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# Acceptance Level of Drone Delivery among Malaysian Consumers

Soh Yee Fang<sup>a</sup>, Umi Kartini Rashid<sup>b</sup>, Lee Te Chuan<sup>a\*</sup>

<sup>a</sup>*Department of Production and Operation Management, Faculty of Technology Management and Business, University Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor, Malaysia.*

<sup>b</sup>*Department of Business Management, Faculty of Technology Management and Business, University Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor, Malaysia.*

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## Abstract

Unmanned aerial vehicle (UAV) is the formal term for a drone that can operate without the pilot, or at ground level, the pilot can use the control operating systems. Today, some companies in Malaysia have begun to test drone parcel delivery, but the acceptance level of Malaysian consumers for this new service is still vague. Thus, the objectives of this study are to (i) measure the level of Malaysian consumer acceptance of drone delivery and (ii) investigate the relationships between perceived attribution of innovation, perceived risks, and individual characteristics and Malaysian consumer acceptance of drone delivery. A total of 158 Malaysian consumers who have knowledge of drones participated in this study through the convenience sampling technique. The data was collected using quantitative methods via an online questionnaire survey based on the Technology Acceptance Model (TAM), and Diffusion of Innovation (DOI). The results showed a high level of Malaysian consumer acceptance of drone delivery, with a mean value ranging from 3.91 to 4.11. Furthermore, the results demonstrated that compatibility (0.702), personal innovativeness (0.688), relative advantages of speed (0.659), complexity (0.627), relative advantages of environmental friendliness (0.612), mass media channel (0.527), and environmental concern (0.346) have positive significant affect toward drone delivery acceptance. However, delivery risks (0.038), privacy risks (0.043) and performance risks (0.019) were found to be insignificant towards the drone delivery acceptance. Ultimately, the study has management implications for companies readying to provide drone deliveries which can use this information to determine consumers' acceptance levels and improve drone delivery systems.

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*Keywords:* Technology Acceptance Model (TAM), Diffusion of Innovation (DOI), Drone parcel delivery, Malaysian consumers, Acceptance level

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\* Corresponding author. Tel.: +60137105310  
E-mail address: [tclee@uthm.edu.my](mailto:tclee@uthm.edu.my)

## 1. Introduction

Over the past few years, technological advancements have consistently shaped human society. Contemplate the impact of electricity's introduction, which has introduced convenience to human life and substantially reshaped modern society. Similarly, drone technology, while not the most recent innovation, has only in recent years begun to gradually integrate into our daily routines [1].

In contemporary times, drone technology frequently garners attention in the news owing to its versatile deployment, exceptional mobility, efficiency, and other notable attributes [2]. A drone, also referred to as an unmanned aerial vehicle (UAV), is capable of autonomous operation without the need for an onboard pilot. Alternatively, the pilot can control it from the ground using remote operating systems [3]. According to [4], it is a flying robot or unmanned aircraft that combines sensors such as cameras, and global positioning systems (GPS) with the flight to allow people to interact and observe the world with unprecedented freedom. The market for emerging drone technology was valued at \$30 billion in 2020 and is anticipated in 2025 to reach \$54.6 billion, 12.7% of the annual growth rate. Previously, the price of a drone was higher, and just for military purposes will use it. Nevertheless, due to the rapid development of drone technology, regulators and policymakers, business leaders, as well as the public, are increasingly interested in using the technology for a wide range of applications, including search and rescue, law enforcement surveillance, aerial photography, commercial deliveries, and infrastructure inspections [5].

Today, specifically with the advent of Industry 4.0 (IR4.0), many companies spanning manufacturing and service sectors have ventured into the realm of drone deliveries. In fact, drone delivery is closely linked to IR4.0 as it represents one of the innovative technologies and practices associated with the fourth industrial revolution. In the context of IR4.0, automation, data-driven decision-making, and the integration of digital technologies play a significant role, and drone deliveries align with these principles by utilizing automation, real-time data, and advanced technology to revolutionize how goods are transported and delivered. Literally, the idea of drone delivery dates back to December 2013, when Amazon revealed that they were trying to use drones to substitute the traditional delivery methods. Subsequently, major companies such as DHL, Mercedes-Benz, and United Parcel Service have rolled out similar initiatives using drones for delivery [2]. Besides that, a survey on drone delivery service in the Christiansburg community reported that 87% of 821 respondents gave positive feedback, and 89% had experienced using this service or would choose to use it if it was available. Hence, if drone technology were to be extensively embraced, it could impact our societal framework in a manner akin to the aforementioned examples. This is because drone deliveries have a tangible impact on people's daily lives, especially for those residing on higher floors of apartment buildings, where it is common to witness delivery drones soaring past their windows [5].

Currently, in Malaysia, 57 areas have been developed as the zone of development of drones, including Pahang, Urban Delivery Drone in Cyberjaya, and Drone and Robotic Iskandar in Johor [6]. Not only that, the Malaysian Global Innovation and Creativity Centre (MaGIC) also cooperates with AirAsia Digital to launch a pilot program for the purpose of analysing the long-term viability of delivery services by drone in urban areas. The six-month program will begin at Cyberjaya, the third national technology and innovation sandbox proving ground, to assess drone operators' capabilities, deployment readiness, approval process, experience, and service expansion. Furthermore, DHL Express Malaysia has teamed up with Pen Aviation to reveal the commercial viability of time-constrained drone delivery in port logistics tasks [7]. In 2021 November, Pharmaniaga completed the first phase of its concept drone delivery program "Project Eagle" by delivering three kilograms of medicines to Pangkor Island, and this project will continue testing in other remote areas, such as in Sabah and Sarawak [8].

While the Malaysian government has reassured citizens that there is no need for excessive concern regarding drones flying overhead, emphasizing that drone delivery is simply an additional method for users to swiftly access goods [5,9], the degree of acceptance among Malaysians when it comes to drone delivery remains unclear, and the absence of comprehensive studies in this field presents an opportunity for enhancement. The existing studies of drone acceptance were mainly carried out in Western countries, such as Canada, Switzerland, Australia, Germany, and America. In Asia, besides Singapore, a study on drone delivery was conducted in Malaysia, yet only focused on the food delivery (DFD) service.

Past research has adopted some theoretical models to develop the framework related to drone delivery services. According to [5], the Knowledge, Attitude and Practice (KAP) model has been used to examine the public acceptance of drone applications in Singapore. In other cases, *Chen et. al* [10] integrated the Motivated Consumer Innovativeness (MCI) Theory, Technology Acceptance Model (TAM), social motivations and hedonic to investigate the consumer innovation. Other researchers have also adopted TAM and Diffusion of Innovation (DOI) to explore the factors

influencing public attitude and willingness to adopt drone delivery in the United States [11]. Therefore, within this study, the TAM and DOI framework were employed to construct the theoretical model. The primary goal was to gauge the extent of acceptance among Malaysian consumers toward drone delivery and explore the connections between the independent variables, namely perceived attribution of innovation, perceived risks, and individual characteristics toward the dependent variable, Malaysian consumer acceptance of drone delivery. The organization of this paper typically follows a standard structure, which includes the review of literature, research methodology, results and discussion, and conclusion and recommendation. This study offers businesses valuable insights into gauging consumer acceptance levels, which can be leveraged to enhance existing drone services or introduce new drone-related offerings. In addition, this study holds significant importance for the government as it can contribute to the growth of the country's economy through the advancement of the drone delivery market, which has the potential to bring about transformative effects in the service industries and e-commerce sector.

## 2. Literature Review

### 2.1. Acceptance Level of Drone Delivery

Acceptance meaning refers to the receiving and decision to use an innovation [12]. According to Kaoy *et al.* [13], by adopting a simple random sampling technique, safety and privacy have little influence on customer acceptance of drone delivery in West Java. Besides that, the survey done by [11] evidenced that by adopting DOI and the TAM, the outcome shows the relative advantage of speed, environmental friendliness, complexity, personal innovativeness, privacy risks, and performance risks influenced the adoption of delivery by drones in America. In different scenarios, Yaprak *et al.* [14] used TAM, DOI, and protection motivation theory (PMT), together with convenience sampling to conduct the survey in Turkey and results revealed that relative advantage, perceived usefulness, perceived ease of use, performance risk, delivery risk, privacy risk, perceived severity, and mass media channels significantly influenced the individual risk perception, attitude, and perceived threat toward drone delivery after online orders.

Meanwhile, Khan *et al.*[15] received some privacy concerns after conducting convenience and purposive sampling to investigate the acceptance level of Pakistani consumers when using drones for delivery via adopting the Theory of Planned Behavior (TPB) and the perceived risks. On the other hand, Chen *et al.* [16] adopted utility marketing theory, social network theory, and information technology adoption theory to determine the factors encouraging American customers to adopt drone delivery services, and the findings showed that perceived usefulness and personal innovativeness significantly impact the dependent variable. In China, Liu *et al.*[17] indicated that effort expectation and facilitation factors are powerful predictors of behavioral intention to use drone delivery using the theory of acceptance and use of technology (UTAUT2). Considering the preceding explanation and the insights derived from previous research, this study opted to employ the TAM, DOI, and perceived risk frameworks since it is evident that these frameworks have been widely utilized by researchers in various studies, and the variables examined within them have consistently demonstrated significant impacts on the outcomes.

### 2.2. Diffusion of Innovation (DOI) and Technology Acceptance Model (TAM)

The DOI theory is one of the oldest theories in social science due to its being established in 1962 by Rogers [12]. It is often used in information and communication systems research to help comprehend factors consumers embrace about innovative technologies [18]. In 1985, the TAM was established by Davis to simulate the acceptance level of users of computer-based information systems [12]. Moreover, the constructs of DOI and TAM are quite similar and can complement each other. Complexity and relative advantage in the DOI are the same as ease of use and perceived usefulness in the TAM. Because of this, numerous studies have applied DOI to the TAM theory and believe that the innovation attribute is the decisive factor that determines the attitude and willingness to accept technology [11].

### 2.3. Perceived Attributes of Innovation

The complexity, compatibility, relative advantage, observability, and trialability as attributes of innovations are recommended by Roger (1983) [19]. As drone delivery is currently in the testing phase in Malaysia and is not open to the public, this study only examines the first three attributes.

Complexity is the level to which an innovation is regarded as hard to use. In a study done by Owusu *et al.* [20], complexity shows a key predictor effect on users' intention to adopt mobile banking technology in Ghana. While Yoo *et al.* [10] suggested that if consumers think that delivery by drone is an easy and less complicated way to receive the products, it means they have more intention to use it (0.047,  $p < 0.05$ ). Due to both technologies being new services, this study proposed:

**H1a:** *There is a positive relationship between complexity and Malaysian consumers' acceptance of drone delivery.*

Compatibility refers to the level to which consumers believe that innovation meets their needs and preferences. Drone delivery is not similar to traditional truck delivery services, so it depends on the customer whether the delivery fits their lifestyle [11]. Next, the compatibility showed a positive impact result on perceived usefulness ( $\beta = 0.27$ ,  $p < 0.01$ ) and perceived ease of use ( $\beta = 0.28$ ,  $p < 0.001$ ) for surveying the customers' adaptation to the Uber mobile applications [21]. Thus, the dimension of compatibility will affect the new technologies. So, the following hypothesis was proposed:

**H1b:** *There is a positive relationship between compatibility and Malaysian consumers' acceptance of drone delivery.*

Relative advantage is the level at which innovation is superior to its precursor. The view that innovative service is better than traditional service may have a positive impact on the use of innovation. Consumers believe drone delivery is fast (0.049,  $p < 0.05$ ) and environmentally friendly (-0.061,  $p < 0.05$ ) and have high intentions to use the service [11]. Then, Owusu *et al.* [20] found that this variable has a higher behaviour intention for business students to adopt mobile banking because it is quick and more convenient compared to traditional offline banking ( $p < 0.01$ ). Thus, it could be postulated that:

**H1c:** *There is a positive relationship between relative advantages of speed and Malaysian consumers' acceptance of drone delivery.*

On the other hand, environmental friendliness is another benefit of drone delivery. This is due to the fact that drones use batteries, so they do not emit as much carbon as trucks [22]. Not only that, several past studies in various fields, like online travel purchases, solar energy, and renewable energy, have shown a significant relationship between relative advantage and willingness to accept [23]. Therefore, the following hypothesis was proposed:

**H1d:** *There is a positive relationship between relative advantages of environmental friendliness and Malaysian consumers' acceptance of drone delivery.*

#### 2.4. Perceived Risks

Since the 1960s, perceived risk theory which consists of variables namely delivery risk, privacy risk and performance risk, has been used to explain the consumer behavior and is an additional variable often used in DOI and TAM. It appears if customers lack knowledge about services or products that use innovative technologies leading to a lack of trust and uncertainty [11].

Delivery risk is the likelihood that the purchase will cause problems during the delivery of the product to the customer [11]. Based on the studies by Yoo *et al.* [11] and Yaprak *et al.* [14] on the cargo transportation and online order respectively, the results on delivery risk came out the same, which is, delivery risk negatively affects the consumers' attitude toward drones delivery. Besides, some think that the drone may malfunction, be delivered inaccurately, or not find a site to land at the residence [24]. Based on this, the following hypothesis was proposed:

**H2a:** *There is a negative relationship between delivery risks and Malaysian consumers' acceptance of drone delivery.*

Privacy risk is the potential failure to control private information. For instance, information about an individual has been used by others without their permission or knowledge [11]. Felch *et al.* [25] suggested that privacy protection is critical for alternative delivery concepts (e.g. controlled access systems, truck delivery, or crowdsourcing among friends) especially those involving private property such as the capacity to open the entry door or car trunk when delivering service. Then, Yaprak *et al.* [14] showed that consumers' attitudes were negatively affected by the privacy risk on online orders toward drone delivery ( $p < 0.01$ ). Based on the previous study, the following hypotheses was formulated:

**H2b:** *There is a negative relationship between privacy risks and Malaysian consumers' acceptance of drone delivery.*

Performance risk means the possibility that a product fails, does not perform as advertised and designed, and therefore does not provide the expected benefits [11]. Amirtha *et al.* [26] found that Indian women have a significant impact on the performance risk of e-shopping toward behavioural intention (-0.526,  $p < 0.001$ ). Therefore, it was postulated that:

**H2c:** *There is a negative relationship between performance risks and Malaysian consumers' acceptance of drone delivery.*

2.5. Individual Characteristics

Purnomo & Nastiti [27] mentioned that individuals differ in their acceptance of information technology based on cognitions, motivations, experiences, influences, and skills. Environmental concern is that individuals are more probably to buy environmentally friendly products when they are aware of the environmental problems facing the world today and truly take responsibility for them [28]. He *et al.* [29] observed that environmental concern has positively influenced consumer behaviour to purchase and adoption of electric vehicles in China (0.085,  $p < 0.05$ ). Additionally, Hwang *et al.* [30] showed that the green image of the drone positively impacts consumers' attitudes toward drone food delivery. Following the previous research, the hypothesis was:

**H3a:** *There is a positive relationship between environmental concerns and Malaysian consumers' acceptance of drone delivery.*

The communication channel is a significant part of innovation diffusion. It includes interpersonal types and mass media [31]. Research by Ghasri & Vij [31] explored 862 residents and 90% selected social media sentiment, which was the highest effect on the intention to use autonomous vehicles compared with different communication channels. Besides that, it also showed that the American consumers had positive intention to adopt drone delivery (0.027,  $p < 0.05$ ) [11]. Hence, the following hypothesis was proposed:

**H3b:** *There is a positive relationship between mass media channel and Malaysian consumers' acceptance of drone delivery.*

Numerous information technologies, like smart watches and mobile hotel booking platforms, demonstrated the causal influence of personal innovativeness on increased intention to adopt. According to [16], drone delivery services have a positive impact on personal innovativeness (0.198,  $p < 0.05$ ). Another example also shows that it has positively affected consumers' purchase intention of electric vehicles, (0.222,  $p < 0.001$ ) [29]. Therefore, based on the past studies, the following hypothesis was proposed:

**H3c:** *There is a positive relationship between personal innovativeness and Malaysians acceptance of drone delivery.*

2.6. Research Framework

Figure 1 below shows the research framework of this study.

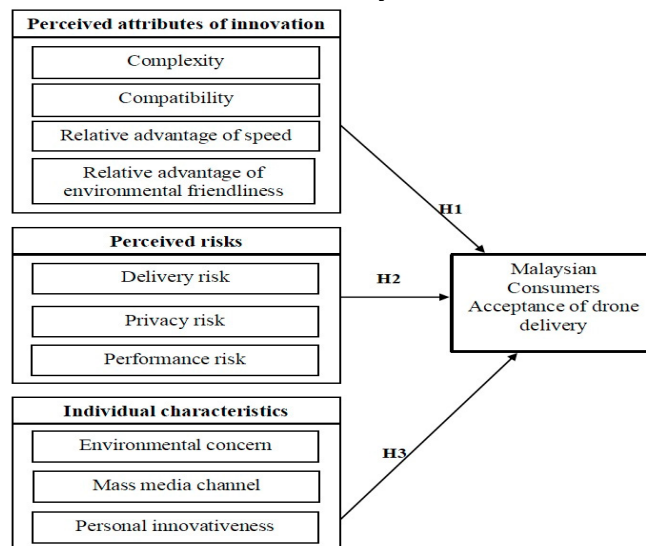


Fig. 1: Research Framework of Drone Delivery Acceptance among Malaysian Consumers.

### 3. Research Methodology

#### 3.1. Research Design

The quantitative method via online survey form was appropriate for this study due to can receive a large sample of data. The researcher selected this survey method because it is an important tool that can collect some evidence of social problems and helps establish the relationship between the independent and dependent variables.

The research questionnaire survey consisted of three main sections (Section A, B and C) with a total of 59 questions. Section A represented the respondent's demographic information and drone delivery questions with adopted polar and multiple-choice questions. In this section, nominal, ratio, and ordinal were used. While in Sections B and C, the ordinal measurement as 5-Likert Scale was adopted in this study to provide respondents to answer independent variables (perceived attributes of innovation, perceived risk, and individual characteristics) and dependent variable (Malaysian consumers acceptance) questions based on their opinion. However, this survey set some criteria as the participants only continued to answer the questionnaire with knowledge of drones; otherwise, the questionnaire was closed. Table 1 shows the construct measurement of all the variables used in this study.

Table 1: Construct Measurement for All the Variables

| Section      | Variables  | Total Questions | Adopted/Adapted |
|--------------|--|-----------------|-----------------|
| A            | Background of Respondents  | 7               | -               |
| B            | Perceived Attributes of Innovation<br>- Complexity<br>- Compatibility<br>- Relative advantage of speed<br>- Relative advantage of environmental friendliness | 18              | [11,12,21,32]   |
|              | Perceived Risk<br>- Delivery Risk<br>- Privacy Risk<br>- Performance Risk  | 14              | [26,28,32,33]   |
|              | Individual Characteristics<br>- Environmental Concern<br>- Mass media Channel<br>- Personal Innovativeness   | 15              | [10,11,29]      |
| C            | Malaysian Consumers Acceptance of Drone Delivery   | 5               | [26, 32]        |
| <b>Total</b> |  | <b>59</b>       |                 |

#### 3.2. Data Collection Technique

The researcher administered survey-based questionnaires to collect data from the selected sample of Malaysian consumers. In doing so, Google Forms was used by the researcher to create surveys for distribution to the respondents due to the fact that it was a web-based application that can be shared via email, social media, WhatsApp, and other mediums. On the other hand, the data collected using this form was saved in a spreadsheet, which reduced the time required for researchers to classify and pre-analyze the data [34]. The survey tends to test the relationships between perceived attributes of innovation, perceived risk, and individual characteristics and the acceptance of Malaysian consumer to use delivery via drones.

#### 3.3. Population and Sampling

The non-probability sampling technique with convenience sampling was used in this study because the population of Malaysian consumers who have knowledge of drones was unknown, and there was no statistic. Thus, the sample

size of this study was 300 respondents, based on the 32.7 million population in Malaysia in 2021, compared to 32.6 million in 2020, with 0.2 % annual growth rate.

### 3.4. Data Analysis Technique

Descriptive analysis was used to understand and describe the characteristics of a particular data set in a meaningful method through a summary of samples and measurements of the data. The collected data were interpreted briefly in the form of percentage, mean, standard deviation, and interpretation of results. Next, all the data collected by the researcher was analysed using the IBM SPSS Statistics Software Version 25. Reliability test, descriptive analysis, and correlation analysis has also been conducted in order to achieve the research objectives.

## 4. Results and Discussion

### 4.1. Return Rate and Acceptable Questionnaires

From the targeted 300 respondents, only 164 responses were managed to be collected, and this showed 54.7% response rate. Among the 164 sets of questionnaires, six were excluded due to ineligible. Thus, this study used 158 answers and the completion rate was 96.3%. According to Willott [35], survey response rates of 5 to 30% were more typical. For instance, a research conducted by Hwang & Choe [33] in Korea only managed to get a return rate of 12.40% (346 responses) through distributing the drone food delivery survey to 2794 respondents. Besides that, the net response rate was 87.77% for drone delivery services from the research of Leon *et al.* [36] in the United States. As such, based on the above justification, this study can be considered an acceptable response rate.

### 4.2. Reliability Analysis

Reliability is a test to assess the consistency with which a measuring instrument measures any concept. If the reliability quality of the instrument is satisfactory, then it can be confident that instantaneous and situational factors do not interfere with its use [37]. The variables that show good reliability levels are the complexity variable (0.865), the relative advantage of speed variable (0.849), the privacy risk variable (0.897), the performance risk variable (0.855), the environmental concern variable (0.837), and the personal innovativeness variable (0.829). While the compatibility variable (0.910), the relative advantage of environmental friendliness variable (0.926), the mass media channel variable (0.923), and the Malaysian consumer acceptance variable (0.920) are at an excellent level of reliability.

### 4.3. Demographics information

From the data collected, 109 (69%) of the respondents were male, and 49 (31%) were females. Malay came out majority of the respondents with 98 (62%), 44 (27.8%) respondents were Chinese, 9 (5.7%) respondents were Indian, and only 7 (4.4%) respondents were from other races. Most of the respondents were between 25 to 34 years old (34.2%), followed by 53 (33.5%) respondents from 18 to 24 years old, 38 (24.1%) respondents from 35 to 44 years old, 11 (7.0%) respondents from 45 to 54 years old, 2 (1.3%) respondents from 55 to 64 years old.

Besides that, a total of 97 (61.4%) respondents were employed, 38 (24.1%) respondents were student, followed by 16 (10.1%) respondents who chose others, and 7 (4.4 %) respondents were unemployed. 118 (74.7 %) respondents have heard about drone parcel delivery services while another 40 (25.3%) respondents have not heard about it. Most of the respondent's frequency of use of parcel delivery services was several times per month; 85 responses with 53.8%. The second highest that the respondents chose was several times per week, which was 34 (21.5%). Followed by those who answered, "less often", "once per week", and "daily" with 23 (14.6%), 12 (7.6%), and 4 (2.5%) respondents respectively.

#### 4.4. Descriptive Statistic

Descriptive statistics were used to define aspects of quantitative data sets for comparison and interpretation. Interpretation of the mean score has three ranges, low (1.00-2.33), moderate or average (2.34-3.67), and high (3.68-5.00). From the data shown in Table 2, the value of the mean ranged from 3.91 to 4.11, which shows all items are at the high mean. Item number 3 has the highest mean value (4.11), while item number 2 was the lowest mean (3.91). Thus, the standard deviation value is different for each item between the ranges from 0.969 to 1.116. Due to that, it could be said that the results showed that the data points were distributed closely around the mean value. Since all the mean items showed high score, thus it was evidenced that there was a high level of acceptance for Malaysian consumers to use parcel drone delivery in the future.

Table 2: Mean and Standard Deviation for the Items Measuring Dependent Variable (Malaysian Consumers Acceptance of Drone Delivery) in Value Analysis Process

|         | N   | Minimum | Maximum | Mean | Std. Deviation | Frequency |
|---------|-----|---------|---------|------|----------------|-----------|
| ACCEP 1 | 158 | 1       | 5       | 4.06 | 0.969          | High      |
| ACCEP 2 | 158 | 1       | 5       | 3.91 | 1.116          | High      |
| ACCEP 3 | 158 | 1       | 5       | 4.11 | 0.981          | High      |
| ACCEP 4 | 158 | 1       | 5       | 4.04 | 1.040          | High      |
| ACCEP 5 | 158 | 1       | 5       | 4.08 | 1.007          | High      |

#### 4.5. Normality Test

There are many ways to test continuous data normality, among which the most commonly used are the Shapiro-Wilk test and the Kolmogorov-Smirnov test. Kolmogorov-Smirnov Test is used when the sample size is greater than 50, while Shapiro-Wilk will be used if the sample size is 50 or less. Moreover, if the  $P > 0.05$ , it indicates that the data is considered normal and parametric tests can be applied. In contrast, the data displays non-normally distributed if the  $p < 0.05$  [38]. In this research, the Kolmogorov-Smirnov were chosen by researchers because the sample size was large than 50, which was 158 valid respondents out of 164 sample size. Based on the Kolmogorov-Smirnov test, the result of Malaysian consumer acceptance variable shows a significant value (0.000,  $P < 0.05$ ), so the data is not normally distributed as shown in Table 3.

Table 3: Normality Test (Kolmogorov-Smirnov)

|                                       | Kolmogorov-Smirnov <sup>a</sup> |     |              | Shapiro-Wilk |     |       |
|---------------------------------------|---------------------------------|-----|--------------|--------------|-----|-------|
|                                       | Statistic                       | df  | Sig.         | Statistic    | df  | Sig.  |
| ACCEP                                 | 0.140                           | 158 | <b>0.000</b> | 0.894        | 158 | 0.000 |
| a. Lilliefors Significance Correction |                                 |     |              |              |     |       |

#### 4.6. Spearman Correlations

The significance of the correlation coefficient value has five levels which range from very strong (0.90 -1.0), strong (0.7 – 0.89), moderate (0.40 – 0.69), weak (0.10 – 0.39), and negligible (0.00 – 0.10) [39] .

##### (a) Correlation between Perceived Attributes of Innovation and Malaysian Consumer Acceptance of Drone Delivery

Table 4 below reveals the value of Spearman's rho correlation coefficient for three variables that show positive value with moderate relation strength, with complexity (CPLX) being 0.627, relative advantage of the speed variable (RAOS) being 0.659, and relative advantage of environmental friendliness variable (RAOEF) being 0.612. While Spearman's rho correlation value of compatibility (CPBL) shows a positive value with strong relation strength, which is 0.702. The value displayed a positive moderate and strong correlation between perceived attributes of innovation towards Malaysian consumer acceptance of drone delivery. Due to the significance value (0.000,  $P < 0.05$ ), these four hypotheses (H1a-H1d) were proven positively significant and accepted.



Table 4: Correlation between Perceived Attributes of Innovation and Malaysian Consumer Acceptance of Drone Delivery

| <b>Correlations</b>   |       |                         |               |               |               |               |               |
|---|-------|-------------------------|---------------|---------------|---------------|---------------|---------------|
|   |       |                         | ACCEP         | CPLX          | CPBL          | RAOS          | RAOEF         |
| Spearman's rho  | ACCEP | Correlation Coefficient | 1.000         | <b>.627**</b> | <b>.702**</b> | <b>.659**</b> | <b>.612**</b> |
|   |       | Sig. (2-tailed)         | .             | <b>.000</b>   | <b>.000</b>   | <b>.000</b>   | <b>.000</b>   |
|   |       | N                       | 158           | 158           | 158           | 158           | 158           |
|   | CPLX  | Correlation Coefficient | .627**        | 1.000         | <b>.788**</b> | <b>.680**</b> | <b>.674**</b> |
|   |       | Sig. (2-tailed)         | .000          | .             | .000          | .000          | .000          |
|   |       | N                       | 158           | 158           | 158           | 158           | 158           |
|   | CPBL  | Correlation Coefficient | <b>.702**</b> | <b>.788**</b> | 1.000         | <b>.697**</b> | <b>.619**</b> |
|   |       | Sig. (2-tailed)         | .000          | .000          | .             | .000          | .000          |
|   |       | N                       | 158           | 158           | 158           | 158           | 158           |
|   | RAOS  | Correlation Coefficient | <b>.659**</b> | <b>.680**</b> | <b>.697**</b> | 1.000         | <b>.782**</b> |
|   |       | Sig. (2-tailed)         | .000          | .000          | .000          | .             | .000          |
|   |       | N                       | 158           | 158           | 158           | 158           | 158           |
|   | RAOEF | Correlation Coefficient | <b>.612**</b> | <b>.674**</b> | <b>.619**</b> | <b>.782**</b> | 1.000         |
|   |       | Sig. (2-tailed)         | .000          | .000          | .000          | .000          | .             |
|   |       | N                       | 158           | 158           | 158           | 158           | 158           |
| ** . Correlation is significant at the 0.01 level (2-tailed). |       |                         |               |               |               |               |               |
| * . Correlation is significant at the 0.05 level (2-tailed).  |       |                         |               |               |               |               |               |

## (b) Correlation between Perceived Risks and Malaysian Consumer Acceptance of Drone Delivery

Perceived risks involve the delivery risk (DVR), privacy risk (PVR) and performance risk (PFR). According to Table 5 below, the value of Spearman's rho correlation coefficient of the DVR is 0.038, PVR 0.043, and PFR 0.019. All results indicated that there were negligible correlations between the variables of perceived risks and Malaysian consumer acceptance of drone delivery. The significance value (p) was 0.436 for delivery risk, 0.596 for privacy risk and 0.813 for performance risk, which was more than 0.05. Hence, all hypotheses were rejected.

Table 5: Correlation between Perceived Risks and Malaysian Consumer Acceptance of Drone Delivery

| <b>Correlations</b>   |       |                         |       |              |               |               |
|---|-------|-------------------------|-------|--------------|---------------|---------------|
|   |       |                         | ACCEP | DVR          | PVR           | PFR           |
| Spearman's rho  | ACCEP | Correlation Coefficient | 1.000 | <b>0.038</b> | <b>.043</b>   | <b>.019</b>   |
|   |       | Sig. (2-tailed)         | .     | <b>.436</b>  | <b>.596</b>   | <b>.813</b>   |
|   |       | N                       | 158   | 158          | 158           | 158           |
|   | DVR   | Correlation Coefficient | 0.038 | 1.000        | 0.021         | 0.046         |
|   |       | Sig. (2-tailed)         | .436  | .            | .726          | .582          |
|   |       | N                       | 158   | 158          | 158           | 158           |
|   | PVR   | Correlation Coefficient | .043  | 0.021        | 1.000         | <b>.583**</b> |
|   |       | Sig. (2-tailed)         | .596  | .726         | .             | .000          |
|   |       | N                       | 158   | 158          | 158           | 158           |
|   | PFR   | Correlation Coefficient | .019  | 0.046        | <b>.583**</b> | 1.000         |
|   |       | Sig. (2-tailed)         | .813  | .582         | .000          | .             |
|   |       | N                       | 158   | 158          | 158           | 158           |
| ** . Correlation is significant at the 0.01 level (2-tailed). |       |                         |       |              |               |               |

(c) *Correlation between Individual Characteristics and Malaysian Consumer Acceptance of Drone Delivery*

Individual characteristics involve the environmental concern variable (EC), mass media channel variable (MMC), and personal innovativeness variable (PI). Based on Table 6 below, the value of Spearman's rho correlation coefficient of the EC is 0.346, which was positive with weak relation strength. While the MMC and the PI both were positive with moderate relation strength, which was 0.527 and 0.688 respectively. The significance (P) value of the three variables was 0.000. Thus, the hypothesis was significant and accepted due to P value less than 0.05.

Table 6: Correlation between Individual Characteristics and Malaysian Consumer Acceptance of Drone Delivery

| Correlations   |       |                         |        |               |               |               |
|----------------|-------|-------------------------|--------|---------------|---------------|---------------|
|                |       |                         | ACCEP  | EC            | MMC           | PI            |
| Spearman's rho | ACCEP | Correlation Coefficient | 1.000  | <b>.346**</b> | <b>.527**</b> | <b>.688**</b> |
|                |       | Sig. (2-tailed)         | .      | <b>.000</b>   | <b>.000</b>   | <b>.000</b>   |
|                |       | N                       | 158    | 158           | 158           | 158           |
|                | EC    | Correlation Coefficient | .346** | 1.000         | .316**        | .498**        |
|                |       | Sig. (2-tailed)         | .000   | .             | .000          | .000          |
|                |       | N                       | 158    | 158           | 158           | 158           |
|                | MMC   | Correlation Coefficient | .527** | .316**        | 1.000         | .533**        |
|                |       | Sig. (2-tailed)         | .000   | .000          | .             | .000          |
|                |       | N                       | 158    | 158           | 158           | 158           |
|                | PI    | Correlation Coefficient | .688** | .498**        | .533**        | 1.000         |
|                |       | Sig. (2-tailed)         | .000   | .000          | .000          | .             |
|                |       | N                       | 158    | 158           | 158           | 158           |

\*\* . Correlation is significant at the 0.01 level (2-tailed).

4.7. *Summary of Hypotheses Testing*

Table 7 presents the summary of hypotheses testing results. All hypotheses were supported except for H2a, H2b and H2c. Both hypotheses were found insignificant as the p-value was more than 0.05. The hypothesis would be accepted if the p-value was less than 0.05. Meanwhile, the highest correlation coefficient was H1b (0.702) which displayed that compatibility was the most important factor influencing Malaysian consumers' acceptance of drone delivery.

Table 7: Summary of Hypotheses Testing

| Hypothesis | Correlation Coefficient | Significance Level | Hypothesis Accepted/ Rejected |
|------------|-------------------------|--------------------|-------------------------------|
| H1a        | 0.627                   | 0.000              | Accepted                      |
| H1b        | 0.702                   | 0.000              | Accepted                      |
| H1c        | 0.659                   | 0.000              | Accepted                      |
| H1d        | 0.612                   | 0.000              | Accepted                      |
| H2a        | 0.038                   | 0.436              | Rejected                      |
| H2b        | 0.043                   | 0.596              | Rejected                      |
| H2c        | 0.019                   | 0.813              | Rejected                      |
| H3a        | 0.346                   | 0.000              | Accepted                      |
| H3b        | 0.527                   | 0.000              | Accepted                      |
| H3c        | 0.688                   | 0.000              | Accepted                      |

4.8. *Discussion*

The first objective of this study was to measure the level of Malaysian consumer acceptance of drone delivery. As shown in Table 2, all the questions revealed positive outcomes, which was a high level of mean agreement. Overall, this means that the results found that Malaysian consumers accepted to use the drone delivery. According to [5], the

level of consumer acceptability toward drones can vary significantly depending on different factors. As Khan *et al.* [15] indicated, if the retailer requires their consumers to accept the drone delivery mechanisms, they should account for the consumer's concerns and address them before operationalization. Companies should convince consumers that drones will not interfere with their daily lives. Therefore, this reveals that the consumers' level of acceptance of drone delivery is more likely to increase if their concerns are solved.

The second objective of this study was to investigate the relationships between perceived attribution of innovation, perceived risks, individual characteristics and Malaysian consumer acceptance of drone delivery. First, the results obtained for these hypothetical relationships indicated that compatibility (H1b;  $r = 0.702$ ) had a positive significant correlation with Malaysian consumer acceptance of drone delivery ( $0.000, p < 0.05$ ), with the highest relationship in the model. Hwang & Kim's [40] findings was coherent with the current studies, which showed that compatibility was the determining element in technology adoption. Then, this result was also supported by past research, emphasizing the significance of compatibility for the adoption of flight innovations technology as a method for parcel transport [41,42].

Secondly, personal innovativeness (H3c;  $r = 0.688$ ) was found to have a positive strong relationship with Malaysian consumer acceptance, the second highest relationship in the model ( $0.000, p < 0.05$ ). [10] also found that personal innovativeness is positively linked with the intention's consumers toward drone delivery because they support that consumers who enjoy trying new technologies are more willing to use them. Many prior studies also proved this causal relationship between personal innovativeness and behavioral intention toward adopting new technology [43,44].

Thirdly, the variable that was proven to correlate with the Malaysian consumer acceptance of drone delivery was the relative advantage of speed (H1c;  $r = 0.659$ ), complexity (H1a;  $r = 0.627$ ), and the relative advantage of environmental friendliness (H1d;  $r = 0.612$ ) respectively. The significance value of each variable was  $0.000, P < 0.05$ , so it was considered positive significant. In Malaysia, drone delivery is still not available to the public, thus it may cause both hypotheses to have an impact indirect on behavioral intention accepted via the construct attitude. This indicates that when consumers aware that drones can bring more benefits than other delivery channels, they will accept to adopt drone delivery. However, [43] stated that both hypotheses have an insignificant positive impact due to German consumers already having fast delivery (e.g. Amazon) and green options for parcel delivery (e.g. many parcel lockers that can help to decrease CO<sub>2</sub> emission) [45]. Hence, this suggests that the assumptions of this study are contradictory to previous studies, as different researchers have reached different results because of the country's development and situation. While for complexity, it is lack of evidence is found to support it. According to Ali *et al.* [46], the complexity shows significance because drone complexity could hamper its adoption facing the problem restricted by numerous regions, considered to be impeding other air traffic controls or mishaps risk and other potential harms.

Fourthly, mass media channel (H3b;  $r = 0.527$ ) and environmental concern (H3a;  $r = 0.346$ ) were found to have significant positive relationships with the Malaysian consumers' acceptance ( $0.000, p < 0.050$ ). In contrast with the study by [11] before the COVID-19 pandemic, where consumers considered the H3b and H3a were not significantly influenced their intention to use drone delivery, but this study presented that both variables were positively significant. In fact, insufficient evidence could support H3b and H3a. Nevertheless, as illustrated by the research of [24], drones have emerged as an innovative technology for parcel delivery and proven to be extremely helpful during the pandemic. Hence, we may consider that the consumers changed their opinion after they started to concern about the environment and were always influenced by mass media channels that reported the benefits of drones during the COVID-19 pandemic. Due to this, they began to believe and yearn for the new technology.

Fifthly, perceived risks including delivery risk (H2a;  $r = 0.038$ ), privacy risks (H2b;  $r = 0.043$ ) and performance risks (H2c;  $r = 0.019$ ) were negatively significant to Malaysian consumers' acceptance of drone delivery in the previous hypotheses. However, the result found that both hypotheses were positively insignificant due to  $P > 0.05$  in this study. They revealed that customers who felt the drones might easily malfunction or violate privacy had low acceptability and intention of using drone delivery. One of the reasons may be the different criteria set by each researcher caused the respondent's background to vary and directly impact the results. Like in this study, the respondents need to have knowledge of the presence of drones, while prior studies focused on their respondents requiring an online ordering experience or for all citizens aged 18 years only [14]. Thus, it can be concluded that the respondents who had experience with drones were less worried about the perceived risk of drones than others with no experience due to their understanding of the drone's function. Nevertheless, Mathew *et al.* [28] indicated that privacy risk also has a significant negative influence on drone delivery, while performance risk and delivery risk are

insignificant effects, which differs in one variable from the findings presented here. Additionally, consumers may be ready to overlook occasional malfunctions with drone deliveries because they have had similar experiences with other technology-based products and services and see them as part of the new technology. Just like it is possible that in the adoption and acceptance of other innovative products, for example, smart glasses, personal privacy did not count excessively [47].

## 5. Conclusion and Recommendation

From the above, all the two research objectives with 10 hypotheses generated had been discussed and answered successfully. The first research objective which measured the level of Malaysian consumer acceptance of drone delivery achieved its goal with positive outcome. The results also proved that the connection between drone delivery acceptance and IR4.0 lies in their mutual alignment with advanced technological advancements and digital transformation. For instance, both drone delivery and IR4.0 are transforming supply chains. Drones optimize the last-mile delivery, while IR4.0 technologies enhance supply chain visibility, traceability, and responsiveness. The acceptance of drone delivery is also indicative of consumers' willingness to embrace innovative solutions. Similarly, IR4.0 encourages industries to innovate and adapt to stay competitive in a rapidly changing technological landscape.

Next, the second objective showed that two factors, namely perceived attributes of innovation and individual characteristics had positive significant relationships with the Malaysian consumer acceptance of drone delivery. In a nutshell, this research completed its objectives to test the level of Malaysian consumer' acceptance and the relationships between perceived attribution of innovation, perceived risks, and individual characteristics and the Malaysian consumer acceptance of drone delivery.

Besides that, this study provides valuable information and some implications for drone delivery in future research. First, the study has management implications for companies readying to provide drone deliveries. Also, some companies have tried to use it for commercial objectives, and it helps to continue to improve their drone delivery systems. Finally, this study also has the significance of green research. That is because drones are an innovative information system powered by electric batteries (hence emitting much less carbon compared to trucks) and move faster and more efficiently. So, it is a green service that might be better for the environment. Furthermore, the future scope of drone delivery extends beyond the manufacturing sector and has a wide range of potential applications across various industries. For instance, in the healthcare sector, drones can be used to transport critical medical supplies, such as medications, vaccines, blood samples, and organs, to remote or hard-to-reach areas quickly and efficiently. Not only that but drones can deliver first-aid kits and medical equipment to disaster-stricken areas or accident scenes, enabling faster response times and potentially saving lives. As technology advances and regulatory frameworks evolve, expanded adoption and integration of drone delivery solutions in these and other industries are expected and therefore, this kind of research is very crucial in determining the customer's acceptance level.

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