

FACTORS INFLUENCING EXPECTATIONS AND ACCEPTANCE OF DRONE DELIVERY SERVICES: A CASE STUDY IN THAILAND

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ABSTRACT

Purpose – This study aims to examine the effects of macro-environmental factors on consumer expectations and the acceptance of drone delivery services within the context of Thailand's logistics industry.

Methodology – A quantitative cross-sectional research design was employed. Data were collected from 400 consumers in Bangkok and surrounding metropolitan areas using a structured questionnaire and analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM) to assess reliability, validity, and the relationships among the proposed constructs.

Results – The findings indicate that macro-environmental factors significantly influence consumer expectations and exert a direct effect on the acceptance of drone delivery. Consumer expectations also have a positive effect on acceptance and serve as a mediating variable between macro-environmental factors and drone delivery acceptance.

Implications – The results highlight the importance of developing technological infrastructure, improving regulatory and public policy frameworks, and communicating service value to consumers in order to strengthen trust and accelerate the sustainable commercial adoption of drone delivery services.

Originality/Value – This study provides new empirical evidence from a developing economy perspective by integrating macro-environmental factors and consumer expectations into a comprehensive technology acceptance framework, thereby extending existing knowledge and supporting innovation strategies in emerging logistics markets.

Keywords: Macro environment factor, Expectation, Acceptance of drone delivery, Thailand

Research Type: Research Article

INTRODUCTION

Drone delivery has emerged as one of the most significant innovations in the global logistics industry, given its potential to effectively address the evolving demands of contemporary consumers. This technology offers distinct advantages in terms of speed, convenience, and the mitigation of environmental impacts. Prior research has underscored the appropriateness of drone technology in advancing logistics systems toward greater modernization and sustainability (Ahmed, 2025; Goodchild & Toy, 2018; Jahani et al., 2025). Currently, drone delivery has been increasingly deployed in developed countries such as the United States and China, with leading corporations like Amazon and JD.com at the forefront of service innovation. Their initiatives are aimed at meeting consumer expectations for rapid and convenient product receipt within restricted timeframes. Nevertheless, despite the technological readiness of drones—encompassing autonomous flight systems, GPS navigation, and the capacity to transport lightweight packages—consumer acceptance remains a decisive factor for the success of such

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services. Concerns persist among certain consumer groups regarding potential risks, including accidents, community safety, and privacy violations (Dabić et al., 2025). In Thailand, while drones have been discussed in various domains such as agriculture, land surveying, and last-mile delivery in remote areas, drone-based logistics services have yet to reach the level of development observed in advanced economies. This situation may stem from limitations in infrastructure, regulatory preparedness, and the high costs of technological advancement. Furthermore, key factors that influence consumer expectations and acceptance of drone delivery—such as technological readiness, risk perception, and attitudes toward emerging technologies—have not been thoroughly examined within the Thai context. Consequently, the integration of drone delivery in Thailand continues to face diverse challenges. A nuanced understanding of these factors is essential to adapting drone technology to consumer needs and enhancing opportunities for its application in both commercial and economic development contexts (Ellenrieder et al., 2023; Kim & Hur, 2024).

Although drone delivery has gained increasing traction in many countries, its adoption in Thailand remains constrained by several issues and limitations, particularly with respect to consumer expectations and acceptance, which are critical determinants of successful implementation in the Thai context (Suvittawat, 2024). At the global level, numerous studies have emphasized the comparative advantages of drone delivery, particularly in enhancing service speed, reducing transportation costs, and mitigating environmental impacts—for example, through the reduction of greenhouse gas emissions compared to conventional vehicles (Aster et al., 2025). However, studies focusing specifically on the feasibility of drone delivery in Thailand remain scarce, thereby leaving a gap in the understanding of factors that may affect adoption in the local context. Macro-environmental conditions—such as infrastructure readiness in urban and suburban areas, including communication networks and enabling technologies like GPS and internet connectivity—constitute crucial considerations. Legal and regulatory constraints, particularly those concerning drone operations in community areas and aviation safety, also remain insufficiently defined to fully support the large-scale implementation of drone delivery (Grofelnik et al., 2022). Furthermore, consumer perceptions of technology represent another vital dimension that requires further scholarly attention. Awareness of the benefits of drones—such as convenience, time efficiency, and environmental advantages—may positively influence consumer acceptance, while risk perceptions relating to safety, privacy, and technological performance in complex environments may undermine trust in drone-based services (Dabić et al., 2025).

Against this backdrop, the present study seeks to examine and analyze the factors influencing consumer expectations and acceptance of drone delivery in Thailand. The research focuses on critical variables, including macro-environmental conditions, technology perception, service expectations, and acceptance behavior, with the aim of developing deeper insights into consumer attitudes and behaviors. The anticipated contributions of this study are threefold: (1) to provide actionable insights for entrepreneurs and business developers in designing services that align with market needs; (2) to offer practical guidelines for enhancing infrastructure and legal frameworks in support of drone-based logistics; and (3) to address academic gaps regarding consumer expectations and the acceptance of emerging technologies in the Thai context. Ultimately, this research is expected to contribute not only to the advancement of commercial innovation but also to fostering a sustainable understanding of drone technology within Thailand's broader socio-economic landscape.

LITERATURE REVIEW

Macro-Environmental Factors

Macro-environmental factors refer to external elements that influence consumer behavior and decision-making. These factors are critical for analyzing the acceptance of emerging technologies such as drone delivery. Social factors play an essential role in shaping community behavior, including readiness to adopt new technologies in daily life, concerns regarding their impact on community relationships, and differences in perspectives between younger and older generations (Schmidt & Saraceni, 2024; Sham et al., 2025). From an environmental perspective, drones have the

potential to reduce air pollution and help address environmental challenges compared to traditional vehicles. However, issues such as noise pollution and disturbances to wildlife in rural areas may present significant limitations (Afridi et al., 2024). In terms of economic factors, drone delivery can reduce costs and enhance economic efficiency for both businesses and consumers, yet challenges remain regarding service pricing and potential impacts on employment in the logistics industry (Belhor & Nya, 2025; Roca-Riu & Menendez, 2019). Political and legal factors are also crucial, as drone-related laws and policies—such as aviation regulations, policy transparency, and the suitability of governance frameworks in Thailand—must be considered (Kim, 2019; Kutynska & Dei, 2023; Nugraha et al., 2016). Finally, technology readiness, including infrastructure systems such as GPS and communication networks in Thailand, as well as the preparedness of businesses and technical support systems like drone maintenance, serve as key indicators of the successful adoption of drone technology (Koellner, 2025). Studying macro-environmental dimensions thus provides researchers with a more comprehensive understanding of the factors influencing technology acceptance in the Thai context.

Consumer Expectations

Consumer expectations serve as a key indicator that reflects the level of demand and service standards anticipated from drone delivery. Expectations regarding speed are among the most significant factors, as consumers expect drones to reduce delivery times efficiently and to serve remote areas rapidly, particularly in urgent cases such as medicines or food (Garg et al., 2023; Lehmann et al., 2025). With respect to safety, consumers expect drones to be equipped with accident-prevention systems, safeguards to protect goods, and measures to ensure the security of personal data along with real-time tracking (Sindiramutty et al., 2024). Regarding cost, consumers perceive that service fees should be comparable to traditional delivery methods or reasonable relative to the value provided, with flexible pricing options based on distance or delivery speed (Nguyen et al., 2019). In terms of convenience, consumers expect the system to be user-friendly, including features such as notifications when the parcel is near the destination and simplified procedures for pick-up and delivery (Penagos et al., 2026). Finally, expectations of service quality also include customer support through call centers, guarantees for damaged goods, and mechanisms for measuring customer satisfaction to continuously improve service (Bennington & Cummane, 1998; Parasuraman et al., 1988; Zeithaml, 1988). Analyzing these dimensions provides valuable insights into the drivers of consumer satisfaction and acceptance of drone delivery in the future.

Acceptance of Drone Delivery

Technology acceptance by Davis (1989) and Venkatesh et al. (2003) is well known and has been used to study how individuals accept new technology across various domains. These foundational frameworks to evaluate consumer willingness to adopt autonomous technology. In the context of drone delivery, these models are particularly crucial for identifying how factors like perceived usefulness, trust, and perceived risk influence public acceptance. The acceptance of drone delivery is a key topic of interest in research on technology and logistics (Shastri & Shrivastav, 2025). Acceptance reflects consumers' willingness to adopt new services, with various factors influencing decision-making. Thai consumers may be willing to try drone delivery if it becomes available, and their trust and confidence in the service are likely to grow if safety and service quality can be demonstrated (Liu et al., 2020; Sithanant et al., 2025). Moreover, consumers seeking rapid delivery, such as for urgent items, may be willing to pay higher service fees (Goebel et al., 2012; Van Droogenbroeck & Van Hove, 2022). Readiness to experiment with drone services also plays an important role, especially when such services are introduced with promotional campaigns or special discounts (Mazur & Borucka, 2025; Waris et al., 2022). Consumers also perceive drones as having the potential to become a part of daily life if they can meet expectations for safety and convenience (Silva et al., 2023; Waris et al., 2022). Factors supporting acceptance include responsiveness to promotions and adaptability in highly competitive markets. Further research in this area will enable businesses to better understand the drivers that facilitate the successful adoption of drone services in Thailand.

Hypothesis Development

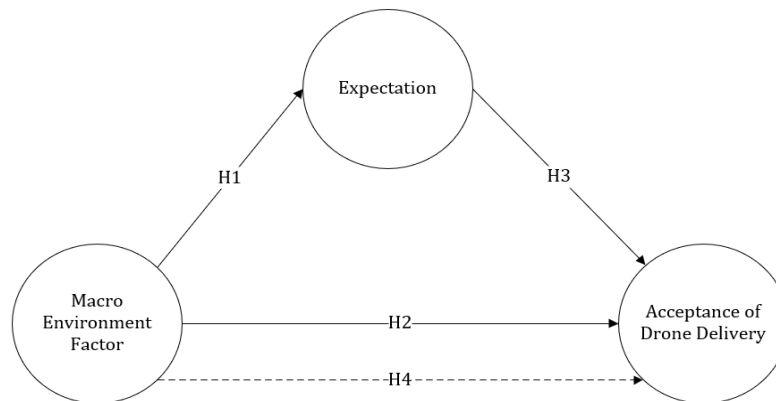


Figure 1. Conceptual Framework

Figure 1. shows conceptual framework. Macro-environmental factors are crucial in shaping consumer expectations regarding new technologies such as drone delivery. Social influences, including generational attitudes toward innovation, can alter how consumers anticipate the benefits or drawbacks of drone services (Schmidt & Saraceni, 2024; Sham et al., 2025). Environmental conditions also matter, as drones offer advantages in reducing air pollution but may create concerns about noise and wildlife disruption (Afridi et al., 2024). Furthermore, technological readiness, such as GPS and communication systems, strengthens consumer confidence in service speed and reliability (Koellner, 2025). These factors collectively define expectations of delivery performance, safety, cost, convenience, and service quality. Thereby, it is hypothesized that H1: macro-environmental factors influence user expectations of drone delivery.

Consumer acceptance of drone delivery is also strongly shaped by macro-environmental conditions. Political and legal frameworks, including drone aviation regulations and policy transparency, directly affect perceptions of safety and governance (Kim, 2019; Kutynska & Dei, 2023; Nugraha et al., 2016). Economic aspects, such as the balance between service pricing and cost-effectiveness, further shape consumer willingness to adopt the service (Belhor & Nya, 2025; Roca-Riu & Menendez, 2019). Additionally, environmental factors such as noise pollution or privacy concerns may reduce trust in drone technologies (Afridi et al., 2024; Dabić et al., 2025). Acceptance is therefore not driven solely by individual attitudes but also by these broader external elements. Hence, it is hypothesized that H2: macro-environmental factors influence user acceptance of drone delivery.

Consumer expectations play an important role in influencing the acceptance of new technologies such as drone delivery. Expectations regarding delivery speed, safety, cost efficiency, convenience, and service quality shape consumers' overall evaluation of the service and significantly affect their behavioral intentions. When expectations are positive, consumers are more likely to trust the service and develop stronger willingness to adopt it, whereas unmet expectations increase perceived risk and reduce acceptance (Dabić et al., 2025; Liu et al., 2020; Sithanant et al., 2025). Prior studies in technology-based logistics services confirm that expectations serve as a direct determinant of adoption behavior (Shastri & Shrivastav, 2025; Silva et al., 2023; Waris et al., 2022). Accordingly, it is hypothesized that H3: user expectations positively influence the acceptance of drone delivery.

User expectations act as a key mediating mechanism between macro-environmental factors and the acceptance of drone delivery. For example, readiness in technological infrastructure and clear regulatory frameworks can elevate expectations of safe, convenient, and rapid delivery services, thereby increasing consumer acceptance (Kim, 2019; Koellner, 2025; Kutynska & Dei, 2023; Liu et al., 2020; Nugraha et al., 2016; Sithanant et al., 2025). Conversely, if macro-level conditions highlight risks such as safety concerns or excessive costs, consumers' expectations may become negative, leading to reduced adoption (Belhor & Nya, 2025; Dabić et al., 2025; Roca-

Riu & Menendez, 2019). This suggests that external conditions influence acceptance not only directly but also indirectly through the expectations consumers hold. Therefore, it is hypothesized that H4: macro-environmental factors influence user acceptance of drone delivery through user expectations.

METHODOLOGY

This study employed a quantitative cross-sectional research design with the objective of explaining the causal relationships among macro-environmental factors, consumer expectations, and the acceptance of drone delivery services. The research was conducted in Bangkok and surrounding metropolitan areas, including Bangkok, Samut Prakan, Nonthaburi, Pathum Thani, and Samut Sakhon. These areas were selected due to their high population density, extensive use of e-commerce platforms and online delivery services, and well-developed technological and logistics infrastructure that supports the examination of consumer behavior toward emerging transportation services. The target population comprises individuals who are likely to become future users of drone delivery services. The sample was defined by specific criteria: respondents were required to be 20 years old or above, have prior experience with online shopping or digital delivery platforms, and reside within the designated study areas. A total sample size of 400 respondents was determined to be sufficient for structural equation modeling and appropriate for a model containing multiple latent constructs. Participants were selected using a combination of purposive sampling, to ensure alignment with the study criteria, and convenience sampling through online channels to enhance accessibility and reflect contemporary consumer characteristics. While a non-probability approach was employed due to the absence of a comprehensive sampling frame for the target population, this method is well-suited for exploratory and predictive models. Furthermore, PLS-SEM is a robust analytical tool that accommodates non-probability samples effectively, provided the sample size is adequate (Hair et al., 2019).

The primary research instrument was a structured, closed-ended questionnaire developed in accordance with the study's conceptual framework and predefined variables. A five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used to measure respondents' perceptions and attitudes. The questionnaire consisted of four sections: (1) demographic information, including gender, age, education, income, and frequency of online delivery usage; (2) macro-environmental factors encompassing social, environmental, economic, political-legal, and technological readiness dimensions; (3) consumer expectations covering speed, safety, cost, convenience, and service quality; and (4) acceptance of drone delivery reflecting intention to try, willingness to use in the future, and confidence in drone services. Content validity was assessed by three subject-matter experts using the Index of Item-Objective Congruence (IOC) which its result was between 0.70-1.00, and the instrument was refined accordingly (Rovinelli & Hambleton, 1976). A pilot test with 30 respondents was subsequently conducted, and reliability was confirmed using Cronbach's alpha coefficients, which were 0.957 – 0.989, ensuring satisfactory internal consistency of all constructs (Tavakol & Dennick, 2011).

Data collection was conducted via an online survey using Google Forms, with the questionnaire disseminated through social media platforms such as Facebook Groups and LINE Groups associated with consumers and e-commerce users to maximize coverage, convenience, and response efficiency. Participants were informed of the research objectives, their voluntary participation rights, and data confidentiality prior to completing the questionnaire. The data collection period lasted approximately four to six weeks, and attention-check questions were included to identify low-quality responses, minimize missing data, and enhance data reliability. After data screening, the responses were analyzed using Structural Equation Modeling (SEM) with the Partial Least Squares (PLS) approach via SmartPLS software. The analysis process began with evaluation of the measurement model using factor loadings, Average Variance Extracted (AVE), Composite Reliability, and discriminant validity assessed through the Fornell-Larcker criterion. Subsequently, the structural model was evaluated using path coefficients, t-values obtained through bootstrapping, and coefficients of determination (R^2) to systematically interpret the relationships among the study variables. This analytical procedure ensured the transparency, robustness, and replicability of the research findings (Hair et al., 2012; Sarstedt et al., 2022).

RESULTS

Results of Respondents' Demographic Analysis

The analysis of demographic characteristics from 400 respondents indicates that the majority of participants were female (295 respondents, 73.8%), while 105 respondents were male (26.2%). The largest age group consisted of individuals with 21–30 age group (274 respondents, 68.5%), the 31–40 age group (56 respondents, 14.0%), the 41–50 age group (50 respondents, 12.5%), and respondents aged 51 years and above, who represented the smallest proportion (5.0%) with 20 respondents.

In terms of educational attainment, most respondents held a bachelor's degree (291 respondents, 72.8%), followed by those with education below the bachelor's level (57 respondents, 14.2%) and those with postgraduate education (52 respondents, 13.0%). Regarding employment status, students constituted the largest group (233 respondents, 58.3%), followed by full-time employees (101 respondents, 25.2%), self-employed individuals (45 respondents, 11.3%), and freelancers or temporary workers (21 respondents, 5.2%).

With respect to monthly income, the largest proportion of respondents reported earning less than 10,000 THB per month (212 respondents, 53.0%), followed by those earning 10,001–20,000 THB (74 respondents, 18.4%), 20,001–30,000 THB (47 respondents, 11.8%), more than 50,000 THB (39 respondents, 9.8%), and 30,001–50,000 THB (28 respondents, 7.0%). In terms of residential area, most respondents lived in suburban areas (183 respondents, 45.8%), followed by urban areas (161 respondents, 40.2%) and rural areas (56 respondents, 14.0%).

Moreover, respondents generally exhibited positive attitudes toward new technologies: 76.4% (306 respondents) reported that they consistently embrace and experiment with new technologies, 22.8% (91 respondents) indicated they adopt new technologies only when necessary, and only 0.8% (3 respondents) expressed resistance or avoidance. This aligns with online purchasing behavior, where a high usage frequency was observed. Specifically, 38.2% of respondents (153 persons) reported making online purchases more than five times per month, followed by 32.8% (131 respondents) who purchased three to five times per month, 24.8% (99 respondents) who purchased one to two times per month, and only 4.2% (17 respondents) who purchased less than once per month.

Table 1. Macro-Environmental Factors, Consumer Expectations, and Acceptance of Drone Delivery

Variables	Mean	SD	Level
Macro-Environmental Factors			
Social Dimension	3.00	0.849	Moderate
Environmental Dimension	3.13	0.807	Moderate
Economic Dimension	3.01	0.844	Moderate
Political and Legal Dimension	3.01	0.822	Moderate
Technological Readiness	2.88	0.887	Moderate
Consumer Expectations			
Expectation of Speed	3.25	0.934	Moderate
Expectation of Cost	3.31	0.926	Moderate
Expectation of Convenience	3.33	0.957	Moderate
Expectation of Service Quality	3.36	0.967	Moderate
Acceptance of Drone Delivery	3.22	0.913	Moderate

Table 1 presents the mean (Mean), standard deviation (SD), and the overall level of respondents' perceptions regarding macro-environmental factors, consumer expectations, and the acceptance of drone delivery. The macro-environmental factors consist of the social dimension (Mean = 3.00, SD = 0.849), environmental dimension (Mean = 3.13, SD = 0.807), economic dimension (Mean = 3.01, SD = 0.844), political and legal dimension (Mean = 3.01, SD = 0.822), and technological readiness (Mean = 2.88, SD = 0.887), all of which were evaluated at a moderate level. Consumer expectations include expectations of speed (Mean = 3.25, SD = 0.934), cost (Mean = 3.31, SD =

0.926), convenience (Mean = 3.33, SD = 0.957), and service quality (Mean = 3.36, SD = 0.967), which were also perceived at a moderate level. Furthermore, the acceptance of drone delivery recorded a mean value of 3.22 with a standard deviation of 0.913, indicating a moderate level of acceptance among respondents.

Measurement Analysis and Hypothesis Testing

Table 2. Measurement Analysis

Name	Mean	SD	CV	Kur	Skew	Loading	t-value	Reliability & Validity
TMA_So	3.00	0.85	3.54	0.50	-0.19	0.839	41.303	rho_c = 0.942
TMA_En	3.13	0.81	3.88	1.03	-0.59	0.882	47.190	rho_a = 0.928
TMA_Ec	3.01	0.84	3.57	0.33	-0.40	0.920	114.965	AVE = 0.766
TMA_Po	3.01	0.82	3.67	0.55	-0.39	0.888	61.711	α = 0.923
TMA_Te	2.88	0.89	3.25	-0.01	-0.25	0.844	44.032	
TEX_Sp	3.31	0.97	3.42	0.12	-0.37	0.949	138.833	rho_c = 0.978
TEX_Sa	3.25	0.93	3.49	0.37	-0.36	0.928	74.273	rho_a = 0.972
TEX_Co	3.31	0.93	3.57	0.40	-0.50	0.953	150.996	AVE = 0.899
TEX_Cn	3.33	0.96	3.48	0.34	-0.43	0.962	197.766	α = 0.972
TEX_Sq	3.36	0.97	3.48	0.16	-0.35	0.950	133.595	
AC_DD1	3.27	1.01	3.24	0.14	-0.25	0.904	69.234	rho_c = 0.964
AC_DD2	3.19	1.02	3.12	-0.02	-0.28	0.893	61.345	rho_a = 0.958
AC_DD3	3.15	1.01	3.12	-0.01	-0.25	0.868	44.974	AVE = 0.794
AC_DD4	3.23	0.99	3.27	0.15	-0.14	0.889	55.221	α = 0.957
AC_DD5	3.19	1.01	3.14	0.13	-0.31	0.896	57.886	
AC_DD6	3.16	1.03	3.06	-0.05	-0.23	0.892	57.432	
AC_DD7	3.35	1.09	3.07	-0.28	-0.25	0.896	64.618	

From the Table 2, the study presents the descriptive statistics and the results of the measurement model assessment for the constructs of Macro-Environmental Factors, Consumer Expectations, and Acceptance of Drone Delivery. It reports the mean (Mean), standard deviation (SD), coefficient of variation (CV), kurtosis (Kur), and skewness (Skew) for each indicator, together with the factor loadings and corresponding t-values obtained from the PLS-SEM analysis. In addition, the table provides key reliability and validity indices for each construct, including composite reliability (rho_c), Dijkstra–Henseler’s rho (rho_a), average variance extracted (AVE), and Cronbach’s alpha (α). The results are presented separately for the indicator sets of Macro Environment (TMA_So, TMA_En, TMA_Ec, TMA_Po, TMA_Te), Expectation (TEX_Sp, TEX_Sa, TEX_Co, TEX_Cn, TEX_Sq), and Acceptance of Drone Delivery (AC_DD1–AC_DD7), thereby offering a comprehensive statistical evaluation of the data distribution characteristics and the measurement quality of each indicator.

Table 3. Discriminant validity by Fornell-Larcker Criterion

Variables	Macro Environment Factor	Expectation	Acceptance of Drone Delivery
Macro Environment Factor	0.875		
Expectation	0.762	0.948	
Acceptance of Drone Delivery	0.761	0.863	0.891

Note: Bold values in diagonal line display the square root of AVE meanwhile the others are correlation matrix

From the Table 3, The square root of the average variance extracted (AVE) for each construct is reported along the diagonal, namely macro environment factor (0.875), expectation (0.948), and acceptance of drone delivery (0.891). This also reports the inter-construct correlations, including the relationship between macro environment factor and expectation (0.762), between macro environment factor and acceptance of drone delivery (0.761), and between expectation and acceptance of drone delivery (0.863). These values provide empirical support for evaluating the distinctiveness of the constructs in the measurement model.

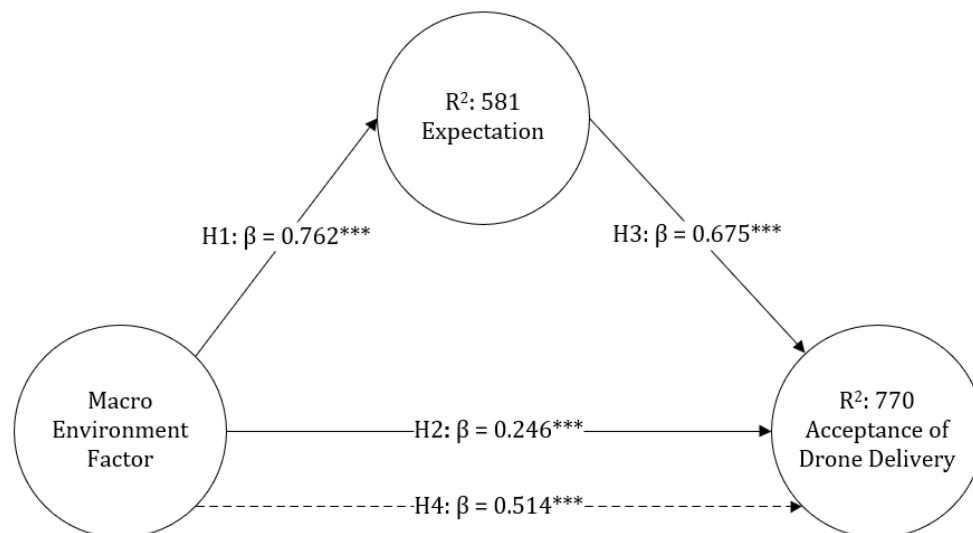


Figure 2. Studied Model

Table 4. Results of Hypothesis Testing

Hypothesis	β	t-value	p-values	Results
H1: Macro Environment Factor -> Expectation	0.762	26.186	0.000	Accepted
H2: Macro Environment Factor -> Ac ceptance of Drone Delivery	0.246	4.533	0.000	Accepted
H3: Expectation -> Acceptance of Drone Delivery	0.675	12.957	0.000	Accepted
H4: Macro Environment Factor -> Expectation -> Acceptance of Drone Delivery	0.514	11.080	0.000	Accepted

In Table 4, the finding presents the results of the hypothesis testing based on Structural Equation Modeling using the Partial Least Squares approach (PLS-SEM). The table reports the path coefficients obtained from the Beta coefficient (β), t-values, and p-values to assess the statistical significance of the relationships among the variables as proposed in the research hypotheses. The results indicate that Hypothesis H1, which examines the relationship between Macro Environment Factor and Expectation, yielded a path coefficient of 0.762, a t-value of 26.186, and a p-value of 0.000, demonstrating a positive and statistically significant relationship. Hypothesis H2, concerning the relationship between Macro Environment Factor and Acceptance of Drone Delivery, produced a path coefficient of 0.246, a t-value of 4.533, and a p-value of 0.000, indicating a significant direct effect of macro-environmental factors on the acceptance of drone delivery. With respect to Hypothesis H3, the relationship between Expectation and Acceptance of Drone Delivery was supported with a path coefficient of 0.675, a t-value of 12.957, and a p-value of 0.000, highlighting the crucial role of consumer expectations in shaping acceptance of drone delivery services. Furthermore, Hypothesis H4, which tests the indirect effect of Macro Environment Factor on Acceptance of Drone Delivery through Expectation, revealed an effect size of 0.514 with a t-value of 11.080 and a p-value of 0.000, confirming that Expectation serves as a statistically significant mediating variable in the relationship between macro-environmental factors and acceptance of drone delivery.

Table 5. Direct Effect, Indirect Effect, and Total Effect

Variables	Expectation			Acceptance of Drone Delivery		
	DE	IE	TE	DE	IE	TE
Macro Environment Factor	0.762	-	0.762	0.246	0.514	0.761
Expectation	-	-	-	0.675	-	0.675

Note. DE = Direct Effect, IE = Indirect Effect, and TE = Total Effect.

From the Table 5, the study presents the results of the analysis of Direct Effects (DE), Indirect Effects (IE), and Total Effects (TE) among the variables in the research model. The table systematically reports the effects of Macro Environment Factor on Expectation and Acceptance of Drone Delivery, as well as the effect of Expectation on Acceptance of Drone Delivery. These results reflect both the direct causal influences and the mediating role of Expectation in the relationship between Macro Environment Factor and Acceptance of Drone Delivery, in accordance with the conceptual framework of the study.

DISCUSSION AND IMPLICATIONS

The findings support Hypothesis H1, indicating that macro-environmental factors exert a positive and statistically significant influence on consumer expectations regarding drone delivery services. This result reflects the crucial role of external conditions—such as social context, environmental concerns, economic conditions, legal frameworks, and technological readiness—in shaping consumers' perceptions and expectations. These findings are consistent with Schmidt and Saraceni (2024) and Sham et al. (2025), who emphasized the impact of social norms and generational attitudes on innovation adoption, as well as with Afridi et al. (2024) and Koellner (2025), who highlighted the importance of environmental conditions and technological infrastructure readiness in influencing perceived service performance. In the Thai context, the results confirm that well-developed communication systems, infrastructure, and clear regulatory frameworks significantly enhance consumer confidence and positive expectations toward drone services, underscoring the necessity of systematic national-level development for building a sustainable drone delivery market.

The results of Hypothesis H2 demonstrate that macro-environmental factors have a significant direct effect on the acceptance of drone delivery. This finding suggests that consumer decision-making is shaped not only by individual attitudes but also by broader structural conditions, including regulatory stability, economic conditions, and environmental context. This outcome aligns with Nugraha et al. (2016), Kim et al. (2019), and Kutynska and Dei (2023), who identified legal frameworks and aviation policies as critical determinants of public trust and perceived safety, and with Belhor and Nya (2025) and Roca-Riu and Menendez (2019), who reported that economic value strongly influences willingness to adopt new services. In Thailand, where commercial drone regulation remains under development, these findings imply that systematic improvements in legal frameworks, infrastructure, and public policy can substantially accelerate consumer acceptance of drone delivery services.

Hypothesis H3 is strongly supported, as consumer expectations exert a positive and significant influence on the acceptance of drone delivery. This result reinforces the pivotal role of perceived service quality in shaping innovation adoption behavior. Consistent with Liu et al. (2020) and Sithanant et al. (2025), expectations related to delivery speed, safety, convenience, and service quality directly enhance consumer trust and adoption intentions. In the context of drone delivery, consumers who anticipate fast, safe, affordable, and user-friendly services are significantly more likely to accept and experiment with such services. These findings corroborate Shastri and Shrivastav's (2025) assertion that expectations function as a critical behavioral determinant in the technology adoption process, emphasizing the importance for service providers to communicate service value and customer experience from the early stages of market development.

The results further confirm Hypothesis H4, demonstrating that consumer expectations serve as a significant mediating variable between macro-environmental factors and the acceptance of drone delivery. This reflects a systematic consumer decision-making mechanism in which structural factors—such as technological readiness, infrastructure development, and regulatory frameworks—shape acceptance both directly and indirectly by influencing consumer expectations regarding service quality and safety. This finding is consistent with Nugraha et al. (2016), Kim et al. (2019), and Kutynska and Dei (2023) and Koellner (2025), who emphasized that clear regulatory structures and technological foundations elevate societal confidence in emerging technologies. In the Thai context, these results suggest that public policy and infrastructure development should be strategically aligned with consumer perception management to foster a sustainable cycle of drone technology adoption.

The study offers significant theoretical and practical contributions. Theoretically, it advances the understanding of logistics technology adoption mechanisms, particularly within the context of developing economies like Thailand. It successfully integrates macro-level structural influences—encompassing social, environmental, economic, legal, and technological readiness dimensions—with behavioral expectations into a unified technology acceptance framework. A key theoretical advancement of this research is the empirical validation of consumer expectations as a crucial mediating variable. The findings demonstrate that macro-environmental conditions do not merely exert a direct influence on consumer acceptance; rather, they systematically and indirectly shape adoption behaviors by first molding consumers' expectations regarding service quality, safety, and efficiency. By bridging external structural factors with internal consumer psychology, this study addresses a critical gap in the existing literature and provides a comprehensive model for predicting the acceptance of emerging autonomous logistics technologies in markets where infrastructure and regulations are still evolving.

Practically, the findings provide actionable and strategic insights for both policymakers and industry practitioners aiming to foster a sustainable commercial drone market. For government authorities, the study emphasizes the urgent need to invest in robust digital infrastructure, such as advanced communication networks and GPS technologies, while simultaneously establishing clear regulatory frameworks and aviation policies to build public trust. For logistics service providers, the research underscores the importance of designing drone delivery offerings that directly address core consumer expectations. Providers must prioritize delivery speed for urgent items, ensure stringent safety and data security measures, offer cost-effective pricing structures, and deliver maximum user convenience. By effectively communicating these service values and aligning operational capabilities with consumer expectations, businesses can mitigate perceived risks, accelerate real-world implementation, and drive the sustainable growth of the drone delivery industry in Thailand.

LIMITATIONS AND FUTURE RESEARCH POSSIBILITIES

This study provides valuable insights into the factors influencing consumer expectations and the acceptance of drone delivery services in Thailand. Nevertheless, several limitations should be acknowledged. First, the research employed a quantitative cross-sectional design, which captures consumer attitudes at a single point in time and therefore cannot fully explain long-term changes in expectations and adoption behavior. Future studies should employ longitudinal designs to track the evolution of consumer attitudes as drone technology becomes more widely implemented. Second, the sample was concentrated in Bangkok and the surrounding metropolitan areas, which may not adequately represent consumers in rural regions or other provinces with different levels of infrastructure readiness and technology accessibility. Third, the study utilized non-probability sampling methods (purposive and convenience sampling), and the demographic profile was heavily skewed toward female university students with relatively low monthly incomes who naturally exhibit high technological readiness. This limits the generalizability of the findings to broader consumer segments with varying purchasing power. Fourth, as commercial drone delivery is not yet widely implemented in Thailand, consumers' acceptance represents hypothetical intentions rather than behaviors based on actual service

experience. Finally, the data were self-reported and may be subject to perceptual bias or social desirability bias. To address these limitations, future research should aim for a more demographically balanced probability sample and incorporate qualitative methods, in-depth interviews, or actual usage data to strengthen empirical validity. Furthermore, future studies may extend the conceptual framework by integrating psychological variables such as trust, technology anxiety, perceived risk, and personal innovativeness, as well as examining the long-term role of government policy and business organizations in shaping the adoption of drone services.

CONCLUSION

This study aimed to examine the factors influencing consumer expectations and the acceptance of drone delivery in Thailand. The findings clearly demonstrate that macro-environmental factors play a critical role in shaping both consumer expectations and direct acceptance of drone technology, while also exerting an indirect influence through the mediating role of expectations. In addition, consumer expectations were found to be a key determinant of the level of acceptance of drone delivery services. These results enhance understanding of consumer decision-making mechanisms in the context of modern logistics technologies and help bridge the knowledge gap regarding drone adoption in developing countries. The study contributes both theoretically, by advancing consumer behavior frameworks, and practically, by offering guidance to entrepreneurs and policymakers in developing infrastructure, regulatory frameworks, and marketing strategies that support the sustainable growth of Thailand's drone industry.

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CONFLICTS OF INTEREST

The author declares that there are no conflicts of interest found in this research.

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