery services). Environmental protection advantage (ENV) had a relatively marginal influence for drone adoption with $\beta = 0.215$ and $p = 0.058$. Therefore, H6 (the increased desire to try drone delivery positively impacts the intention of Gen Zers to adopt drone delivery services) was marginally supported.

Table 6 and Figure 6 summarize all hypothesis test results. The analysis results indicate that from the BDI perspective, Gen Zers desire to use drone delivery services if they find they are compatible with their lifestyle. Being near the actual e-commerce delivery drone does increase the desire of Gen Zers to adopt drone delivery services. “Seeing is believing” is also relevant to the increased desire for Gen Zers to try drone delivery services. Gen Zers have the desire to use drone delivery services. E-commerce vendors may want to increase their intention to try the service by emphasizing lifestyle compatibility and its relative advantages in speed and environmental protection.

5. Implications

There are three key implications of this study. First, the results confirm that seeing drones with one’s own eyes increases the desire and intention to use them for delivery. Second, the results demonstrate the applicability of BDI theory for experimental types of equipment or systems to assess the degree of behavioral intention for adopting them. Third, our research model gives an example of assessing the psychological process of prospective users of a new technology with

Figure 4. Influential factors for desire to try drones.

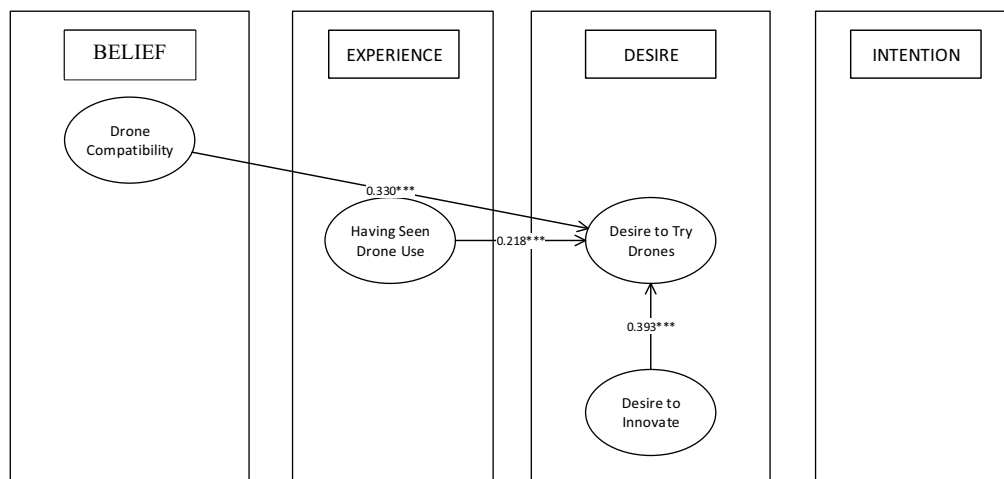


Table 5. Summary of the second regression model (IAD as the DV)

	B	BootBias	BootSE	β	t	p	VIF
DTD	0.243	-1.1%	0.116	0.267	2.521	0.040	1.417
COMP	0.339	-3.6%	0.105	0.314	2.968	0.002	1.410
ENV	0.182	0.9%	0.095	0.215	2.277	0.058	1.122

Dependent Variable: IAD Adjusted-R²: 0.351

BootBias: Percentage of the estimated bias over the regression coefficient based on 10,000 bootstrap samples

BootSE: Standard error of bootstrap estimate

p: Estimates based on 10,000 bootstrap samples

a relatively parsimonious model where it describes the process with four stages and only a few variables in each stage.

Drone use by retailers is still in the experimental or early adoption stage. For instance, Amazon plans to implement drone delivery in California (De Avila, 2022) and Walmart is expanding drone use in six American states (Feuer, 2022). Furthermore, wide-spread drone use should clear midair or ground collisions (De Avila, 2022) and explore what level of privacy would be adequate at local or state levels (Stanley, 2022). In other words, drone adoption has to go through the process of trial and error. Some level of first-hand experience is deemed critical for technology adoption involving high degrees of uncertainty.

The BDI model is also known as the theory of human practical reasoning and rooted in human’s practical reasoning process (M.E. Bratman, 1987) as opposed to the theoretical reasoning process (Michael E. Bratman, 1991). In case of drone use, there have been many media coverages—both traditional and social media—on its potentials, possible applications, and socioeconomic impacts. Gen Zers are commonly regarded as the first generation of digital natives and rely heavily on the information circulated on social media. While Gen Zers hear much about drone delivery over the internet, not all of them have first-hand knowledge of drones. This results in a theoretical understanding of drone adoption. Practical understanding may be helpful to understand the obstacles of drone delivery (e.g., reliability, local zoning laws and privacy implications).

The complexity of research models is a double-edged sword. A “comprehensive” model with multiple variables may cover many factors influencing drone adoption intension. Nevertheless, such a model may spread practical focal points to increase the likelihood of drone adoption. Our parsimonious model has four focal points. First, those who want to see the higher likelihood have

Figure 5. Influential factors for adopting drones.

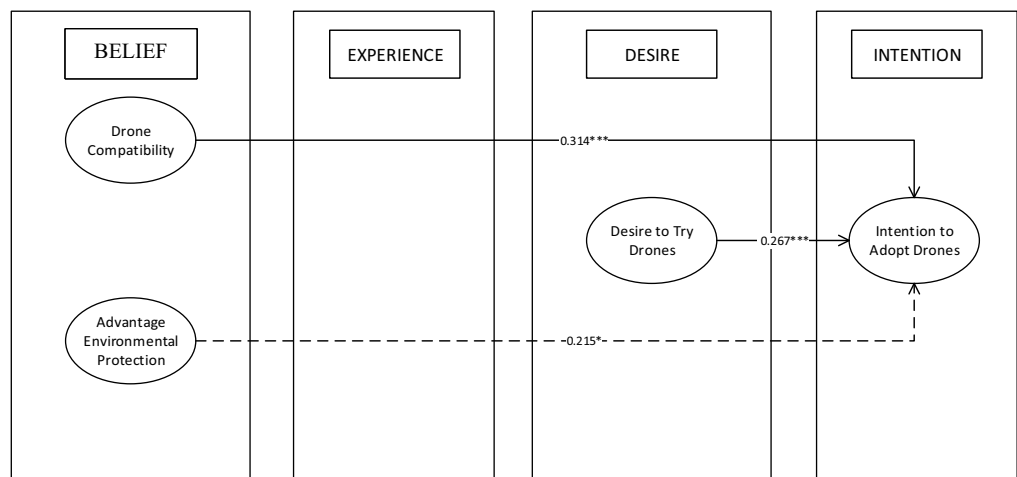


Table 6. Hypothesis Test Results	
Hypothesis	Test Results
H1: The improved lifestyle compatibility can increase the desire of Gen Zers to try drone delivery services.	Supported
H2: Being in close contact with e-commerce delivery drones can increase the desire of Gen Zers to try drone delivery services.	Supported
H3: The increased desire of Gen Zers to innovate has a positive impact on their desire to try drone delivery services	Supported
H4: The improved lifestyle compatibility can increase the intention of Gen Zers to switch to drone delivery services.	Supported
H5: The perceived relative advantage of environmental protection can increase the intention of Gen Zers to switch to drone delivery services.	Supported
H6: The increased desire to try drone delivery positively impacts the intention of Gen Zers to adopt drone delivery services.	Marginally Supported

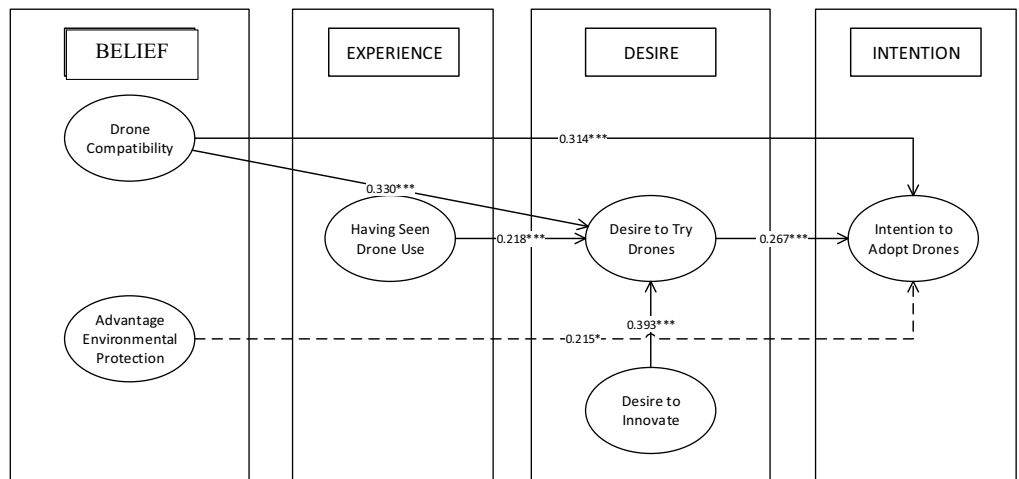
to make sure that there are practical reasons for believing in the adequate level of drone compatibility. Second, they want to show drone demonstrations and have target stakeholders see how drone delivery works. Third, brief experience lead to the desire for drone delivery. Fourth, experience and desire combined will drive more drone delivery adoption.

5.1. Theoretical implications

Different theoretical frameworks bring different emphases (Table 7). For intention, TAM looks at usefulness and ease of use whereas UTAUT focuses on performance expectancy, effort expectancy, social influence, facilitating condition, and new endogenous mechanisms. Those focal factors may not necessarily be the best assessment factors when the assessor has only second-hand information they obtained via media reports and social media posts. Similarly, DOI and privacy calculus each focus on the communication process and perceived benefits/risks. Without some experience, the assessor can provide “guesses” at best.

As our model shows the importance of experience, future theoretical developments should include some variables to measure a deeper level of experience than having seen drone use. Y. Kim et al. (2012) found that relevant experience gained in one IT problem type would be vital for

Figure 6. Influential factors for desire to try drones and adopting drones.



problem-solving of other IT problem types. They note, “experience from diverse heterogeneous problems leads to better analyses and responses because of better understanding of the underlying structure of problems” (p. 890). In the context of a new product development community, Liu et al. (2020) identified relations among past success experience, new product idea length, and idea implementation. The variable to assess drone experience can include not only the extent (e.g., context, duration, count) of seeing drone use but also the assessment (e.g., favorable, reserved, unfavorable) of seeing drone demonstrations.

Table 7. Focus factors for intention and attitude

Framework	Focal Factor for Intention and Attitude
TAM (Davis et al., 1989)	usefulness, ease of use
UTAUT (Venkatesh et al., 2016)	performance expectancy, effort expectancy, social influence, facilitating condition, new endogenous mechanisms
DOI (Rogers, 1962)	communication process aspect communication channels
Privacy Calculus (Laufer & Wolfe, 1977)	perceived benefits, risks

5.2. Managerial implications

The most pertinent implication for retailers and restaurants is that they set up a prototype drone delivery demonstration—preferably a month or so. They should film the demonstration and post the highlights to social media platforms and online video sites like YouTube. The goals of a demonstration are not only to arouse the desire to try drone delivery but also to stimulate discussions among local officials and legal experts to identify potential business/legal issues and privacy infringement. Although this study’s results have $\beta = 0.196$ for “having seen drone use,” once drone use enters the more mature phase of early implementation, the β value may exceed that of “drone compatibility ($\beta = 0.262$ in our study) if the drone demonstration can portray its benefits for different products and delivery settings. The results also suggest that “desire to innovate” is a very strong factor for “desire to try drones” ($\beta = 0.358$). That is, retailers and restaurants should target those who are curious and willing to try something new. Finally, environmental protection advantage was a marginal factor in this study. Previous studies such as Hwang, Kim, Gulzar et al. (2020) and Yoo et al. (2018) looked at the environmental/ecological factor for drone adoption. Hwang, Kim, Gulzar et al. (2020) found environmental/ecological concerns were a factor for restaurant customers in South Korea whereas Yoo et al. (2018) found they were not a factor for US citizens in 2017. Thus, environmental/ecological concerns may depend on location and/or specific product/service types.

6. Limitations and future research

There are a few limitations of this study. Our sample was Gen Zers in the US. Also, they responded to the survey without specifying product/service types. Future studies should investigate drone adoption intention with consumers in different age groups and specify delivery scenarios for specific product/service types. Another limitation is that experience was assessed with one question. As noted in the previous section, future research should explore sub-dimensions of experience such as the extent (e.g., context, duration, count) and assessment (e.g., favorable, reserved, unfavorable) of seeing drone experience. Finally, future studies could integrate the different theoretical frameworks listed in Table 6. This study is also limited by its small sample size. A small sample size could be a major problem for structural equation analysis. Nevertheless, this study used regression analysis, for which there is no recommended sample size (Virtanen et al., 1998). Increasing the sample size would make our findings more representative, and we recognize this need. As a solution to the need for a larger sample size, bootstrap simulation is employed in this study using 10,000 samples. A VIF analysis was further performed to determine whether all the variables were collinear based on our findings. Based on our findings, collinearity was not an

issue. While these technical solutions have been successful in addressing the sample size issue, future studies could include users from different generations.

7. Conclusion

This study examined the drone delivery adoption intention of Gen Zers. As the early implementation phase of drone use is seen around the globe, we chose drone experience in terms of seeing its use as one new variable because previous studies were not clear about that aspect. We also used the BDI framework to incorporate the variable on experience. The results show that experience is indeed an important driver for the desire to try drones, which is also motivated by the drone compatibility for delivery and the desire to innovate. The intention to adopt drone delivery is in turn driven by drone compatibility and the desire to try drones. Environmental or ecological consideration was found to be a marginal factor for Gen Zers. Future studies should explore the dimensions of end-user experience with drone use and assess drone adoption intention for product/service types with different delivery settings such as location, zoning regulations, delivery duration.

Funding

The authors received no direct funding for this research.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Citation information

Cite this article as: Increasing the intention of Gen Zers to adopt drone delivery services based on a three-step decision-making process, Charlie Chen, Makoto Nakayama & Peter Ractham, *Cogent Business & Management* (2023), 10: 2188987.

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