



A Bibliometric Analysis of Empirical Studies on Drone Delivery *Drone Teslimatı İle İlgili Yapılan Ampirik Çalışmaların Bibliyometrik Analizi*

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Abstract

Product delivery by drone has become a topic of increasing interest in the academic community. This study aims to provide information about the authors who conducted the studies, the countries where the studies were conducted, the years of the studies, the methodology of the studies, the theoretical background of the studies, and the variables used in the studies by making a bibliometric analysis of 30 studies, which were selected based on certain criteria, including the subject of product delivery by drone. For this purpose, a bibliometric analysis of selected studies was carried out using VOSviewer software. The fact that it is a new technology and most people do not have real-life drone delivery experience has been influential in researching consumers' intentions and attitudes towards this technological innovation. In addition, it has been seen in the findings that the subject of delivery by drone has been studied more and more every year, and it has been understood that this new technology has attracted the attention of researchers more and more. According to the other results obtained, Jinsoo Hwang is the one who has done the most work on product delivery by drone. Most studies were conducted in South Korea. The survey method was used in all of the studies. The most technology acceptance model was used in the studies. The most used variables are intention, attitude, risk, and innovativeness, respectively. It is expected that these results will provide researchers with foresight.

Keywords: Drone delivery, bibliometric analysis, literature review.

Öz

Drone ile ürün teslimatı giderek artan şekilde akademik çevrelerin ilgisini çeken bir konu olmuştur. Bu çalışmanın amacı belli kriterlere bağlı olarak seçilen, drone ile ürün teslimatı konusunu içeren 30 çalışmanın bibliyometrik analizinin yapılarak, çalışmalarını yapan yazarlar, çalışmalarının yapıldığı ülkeler, çalışmalarının yapıldığı yıllar, çalışmalarının metodolojisi, çalışmalarının teorik alt yapıları ve çalışmalarda kullanılan değişkenler hakkında bilgiler sunmaktır. Bu amaç doğrultusunda VOSviewer yazılımı kullanılarak seçilen çalışmaların bibliyometrik analizi gerçekleştirilmiştir. Yeni bir teknoloji olması ve çoğu kişinin gerçek hayatta drone ile teslimat deneyiminin olmaması, tüketicilerin bu teknolojik yeniliğe yönelik niyet ve tutumlarının araştırılmasında etkili olmuştur. Ayrıca elde edilen bulgularda drone ile teslimat konusunun her geçen yıl daha fazla çalışıldığı görülmüş ve bu yeni teknolojinin araştırmacıların dikkatini giderek daha fazla çektiği anlaşılmıştır. Elde edilen başka sonuçlara göre drone ile ürün teslimatı konusunda en fazla çalışmayı yapan Jinsoo Hwang'dır. En fazla çalışma Güney Kore'de gerçekleştirilmiştir. Çalışmaların tümünde anket yöntemi kullanılmıştır. Çalışmalarda en fazla teknoloji kabul modeli kullanılmıştır. En fazla kullanılan değişkenler ise sırasıyla niyet, tutum, risk ve yenilikçiliktir. Elde edilen bu sonuçların araştırmacılara öngörüler sunması beklenmektedir.

Anahtar Kelimeler: Drone teslimatı, bibliyometrik analiz, literatür taraması.

Introduction

Transport and logistics industries are exploding with growth, as are the innovations that support new methods of transportation and delivery (Benarbia & Kyamakya, 2022). Benarbia and Kyamakya (2022) stated that companies are seeing a huge uptick in packages each year, thanks to the ever-growing e-commerce industry, coupled with innovative advancements in methods of delivery. A report by Pitney Bowes found a 27-per cent increase in global e-commerce parcel volume in 2020, rising to 4160 shipments worldwide every second, and creating 34 parcels per person, on average. By 2026, parcel volume could reach 232 billion (Pitney Bowes, 2021). Drones can be one of the first technologies to dramatically change last-mile logistics; they are expected to be primarily used in rural and suburban areas, rather than in big cities (McKinsey & Company, 2019). Although large companies like Amazon, Google, UPS, DHL, and Deutsche Post have been interested in drone delivery systems, from large companies like Amazon, Google, UPS, DHL, and Deutsche Post, most of the current research focuses on smaller-scale experiments regarding business models, consumer acceptance, technology reliability, and regulations (Simoudis, 2020). Researchers have been concentrating on ways to find optimal locations for drone depots (Aurambout et al., 2019) as well as determining routings for both drones and trucks (Moshref-Javadi et al., 2020; Murray & Raj, 2020).

It is known that studies on drone delivery have increased in recent years. The number of studies on this subject, for instance, increased from 21 in 2015 to 78 in 2017, 178 in 2019, and 312 in 2022 (Web of Science, 2022). Some studies dealt with the overall applications of drones in commercial uses like business travel and cargo transportation (MacSween-George, 2003). Other studies focused on a specific drone, exploring various situations that the drone could be used in, such as leisure (Lidynia et al., 2017) and comparing the risks of a drone to manned and remote-controlled aircraft (Clothier et al., 2015). Lidynia et al. (2018) indicated that people have a minor lack of consent for flying a drone over private property, which is not significantly different for people who are experienced with drones. Addressing the issue of vehicle routing in drone delivery, Dorlin et al. (2017) developed two proposals to solve this problem, which minimize costs and reduce delivery time. The topics of research on drone delivery, which were mostly published in 2019 and later and are also among the materials of this study, are as follows: hedonic motivation, adoption of drone delivery services, intentions to use drone delivery, behavioral intention, attitudes toward drone delivery, perceived risk, green image, expected benefits, innovativeness, product involvement, consumer acceptance, and consumer perceptions.

Researchers use bibliometric analysis to understand many aspects of bibliometric data, including the quantity of publications, the frequency with which they are cited, and even research outcomes. They also use it to identify trends and patterns in research efforts and to give a thorough overview of how the field's research has been evaluated (Muhammad et al., 2021). Bibliometric analysis is the combination of mathematics, statistics, and bibliography, and was first suggested by Alan Pritchard (Pritchard, 1969). Bibliometric analysis can give researchers a wide perspective of the advancement of a field of study, both in comparison charts and visually (Gao et al. 2021). Scientists can see the progression of different countries, institutions, journals, and even the authors themselves in the research area (See et al., 2022). Despite other new technologies using the method as an auxiliary research tool (Boakye et al., 2022; Fasogbon & Adebo, 2022; Hajek et al., 2022) drone delivery has not been researched using bibliometrics to investigate the following questions: (1) What is discussed in the literature about drone delivery? (2) Who are the authors who have done empirical research on drone delivery, and in which years are the studies in question more common? (3) In which countries is research on drone delivery being conducted? (4) In the literature, what are the most used theories about drone delivery? (5) What variables are used in drone delivery studies? (6) What are the methods used in drone delivery studies? (7) What gaps are there in the literature about drone delivery? (8) What other areas should be researched regarding drone delivery?

Drone delivery is a new and exciting technology, and in this article, in addition to some basic concepts related to this field, the methods and materials used in our research are also examined. This study contributes to the understanding of drone delivery and encourages further studies in this field by following the development of the literature. The article will be divided into three main parts: first the

basic concepts of drone delivery are discussed, then our materials and research method are discussed, and finally the research itself is focused on, including key findings. In the conclusion and discussion part, suggestions for future studies will be made.

1. Drone Delivery

Delivery drones, also known as unmanned aerial vehicles, are being tested for commercial services (Yoo et al., 2018). The use of unmanned aerial vehicles by the Austrian army for war against Venice in 1849 and the emergence of unmanned vehicles after the First World War show that the first unmanned aerial vehicles were used by military forces (Lokhande et al., 2018). According to Lokhande et al. (2018), the first mass-produced drone idea was proposed by a famous Hollywood actor, Reginald Denny, after which the company of the same name (Reginald Denny Company) produced the radio plane (It was used by the US military during the cold war to target aircraft to collect radioactive data). The first commercial permit for drones, which have been used for military purposes for many years, was granted in 2006, and just two years later, after French startup Parrot launched the first drone that could be controlled via smartphones and Wi-Fi connections, Amazon launched a drone-based delivery system in 2013 (Frachtbox, 2020). With the launch of the Phantom 4 Drone in 2016, the first drone to use smart tracking technology (as it does today) became available instead of following a GPS signal or navigating (Frachtbox, 2020).

According to Yoo et al. (2018), these drones have a minimum landing area of 2 square meters, can fly up to 50 kilometers, move between 15 and 65 kilometers per hour, can carry up to 5 kilograms, and can soar between 30 and 120 meters in the air. Drone delivery is a quick delivery method because it can get a package to its destination quickly and can fly over any road obstructions (Yoo et al., 2018). Drone tech has also improved in many ways - lithium polymer batteries give the drone higher energy density, carbon fiber drones are stronger yet lighter than previous models, and localization techniques like image processing have been refined (Dorling et al., 2017). According to a report published by The Brainy Insights (2022), drone package delivery is a self-contained, unmanned flying vehicle that transports emergency supplies (food, medicine, etc.) faster and safer, also they are great for the last mile and middle mile delivery and can avoid traffic congestion, delivering them safely and autonomously thanks to new technology like AI (the drones can fly at high speeds and take off and land vertically). These drones can perform many tasks, such as data collection and analysis, navigation and launch, all independent of human control, and many logistics and cargo companies are beginning to use drones to deliver their packages (The Brainy Insights, 2022).

In terms of economy and finance, it can be said that drone delivery has producer and consumer dimensions. In this respect, reduction of delivery costs and speed (time saving) are among the most important issues. (Yoo et al., 2018).

Reducing delivery costs: Before explaining the reduction of distribution costs for the manufacturer, it is useful to mention the fact that the drone delivery system is an emerging technology. A news report in 2017 is a good example for this. According to the news, Wal-Mart has applied for a US patent for a warehouse in the sky that can deliver to shoppers' homes via drones (Thomas, 2017). According to Thomas (2017), the warehouse in the sky will be able to fly up to 1000 feet high and be autonomously or remotely controlled by a human. It is known that Amazon has also obtained a patent for a similar product (product distribution warehouses floating in the sky) (Baron, 2018). Compared to the conversion of containerhips to floating warehouses (Styliadis & Chlomoudis, 2021), floating warehouses in the sky can be considered quite interesting and innovative. According to Baron (2018), the cost savings of floating warehouses in the sky to Amazon are \$887 billion (Baron, 2018). Carrying capacity and flight distance are among the most important problems of drones in terms of cost, and as a solution to this problem, "last mile delivery with drone" has been developed (Ha et al., 2018). This solution refers to the use of the drone from a place within flight distance, where the delivery will be made in order to increase the usability of the drones (Ha et al., 2018). de Freitas and Penna (2020) explain that time and cost go hand in hand, and that the main cost of a drone is the upfront cost of purchasing the drone itself. Reducing the cost of delivery has multiple factors, according to the authors. Using multiple drones at once with a delivery truck can decrease the distance that the truck has to drive, which decreases the overall cost of deliveries by 30.08% (Dukkanci et al., 2021).

Speed (Time Saving): The main benefit of drone delivery is the speed of the drones (Yoo et al., 2018). Drones can deliver items in a specified time window very efficiently (Joeress et al., 2016). Yoo et al. (2018) state that when a customer orders something online and gets it delivered by a drone, they would receive their product within 30 minutes. Yoo et al. (2018) wondered how much time could be saved by drones versus trucks. Their research demonstrated that drones can fly over any road obstacles, unlike trucks that have to slow down due to traffic or road infrastructure (Yoo et al., 2018). Drones can also deliver packages faster and with more accurately than trucks, taking the most efficient route from start to finish (Yoo et al., 2018). Poikonen et al. (2017) found that when drones are 50% faster than trucks, they can reduce delivery completion time by 75%.

2. Materials and Methods

For studies on drone delivery or product delivery by drone, the Google Scholar database was used without language restrictions. The studies had to have been published between 2017 and 2022. The studies must be empirical and published between 2017 and 2022. It was determined that there were 30 empirical studies conducted between the mentioned years. Google Scholar was selected because it has higher citation counts per document than other databases that are used for bibliometric analysis, like Web of Science and the database also has high coverage of literature (Kulkarni et al., 2009). Google Scholar is particularly useful for conducting citation analysis, as it can be accessed for free, whereas other databases charge a fee (Neuhaus & Daniel, 2008). Unlike other databases, such as Web of Science, Google Scholar searches many non-traditional sources, including pre-print archives, conference proceedings, and institutional repositories, often the documents found are on the authors website, free to access (Giles, 2005). Aside from being free to use, Giles (2005) states that another great benefit of Google Scholar is its speed in comparison to other databases. Kousha and Thelwall (2007) believe that the citation feature of Google Scholar could be a new tool in bibliometrics. Accordingly, the following query was followed: “drone delivery” OR “product delivery by drone” AND “perceived” OR “attitude” OR “empirical”.

Only original articles were included in the analysis after all documents were retrieved. Non-empirical documents not related to drone delivery or product delivery by drone are excluded. All bibliometric data points, including authors' names, year of publication, title and keywords, and countries that make up the subject of each article, were then exported to an Endnote file. Visual maps were made for the selected studies, the countries where the studies were conducted, the publication years of the studies, the method sections of the studies, the theory/models used in the studies, and the variables evaluated in the studies using the VOSviewer software (version 1.6.16).

3. Results

3.1. Selected Studies and Years of Publication of Studies

According to Table 1, Aydin (2022), Chen et al. (2022), Choe et al. (2021a), Choe et al. (2021b), Çelik and Aydın (2021), Frazier (2021), Ganjipour and Edrisi (2022), Hwang and Choe (2019), Hwang and Kim (2019), Hwang and Kim (2020), Hwang et al. (2019a), Hwang et al. (2019b), Hwang et al. (2020a), Hwang et al. (2020b), Hwang et al. (2021a), Jasim et al. (2022), Khan et al. (2019), Kim and Hwang (2020), Kim et al. (2021), Leon et al. (2021), Liu et al. (2020), Mathew et al. (2021), Michels et al. (2021), Mittendorf et al. (2017), Napaporn (2020), Osakwe et al. (2022), Sham et al. (2022), Waris et al. (2022), Yaprak et al. (2021) and Yoo et al. (2018) are the thirty studies selected for this current study. Accordingly, there are empirical studies conducted on drone delivery from 2017 to the present (i.e. 2022). According to the thirty studies selected, there is 1 study in 2017, 1 study in 2018, 5 studies in 2019, 6 studies in 2020, 10 studies in 2021, and 7 studies in 2022. Although most studies were published in 2021, when we consider that we are in the middle of 2022, it is seen that the number of studies on drone delivery has increased since 2017. Researchers have paid slightly more attention to drone delivery subjects since 2017.

Table 1.

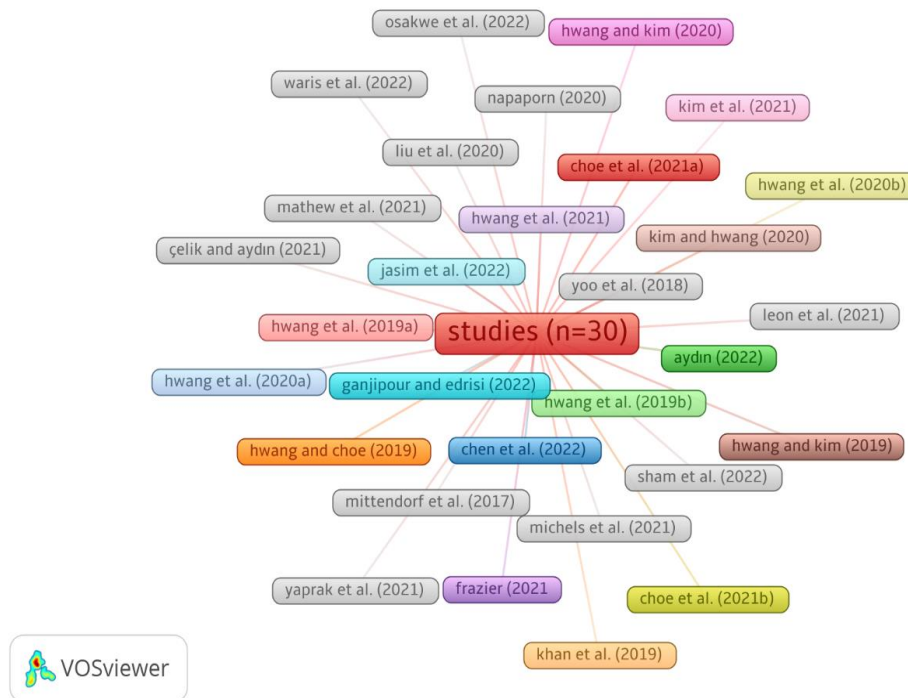
Selected Studies and Years of Publication of Studies

Documents=30			
Year	Selected Studies	Frequency	Percent
2022	Aydin (2022); Chen et al. (2022); Ganjipour and Edrisi (2022); Jasim et al. (2022); Osakwe et al. (2022); Sham et al. (2022); Waris et al. (2022)	7	23.33
2021	Choe et al. (2021a); Choe et al. (2021b); Çelik and Aydın (2021); Frazier (2021); Hwang et al. (2021a); Kim et al. (2021); Leon et al. (2021); Mathew et al. (2021); Michels et al. (2021); Yaprak et al. (2021)	10	33.33
2020	Hwang and Kim (2020); Hwang et al. (2020a); Hwang et al. (2020b); Kim and Hwang (2020); Liu et al. (2020); Napaporn (2020)	6	20.00
2019	Hwang and Choe (2019); Hwang and Kim (2019); Hwang et al. (2019a); Hwang et al. (2019b); Khan et al. (2019)	5	16.67
2018	Yoo et al. (2018)	1	3.33
2017	Mittendorf et al. (2017)	1	3.33

According to Figure 1, it should be stated that Hwang has the most co-authorship among the thirty selected studies. Jinsoo Hwang is the author who conducted the most research on drone delivery, as he co-authored most of the thirty selected studies (n=14).

Figure 1.

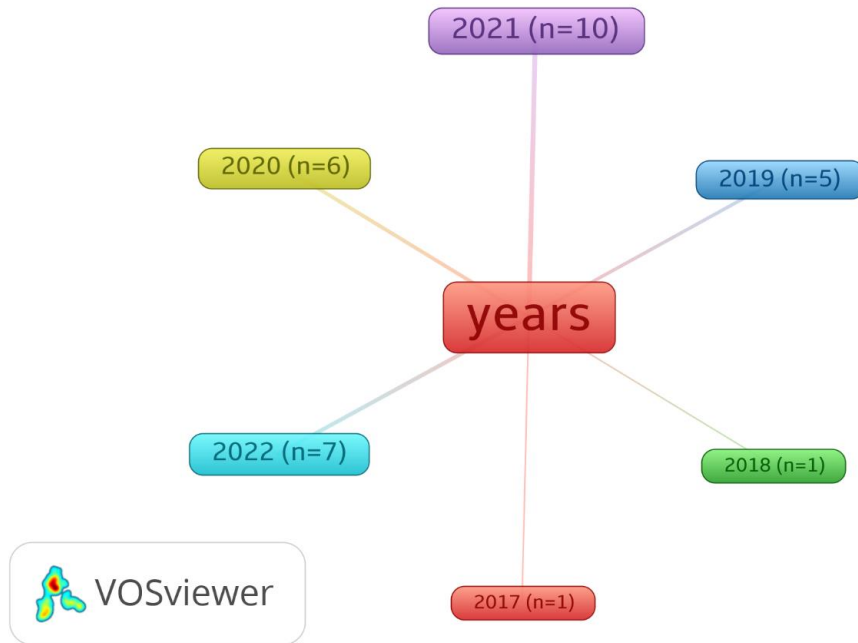
Co-Occurrences for Selected Studies



According to Figure 2, 2021 is the year in which the most studies were published simultaneously among the 30 selected studies. The year 2021 is co-occurrence for ten selected studies.

Figure 2.

Co-Occurrences for Years of Publication of Studies



3.2. Countries of Studies

According to Table 2, the other countries where the studies were conducted and the number of studies conducted in these countries are as follows: 12 in South Korea, 3 in Türkiye, 3 in the USA, 2 in Malaysia, 2 in Pakistan, 2 in Thailand, 1 in Germany, 1 in India, and 1 in Iran. However, it is not known in which country the 3 studies were conducted.

Table 2.

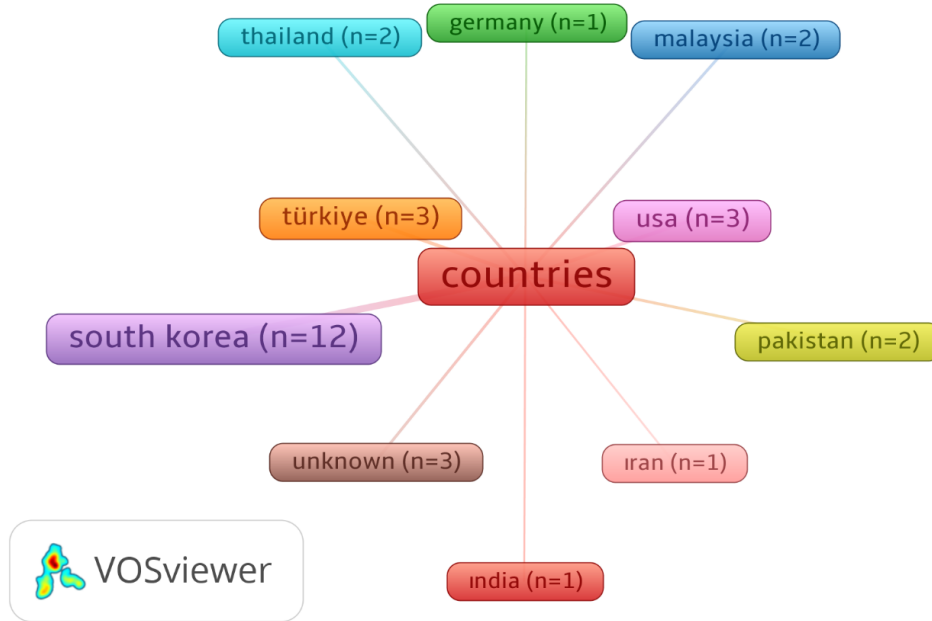
Countries of Studies

Documents=30					
Countries	Frequency	Percent	Countries	Frequency	Percent
South Korea	12	40.00	Pakistan	2	6.67
Türkiye	3	10.00	Thailand	2	6.67
Unknown	3	10.00	Germany	1	3.33
USA	3	10.00	India	1	3.33
Malaysia	2	6.67	Iran	1	3.33

According to Figure 3, there are studies conducted in many different countries. Looking at Figure 3, it will be seen that there are no studies carried out in partner countries (ie at an international level), but only studies carried out in any country (i.e. at a national level). Because there is no ties/relationship, that is, a common cluster, between the countries where the studies are carried out. However, it should be noted that no information was available about the countries where the three studies were conducted. In conclusion, apart from 3 studies, each of the other 27 studies was conducted at the national level. 12 of the 27 studies were conducted in South Korea. South Korea is a common cluster where most studies are conducted.

Figure 3.

Co-Occurrences for Countries of Studies



3.3. Theoretical Foundations of Studies

According to Table 3, the technology acceptance model (n=11), diffusion of innovations theory (n=6), theory of planned behavior (n=5), theory of perceived risk (n=3), unified theory of acceptance and use of technology (n=2), consumer coproduction theory (n=1), model of goal-directed behaviour (n=1), norm activation model (n=1), protection motivation theory (n=1), social cognitive theory (n=1), word-of-mouth theory (n=1), and value-belief-norm theory (n=1) are the theories/models on which the theoretical foundations of some studies are based among 30 selected studies.

Table 3.

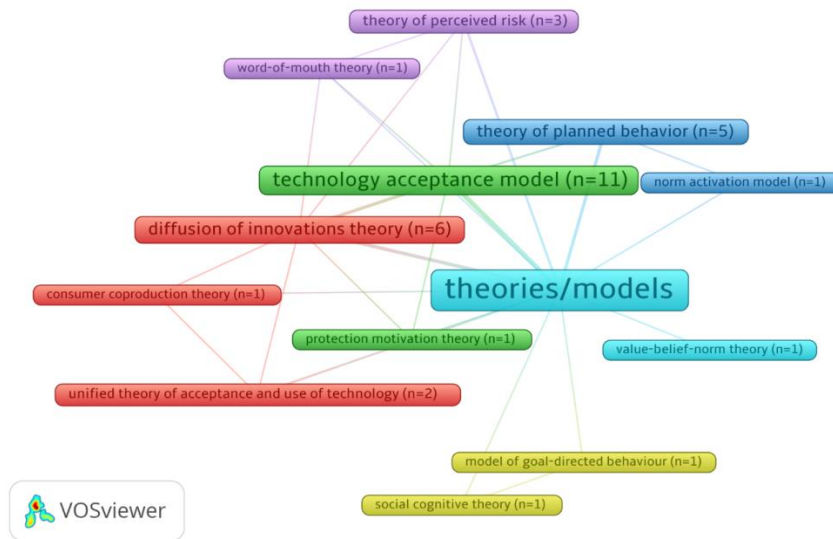
Theoretical Foundations of Studies

Documents=30		
Models/Theories	Frequency	Percent
Technology acceptance model	11	36.67
Diffusion of innovations theory	6	20.00
Theory of planned behavior	5	16.67
Theory of perceived risk	3	10.00
Unified theory of acceptance and use of technology	2	6.67
Consumer coproduction theory	1	3.33
Model of goal-directed behaviour	1	3.33
Norm activation model	1	3.33
Protection motivation theory	1	3.33
Social cognitive theory	1	3.33
Word-of-mouth theory	1	3.33
Value-belief-norm theory	1	3.33

According to Figure 4, While the theoretical foundations of the studies carried out were mostly based on the Technology Acceptance Model, the Technology Acceptance Model provided the theoretical basis for the studies together with other theories/models. Because when looking at Figure 4, it will be seen that the Technology Acceptance Model has a connection with other theories/models. On the other hand, it will be seen that Diffusion of Innovations Theory provides the theoretical basis for the most studies after the Technology Acceptance Model.

Figure 4.

Co-Occurrences for Theoretical Foundations of Studies



3.4. Methodology of Studies

According to Table 4, the survey was used to collect data in all thirty studies conducted. On the other hand, in one study, data were collected by using the survey and interview method together. While the total (or sample) size of the data obtained in 20 studies is less than 384, the total size of the data obtained in the remaining ten studies is more than 384. SEM, regression analysis, Process Macro and t-tests were performed to test the research hypotheses thanks to the data obtained in the studies carried out. However, it should be noted that while SEM was employed in 22 of the 30 studies, regression analysis was performed in the remaining 8 studies. It should be noted that in any study conducted, regression analysis as well as t-test or Process Macro were performed.

Table 4.

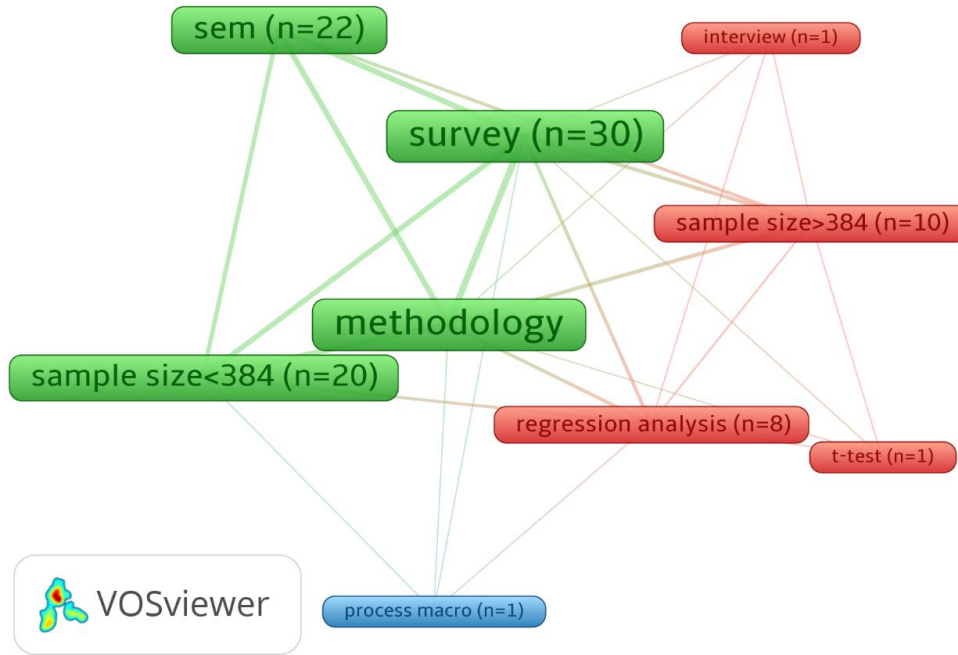
Methodology of Studies

Documents=30					
Data collection method	Frequency	Percent	Analysis method	Frequency	Percent
Survey	30	100.00	SEM	22	73.33
Interview	1	3.33	Regression analysis	8	26.67
Sample size	Frequency	Percent	Process Macro	1	3.33
Sample size<384	20	66.67	t-Test	1	3.33
Sample size>384	10	33.33			

According to Figure 5, the most common methodological features of the 30 selected studies are the use of a survey to collect data, the resulting data size being less than 384, and the performing SEM to test hypotheses.

Figure 5.

Co-Occurrences for Methodology of Studies



3.5. Variables of Studies

According to Table 5, the intention (n=27), attitude (n=18), risk (n=14), innovativeness (n=13), compatibility (n=8), usefulness (n=8), ease of use (n=7), pay more (n=6), WOM (n=6), desire (n=5), hedonism (n=5), image (n=5), speed (n=4), subjective norm (n=4), trust (n=4), actual use (n=3), behavioral control (n=3), complexity (n=3), expectancy (n=3), facilitating conditions (n=3), friendliness (n=3), gender (n=3), social influence (n=3), environmental concern (n=2), functionality (n=2), mass media channel (n=2), personal norm (n=2), price (n=2), privacy concern (n=2), problem awareness (n=2), relative advantage (n=2), responsibility (n=2), self-efficacy (n=2) are variables that were evaluated in more than one study. However, age (n=1), convenience (n=1), COVID-19 (n=1), education (n=1), ecological worldview (n=1), effect on the environment (n=1), emotion (n=1), familiarity (n=1), generations (n=1), habits (n=1), interaction (n=1), job relevance (n=1), leadership influence (n=1), level of criminal activity (n=1), motives (n=1), opinion passing (n=1), privacy disposition (n=1), pro-environmental actions (n=1), rural & urban (n=1), safety (n=1), severity (n=1), state (n=1), threat (n=1), value (n=1), valued objects (n=1), and vulnerability (n=1) variables were only evaluated in (any) study. Accordingly, intention, attitude, risk, and innovativeness were the top four variables that were evaluated most in more than ten studies.

Table 5.

Variables of Studies

Documents=30					
Variables	Frequency	Percent	Variables	Frequency	Percent
Intention	27	90.00	Relative advantage	2	6.67
Attitude	18	60.00	Responsibility	2	6.67
Risk	14	46.67	Self-efficacy	2	6.67
Innovativeness	13	43.33	Age	1	3.33

Compatibility	8	26.67	Convenience	1	3.33
Usefulness	8	26.67	COVID-19	1	3.33
Ease of use	7	23.33	Education	1	3.33
Pay more	6	20.00	Ecological worldview	1	3.33
WOM	6	20.00	Effect on the environment	1	3.33
Desire	5	16.67	Emotion	1	3.33
Hedonism	5	16.67	Familiarity	1	3.33
Image	5	16.67	Generations	1	3.33
Speed	4	13.33	Habits	1	3.33
Subjective norm	4	13.33	Interaction	1	3.33
Trust	4	13.33	Job relevance	1	3.33
Actual use	3	10.00	Leadership influence	1	3.33
Behavioral control	3	10.00	Level of criminal activity	1	3.33
Complexity	3	10.00	Motives	1	3.33
Expectancy	3	10.00	Opinion passing	1	3.33
Facilitating conditions	3	10.00	Privacy disposition	1	3.33
Friendliness	3	10.00	Pro-environmental actions	1	3.33
Gender	3	10.00	Rural & urban	1	3.33
Social influence	3	10.00	Safety	1	3.33
Environmental concern	2	6.67	Severity	1	3.33
Functionality	2	6.67	State	1	3.33
Mass media channel	2	6.67	Threat	1	3.33
Personal norm	2	6.67	Value	1	3.33
Price	2	6.67	Valued objects	1	3.33
Privacy concern	2	6.67	Vulnerability	1	3.33
Problem awareness	2	6.67			

In Figure 6, it will be seen that the variables of intention, attitude, and innovativeness are shown/clustered in yellow, that is, these variables are evaluated together in many studies. Therefore, it should be stated that there are many relationships/connections between intention, attitude, and innovativeness.

Figure 6.

Co-Occurrences for Variables of Studies



Conclusion and Discussion

Product delivery with drones is a very important issue in many aspects such as marketing, economy, transportation, and city traffic. Product delivery by drone, which is a fairly new subject, is increasingly attracting the attention of academic circles and the business world in terms of its importance. In this study, a bibliometric analysis of 30 studies selected by considering certain criteria was performed. As a result of the bibliometric analysis, information such as the authors who carried out the studies, the countries where the studies were conducted, the years in which the studies were conducted, the theories used in the studies, the analyzes used in the studies, and the variables discussed in the studies were revealed. This information is important in terms of providing insights to researchers who will work on drone delivery and understanding the important aspects of such studies. It is also thought that this information will provide insights for the business world to consider which variables are studied more and determine delivery strategies with drones accordingly.

As a result of the analysis, it is seen that Jinsoo Hwang from South Korea did the most work. Considering the studies of the related author, it was seen that he worked on new technologies such as robotic restaurants (Hwang et al., 2020c), and robot baristas (Hwang et al., 2021b). It has been understood that the author has also worked on the subject of delivery by drone, which is one of the new technologies. Considering the publication years of the studies, most studies were conducted in 2021. It was seen that 10 studies were carried out in 2021, and 7 studies were carried out in 2022. When this study is carried out, it is estimated that the number of studies in 2022 will be more than the studies carried out in 2021, since it is only halfway through 2022. Looking at the years of the studies, another important result is that more studies are carried out every year. Accordingly, it can be said that the subject of delivery by drone attracts more and more attention among researchers. It has been observed that most studies on drone delivery were carried out in South Korea, followed by Turkey and the USA. It can be said that the fact that the author who has done the most studies on the relevant subject is from South Korea is effective in the fact that most studies are in South Korea. When the theoretical foundations of the studies are examined, it is seen that the technology acceptance model, the diffusion of innovations theory, and the planned behavior theory are used in most studies, respectively. Considering that drone delivery is a new technology and delivery is made for consumers, it will be easily understood why the relevant models/theories are used the most. Surveys were used in

all of the studies. A survey is among the most important techniques in understanding consumer behavior. Since the delivery is for consumers, it is quite natural to use surveys in all studies. Structural equation modeling was mostly used in the studies. In the studies, mostly intention, attitude, risk, and innovativeness variables were used. The fact that it is a new technology and most people have no experience with drone delivery in real life has been effective in investigating the intentions and attitudes of consumers towards this technological innovation. In addition, since drone delivery has risks such as causing accidents and theft, the risk variable is among the most studied variables. Moreover, another striking result about the variables is that intention, attitude, and innovativeness variables are considered together in many studies. It is considered valuable to investigate the usage intention and attitude towards delivery with a drone, which is an innovation in the emergence of this result.

The results obtained will provide a prediction of the theory/models and variables used in the studies for researchers who are considering working on drone delivery, and they contain important information for researchers who want to study more specific topics.

References

- Aurambout, J. P., Gkoumas, K., & Ciuffo, B. (2019). Last mile delivery by drones: An estimation of viable market potential and access to citizens across European cities. *European Transport Research Review*, 11(1), 11-30. DOI: 10.1186/s12544-019-0368-2
- Aydın, İ. (2022). Hedonik motivasyonun drone ile teslimata yönelik tutum üzerindeki etkisi: Ağızdan ağıza iletişimin aracılık rolü. *İşletme Akademisi Dergisi*, 3(1), 34-45. DOI:10.26677/TR1010.2022.962
- Baron, E. 2018. Amazon looks to floating warehouses in the sky for drone deliveries. *The Mercury News*, <https://www.mercurynews.com/2018/07/24/amazon-looks-to-floating-warehouses-in-the-sky-for-drone-deliveries/>
- Benarbia, T., & Kyamakya, K. (2022). A literature review of drone-based package delivery logistics systems and their implementation feasibility. *Sustainability*, 14(1), 360. DOI:10.3390/su14010360
- Boakye, E. A., Zhao, H., & Ahia, B. N. K. (2022). Emerging research on blockchain technology in finance; a conveyed evidence of bibliometric-based evaluations. *The Journal of High Technology Management Research*, 33(2), 100437. DOI: 10.1016/j.hitech.2022.100437
- Chen, C., Leon, S., & Ractham, P. (2022). Will customers adopt last-mile drone delivery services? An analysis of drone delivery in the emerging market economy. *Cogent Business & Management*, 9(1), 2074340. DOI: 10.1080/23311975.2022.2074340
- Choe, J. Y. J., Kim, J. J., & Hwang, J. (2021a). Perceived risks from drone food delivery services before and after COVID-19. *International Journal of Contemporary Hospitality Management*, 33(4), 1276-1296. DOI: 10.1108/IJCHM-08-2020-0839
- Choe, J. Y., Kim, J. J., & Hwang, J. (2021b). Innovative marketing strategies for the successful construction of drone food delivery services: Merging TAM with TPB. *Journal of Travel & Tourism Marketing*, 38(1), 16-30. DOI: 10.1080/10548408.2020.1862023
- Clothier, R. A., Greer, D. A., Greer, D. G., & Mehta, A. M. (2015). Risk perception and the public acceptance of drones. *Risk Analysis*, 35(6), 1167-1183. DOI: 10.1111/risa.12330
- Çelik, Z., & Aydın, İ. (2021). Perakendecilikte drone ile ürün teslimatının tüketicilerin davranışsal niyetlerine etkisi. *Business & Management Studies: An International Journal*, 9(4), 1422-1436. DOI: 10.15295/bmij.v9i4.1919
- de Freitas, J. C., & Penna, P. H. V. (2020). A variable neighborhood search for flying sidekick traveling salesman problem. *International Transactions in Operational Research*, 27(1), 267-290. DOI: 10.1111/itor.12671

- Dorling, K., Heinrichs, J., Messier, G. G., & Magierowski, S. (2017). Vehicle routing problems for drone delivery. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 47(1), 70-85. DOI: 10.1109/TSMC.2016.2582745
- Dukkanci, O., Kara, B. Y., & Bektaş, T. (2021). Minimizing energy and cost in range-limited drone deliveries with speed optimization. *Transportation Research Part C: Emerging Technologies*, 125, 102985. DOI: 10.1016/j.trc.2021.102985
- Fasogbon, B. M., & Adebo, O. A. (2022). A Bibliometric Analysis of 3D Food Printing Research: A Global and African Perspective. *Future Foods*, 100175. DOI: 10.1016/j.fufo.2022.100175
- Frachtbox (2020). A revolution in logistics: Drone delivery. <https://www.frachtbox.com/blog/a-revolution-in-logistics-drone-delivery>
- Frazier, J. A. (2021). An Analysis of the factors affecting attitudes toward drone delivery and the moderating effect of COVID-19. *PhD Dissertations and Master's Theses*. 612. <https://commons.erau.edu/edt/612>
- Ganjipour, H., & Edrisi, A. (2022). Applying the integrated model to understanding online buyers' intention to adopt delivery drones in Iran. *Transportation Letters*, 1-13. DOI: 10.1080/19427867.2022.2035130
- Gao, Q., Fang, C., & Cui, X. (2021). Carrying capacity for SDGs: A review of connotation evolution and practice. *Environmental Impact Assessment Review*, 91, 106676. DOI: 10.1016/j.eiar.2021.106676
- Giles, J. (2005). Science in the web age: Start your engines. *Nature*, 438(7068), 554-556. DOI: 10.1038/438554A
- Ha, Q. M., Deville, Y., Pham, Q. D., & Hà, M. H. (2018). On the min-cost traveling salesman problem with drone. *Transportation Research Part C: Emerging Technologies*, 86, 597-621. DOI: 10.1016/j.trc.2017.11.015
- Hajek, P., Youssef, A., & Hajkova, V. (2022). Recent developments in smart city assessment: A bibliometric and content analysis-based literature review. *Cities*, 103709. DOI: 10.1016/j.cities.2022.103709
- Hwang, J., & Choe, J. Y. J. (2019). Exploring perceived risk in building successful drone food delivery services. *International Journal of Contemporary Hospitality Management*, 31(8), 3249-3269. DOI: 10.1108/IJCHM-07-2018-0558
- Hwang, J., & Kim, H. (2019). Consequences of a green image of drone food delivery services: The moderating role of gender and age. *Business Strategy and the Environment*, 28(5), 872-884. DOI: 10.1002/bse.2289
- Hwang, J., & Kim, H. (2020). The effects of expected benefits on image, desire, and behavioral intentions in the field of drone food delivery services after the outbreak of COVID-19. *Sustainability*, 13(1), 117. DOI: 10.3390/su13010117
- Hwang, J., Kim, H., & Kim, W. (2019a). Investigating motivated consumer innovativeness in the context of drone food delivery services. *Journal of Hospitality and Tourism Management*, 38, 102-110. DOI: 10.1016/j.jhtm.2019.01.004
- Hwang, J., Lee, J. S., & Kim, H. (2019b). Perceived innovativeness of drone food delivery services and its impacts on attitude and behavioral intentions: The moderating role of gender and age. *International Journal of Hospitality Management*, 81, 94-103. DOI: 10.1016/j.ijhm.2019.03.002
- Hwang, J., Kim, W., & Kim, J. J. (2020a). Application of the value-belief-norm model to environmentally friendly drone food delivery services: The moderating role of product involvement. *International Journal of Contemporary Hospitality Management*, 32(5), 1775-1794. DOI: 10.1108/IJCHM-08-2019-0710

Hwang, J., Kim, D., & Kim, J. J. (2020b). How to form behavioral intentions in the field of drone food delivery services: The moderating role of the COVID-19 outbreak. *International Journal of Environmental Research and Public Health*, 17(23), 9117. DOI: 10.3390/ijerph17239117

Hwang, J., Park, S., & Kim, I. (2020c). Understanding motivated consumer innovativeness in the context of a robotic restaurant: The moderating role of product knowledge. *Journal of Hospitality and Tourism Management*, 44, 272-282. DOI: 10.1016/j.jhtm.2020.06.003

Hwang, J., Kim, J. J., & Lee, K. W. (2021a). Investigating consumer innovativeness in the context of drone food delivery services: Its impact on attitude and behavioral intentions. *Technological Forecasting and Social Change*, 163, 120433. DOI: 10.1016/j.techfore.2020.120433

Hwang, J., Choe, J. Y. J., Kim, H. M., & Kim, J. J. (2021b). Human baristas and robot baristas: How does brand experience affect brand satisfaction, brand attitude, brand attachment, and brand loyalty?. *International Journal of Hospitality Management*, 99, 1-12. DOI: 10.1016/j.ijhm.2021.103050

Jasim, N. I., Kasim, H., & Mahmoud, M. A. (2022). Towards the development of smart and sustainable transportation system for foodservice industry: Modelling factors influencing customer's intention to adopt drone food delivery (DFD) services. *Sustainability*, 14(5), 2852. DOI: 10.3390/su14052852

Joeress, M., Schröder, J., Neuhaus, F., Klink, C., & Mann, F. (2016). How customer demands are reshaping last-mile delivery. *McKinsey & Company*, 1-32. <https://www.mckinsey.com/~media/mckinsey/industries/travel%20logistics%20and%20infrastructure/our%20insights/how%20customer%20demands%20are%20reshaping%20last%20mile%20delivery/how-customer-demands-are-reshaping-last-mile-delivery.pdf>

Khan, R., Tausif, S., & Javed Malik, A. (2019). Consumer acceptance of delivery drones in urban areas. *International Journal of Consumer Studies*, 43(1), 87-101. DOI: 10.1111/ijcs.12487

Kim, J. J., & Hwang, J. (2020). Merging the norm activation model and the theory of planned behavior in the context of drone food delivery services: Does the level of product knowledge really matter?. *Journal of Hospitality and Tourism Management*, 42, 1-11. DOI: 10.1016/j.jhtm.2019.11.002

Kim, J. J., Kim, I., & Hwang, J. (2021). A change of perceived innovativeness for contactless food delivery services using drones after the outbreak of COVID-19. *International Journal of Hospitality Management*, 93, 102758. DOI: 10.1016/j.ijhm.2020.102758

Kousha, K., & Thelwall, M. (2007). Google Scholar citations and Google Web/URL citations: A multi-discipline exploratory analysis. *Journal of the American Society for Information Science and Technology*, 58(7), 1055-1065. DOI: 10.1002/asi.20584

Kulkarni, A. V., Aziz, B., Shams, I., & Busse, J. W. (2009). Comparisons of citations in Web of Science, Scopus, and Google Scholar for articles published in general medical journals. *Jama*, 302(10), 1092-1096. DOI: 10.1001/jama.2009.1307

Leon, S., Chen, C., & Ratcliffe, A. (2021). Consumers' perceptions of last mile drone delivery. *International Journal of Logistics Research and Applications*, 1-20. DOI: 10.1080/13675567.2021.1957803

Lidynia, C., Philipsen, R., & Ziefle, M. (2017). Droning on about drones—acceptance of and perceived barriers to drones in civil usage contexts. In *Advances in human factors in robots and unmanned systems* (pp. 317-329). Springer, Cham. DOI: 10.1007/978-3-319-41959-6_26

Lidynia, C., Philipsen, R., & Ziefle, M. (2018). The Sky's (not) the limit-influence of expertise and privacy disposition on the use of multicopters. In *International Conference on Applied Human Factors and Ergonomics* (pp. 270-281). Springer, Cham. DOI: 10.1007/978-3-319-60384-1_26

Liu, D., Lai, M. C., & Tsay, W. D. (2020). Determinants analysis of drone delivery service adoption. In *2020 3rd IEEE International Conference on Knowledge Innovation and Invention (ICKII)* (pp. 1-4). IEEE. DOI: 10.1109/ICKII50300.2020.9318942

- Lokhande, A.P., Shaikh, A. N., & Patil, O. S. (2018). Drones in production, supply chain and logistics. *International Research Journal of Engineering and Technology (IRJET)*, 5(2), 2179-2182.
- Macsween-George, S. L. (2003). Will the public accept UAVs for cargo and passenger transportation?. In *2003 IEEE Aerospace Conference Proceedings (Cat. No. 03TH8652)* (Vol. 1, pp. 1-367). IEEE. DOI: 10.1109/AERO.2003.1235066
- Mathew, A. O., Jha, A. N., Lingappa, A. K., & Sinha, P. (2021). Attitude towards drone food delivery services—role of innovativeness, perceived risk, and green image. *Journal of Open Innovation: Technology, Market and Complexity*, 7(2), 144. DOI: 10.3390/joitmc7020144
- McKinsey&Company (2019). The Next Normal The future of parcel delivery: Drones and disruption. <https://www.mckinsey.com/~media/McKinsey/Featured%20Insights/The%20Next%20Normal/The-Next-Normal-The%20future-of-parcel-delivery-vF>
- Michels, M., von Hobe, C. F., Weller von Ahlefeld, P. J., & Musshoff, O. (2021). The adoption of drones in German agriculture: a structural equation model. *Precision Agriculture*, 22(6), 1728-1748. DOI: 10.1007/s11119-021-09809-8
- Mittendorf, C., Franzmann, D., & Ostermann, U. (2017). Why would customers engage in drone deliveries?. *Twenty-third Americas Conference on Information Systems, Boston, 2017*. <https://core.ac.uk/download/pdf/301371848.pdf>
- Moshref-Javadi, M., Hemmati, A., & Winkenbach, M. (2020). A truck and drones model for last-mile delivery: A mathematical model and heuristic approach. *Applied Mathematical Modelling*, 80, 290-318. DOI: 10.1016/j.apm.2019.11.020
- Muhammad, A., Ali, M. A., Shanono, I. H., & Abdullah, N. R. H. (2021). A systematic and bibliometric analysis on 3D printing published in scientific citation index-expanded indexed journals between 1999 and 2019. *Materials Today: Proceedings*, 44, 1739-1743. DOI: 10.1016/j.matpr.2020.11.902
- Murray, C. C., & Raj, R. (2020). The multiple flying sidekicks traveling salesman problem: Parcel delivery with multiple drones. *Transportation Research Part C: Emerging Technologies*, 110, 368-398. DOI: 10.1016/j.trc.2019.11.003
- Napaporn, P. (2020). The intention to use drone technology in Thailand's construction industry. URI: <https://archive.cm.mahidol.ac.th/handle/123456789/3569>
- Neuhaus, C., & Daniel, H. D. (2008). Data sources for performing citation analysis: An overview. *Journal of documentation*, 64(2), 193-210. DOI: 10.1108/00220410810858010
- Osakwe, C. N., Hudik, M., Řiha, D., Stros, M., & Ramayah, T. (2022). Critical factors characterizing consumers' intentions to use drones for last-mile delivery: Does delivery risk matter?. *Journal of Retailing and Consumer Services*, 65, 102865. DOI: 10.1016/j.jretconser.2021.102865
- Pitney Bowes (2021). Global Parcel Volume Exceeds 131 Billion in 2020, up 27 Percent Year-Over-Year, Finds Pitney Bowes Parcel Shipping Index. URL: https://news.pb.com/article_display.cfm?article_id=6007
- Pritchard, A. (1969). Statistical bibliography or bibliometrics. *Journal of Documentation*, 25(4), 348.
- Poikonen, S., Golden, B., & Wasil, E. A. (2019). A branch-and-bound approach to the traveling salesman problem with a drone. *INFORMS Journal on Computing*, 31(2), 335-346. DOI: 10.1287/ijoc.2018.0826
- See, K. F., Ülkü, T., Forsyth, P., & Niemeier, H. M. (2022). Twenty years of airport efficiency and productivity studies: A machine learning bibliometric analysis. *Research in Transportation Business & Management*, 100771. DOI: 10.1016/j.rtbm.2021.100771

Sham, R., Siau, C. S., Tan, S., Kiu, D. C., Sabhi, H., Thew, H. Z., ... & Ramli, M. H. M. (2022). Drone Usage for Medicine and Vaccine Delivery during the COVID-19 Pandemic: Attitude of Health Care Workers in Rural Medical Centres. *Drones*, 6(5), 109. DOI: 10.3390/drones6050109

Simoudis, E. (2020). The autonomous mobility innovation lifecycle. *IEEE Potentials*, 39(1), 9-14. DOI: 10.1109/MPOT.2019.2935268

Styliadis, T., & Chlomodis, C. (2021). Analyzing the evolution of concentration within containerized transport chains through a circuitist approach: The role of innovations in accelerating the circuits of liner and container terminal operators. *The Asian Journal of Shipping and Logistics*, 37(4), 321-328. DOI: 10.1016/j.ajsl.2021.09.002

The Brainy Insights (2022). Market research report. <https://www.thebrainyinsights.com/report/drone-package-delivery-market-12826>

Thomas, L. (2017). Wal-Mart has an idea for a floating warehouse that could make deliveries via drones. *CNBC Retail*, <https://www.cnbc.com/2017/08/18/wal-mart-files-patent-for-floating-warehouse-that-could-make-deliveries-with-drones.html>

Waris, I., Ali, R., Nayyar, A., Baz, M., Liu, R., & Hameed, I. (2022). An empirical evaluation of customers' adoption of drone food delivery services: An extended technology acceptance model. *Sustainability*, 14(5), 2922. DOI: 10.3390/su14052922

Web of Science (2022). Refine by Publication Years. URL: <https://www.webofscience.com/wos/woscc/summary/6988a50b-2b10-4f2e-b271-786d3a7fb926-638ff9e6/relevance/1>

Yaprak, Ü., Kılıç, F., & Okumuş, A. (2021). Is the Covid-19 pandemic strong enough to change the online order delivery methods? Changes in the relationship between attitude and behavior towards order delivery by drone. *Technological Forecasting and Social Change*, 169, 120829. DOI: 10.1016/j.techfore.2021.120829

Yoo, W., Yu, E., & Jung, J. (2018). Drone delivery: Factors affecting the public's attitude and intention to adopt. *Telematics and Informatics*, 35(6), 1687-1700. DOI: 10.1016/j.tele.2018.04.014

Declaration of Publication and Research Ethics

The authors declares that all ethical principles and rules were followed in data collection, analysis and reporting processes.

Ratio of Authors' Contribution to the Article

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Declaration on Interest

No conflict of interest exists between authors.