# ADVANTAGES AND CHALLENGES REGARDING THE USAGE OF DRONES IN E-COMMERCE

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**Abstract**

E-commerce has been on the rise in recent years, as more and more businesses have moved their operations online. There are many advantages to this shift, including increased reach, lower costs, and greater convenience. However, there are also some challenges that need to be addressed, such as security and delivery. One potential solution to some of these challenges is the use of drones. Drones have many advantages when it comes to e-commerce, such as being able to navigate around obstacles, carrying heavy loads, and working in difficult weather conditions. They also have the potential to be much faster than traditional delivery methods. Nevertheless, there are also some challenges that need to be considered when using drones for e-commerce. These include the potential for crashes, regulations, and privacy concerns. Under these circumstances, this paper aims to study the use of drones in e-commerce, in view of identifying directions that have to be followed in view of improving the efficiency and safety of e-commerce.

**Keywords:** E-commerce, Drones, Advantages, Challenges, Delivery

**JEL Classification**: L62, L81, L87, L93

## 1. Introduction

E-commerce is currently one of the most popular methods of shopping, however it has several areas in which it could be improved. One such area is the use of drones to improve the efficiency of e-commerce. Due to the increasing popularity of drones, it is important to study the current state of their usage in e-commerce activity. There is a growing body of literature on the subject, which suggests that drones can have a positive impact on e-commerce. The main challenges for using drones in e-commerce are safety and regulation. However, there are drone-based solutions for these challenges.

A drone is an unmanned aircraft or spacecraft, typically controlled by a remote pilot or by on-board computers. Drones have a long history, with the first UAVs being used in World War I for reconnaissance missions. Modern drones are used for a variety of purposes, including surveillance, photography, mapping, search and rescue. A brief history of drones would start with the use of balloons for surveillance during the American Civil War followed by the use of unmanned, remotely piloted aircraft during World War I. Drones

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truly came into their own during the Cold War with the use of reconnaissance drones by both the United States and the Soviet Union [1].

In recent years, there has been an exponential increase in drone usage by both civilian and military organizations around the world. Drones can be classified according to a plethora of criteria, such as their range, flight time, payload, and autonomy. Controlled drones are those that are always under the control of a remote pilot, while autonomous drones are capable of flying without human intervention. The main features of controlled drones include their small size, quiet operation, and ability to fly in difficult-to-reach places. Potential applications for controlled drones include surveillance, mapping, delivery, search and rescue. The main features of autonomous drones include their ability to fly for long periods of time and to cover large areas. In addition, they can also be classified into categories based on their weight, size, intended use, and how they are launched.

According to [1], the four main categories are "multi-rotor", "single-rotor", "helicopter", and "fixed-wing". Multi-rotor drones are the most popular type of drones. They are easy to fly and can stay in the air for a long time. Single-rotor drones are harder to fly but can go faster and further. Helicopter drones are the most stable in the air but can only stay in the air for a short time. Fixed-wing drones are the fastest but are more difficult to control. Another common classification method of drones is by the altitude criteria. Drones can be classified as "either low", "medium", or "high altitude". Low altitude drones are those that fly below 400 feet, medium altitude drones fly between 400 and 10,000 feet, and high-altitude drones fly above 10,000 feet. The criteria "range" is also commonly used as a method of classification. Therefore, drones can be classified as either short range, medium range, or long range. Short range drones have a range of less than 50 miles, medium range drones have a range of 50 to 500 miles, while long-range drones have a range of greater than 500 miles.

Drones can be either controlled or autonomous. Controlled drones are those that require a human operator to control them, while autonomous drones are those that can operate without a human operator. Autonomous drones are further classified as either "semi-autonomous" or "fully autonomous". Semi-autonomous drones are those that require a human operator to control them part of the time, while fully autonomous drones are those that can always operate without a human operator [1].

The weight of a drone determines how much it can carry and how much power it needs. The heavier the drone, the more powerful the motors and batteries need to be. The size of a drone determines how much space it takes up and how much wind it can fly in. The larger the drone, the more space it will need to take off and land. The smaller the drone, the less wind it can fly in. The intended use of a drone determines what it can be used for. Drones can be used for photography, videography, mapping, surveying, search and rescue, and for more other activities. The way a drone is launched determines how it gets into the air. Drones can be launched by hand, from a ground station, or from a ship or vehicle.

Several companies are already making use of drones, including Amazon [2], Google [3], Apple, Intel, Microsoft, Uber [4], Prime Time Air, FedEx, UPS Flight Forward, DHL Parcelcopter, Wing, Matternet, Zipline, Flytrex, Flirtey, Wingcopter [5]. These companies use drones for a variety of purposes including delivery, data collection, and mapping. There

are a number of legal aspects concerning drones that are still being worked out, but there are some concerns about privacy and safety.

As the usage of drones or Unmanned Aerial Vehicles (UAVs) has increased rapidly in recent years, covering a wider range of applications such as photography, journalism, search, rescue, and delivery services, a number of legal aspects concerning drones have emerged. This increase in popularity has been accompanied by a corresponding increase in the number of legislative issues. The main legislative challenges faced by drone operators relate to obtaining operating licenses, ensuring regulatory compliance, addressing privacy and liability concerns. Operating licenses are typically required for commercial drone operations, and the process for obtaining a license can be complex and time-consuming. In order to ensure regulatory compliance, drone operators must be aware of the relevant rules and regulations governing the use of UAVs in their jurisdiction.

Privacy issues are of particular concern when drones are equipped with cameras, and there have been a number of instances where drone operators have been accused of invading the privacy of individuals. In order to address these concerns, drone operators should take steps to ensure that they are not capturing images of individuals without their consent. Liability issues can also arise in relation to the use of drones, particularly in the event of an accident or incident involving a UAV. In order to address these concerns, drone operators should ensure that they have adequate insurance coverage in place. Airspace issues can also be a challenge for drone operators, as there are a number of restrictions in place on the use of UAVs in certain areas. In order to overcome these challenges, drone operators should familiarize themselves with the relevant rules and regulations governing the use of UAVs in their jurisdiction.

The use of drones for e-commerce has been of great interest to many countries and organizations for a variety of reasons. One of the most important reasons is the potential for increased efficiency and productivity. Current postal and shipping systems are often slow and unreliable, and drones could provide a much-needed update. In addition, the use of drones could also help to reduce traffic congestion and pollution.

There is a substantial body of literature on the subject that argues for the importance of studying this topic. In particular, the current literature points to the potential of drones to improve the efficiency and effectiveness of e-commerce. The advantages of using drones in e-commerce are many and varied. Drones can be used to deliver goods to customers in a timely and efficient manner. They can also be used to improve the accuracy of inventory management and to reduce the need for manual labor in the warehouse. In addition, drones offer the potential to improve customer service by providing real-time information on the status of orders and by offering customer assistance. The main challenges for using drones in e-commerce are also numerous. These include issues related to regulatory hurdles, public acceptance, technology, safety and security. However, there are drone-based solutions for each of these challenges. With proper planning and execution, drones can be used to improve the efficiency and effectiveness of e-commerce.

The study of drones in e-commerce is important for several reasons. Firstly, the use of drones in e-commerce is a rapidly growing phenomenon. Secondly, the literature on drones in e-commerce is still in its infancy, and there is a need for more research in this area.

Thirdly, the use of drones in e-commerce has the potential to improve the efficiency and effectiveness of e-commerce operations.

The purpose of this paper is to review the scientific literature regarding the usage of drones in e-commerce activity. It will argue that drones can improve e-commerce by increasing efficiency and reducing costs. The paper highlights the advantages of using drones in e-commerce, as well as the main challenges that need to be overcome in order to make this a reality. It is important to study this topic in order to better understand the potential benefits and drawbacks of using drones in e-commerce, as well as the feasibility of this technology.

There is a rapidly growing interest in the use of drones in e-commerce, as evidenced by the sharp increase in the number of scientific articles published on the subject in recent years. Some of the benefits of conducting a literature review on drones and e-commerce include understanding the potential benefits of using this technology, familiarizing oneself with the current state of the art, and becoming familiar with the current debates surrounding the use of drones. In addition, this research can help identify gaps in the existing literature and provide suggestions for future research.

Arguments in favor of the importance of carrying out this review include the following: (1) the potential of drones to revolutionize e-commerce by providing fast, efficient, and cost-effective delivery of goods; (2) the need to better understand the opportunities and challenges posed by drone technology; and (3) the scarcity of empirical research on the use of drones in e-commerce.

The upcoming sections of the paper are as follows. In section 2, "Research Methodology" there are presented the search query, the filtering process, details regarding the final pool of scientific papers concerning the number of publications per year, the classification of the retrieved publications by type, the number of article type documents by subject area, the number of article type documents by Web of Science index. Section 3, "Results" presents a synthesis of several scientific articles tackling the role of drones in e-commerce, selected by applying the devised methodology (3 of the most recent articles, along with 3 of the most highly cited ones) and an interpretation of this synthesis. Afterwards, Section 4, "Discussion and Conclusions", highlights the most important findings of the paper, presents an analysis of the conducted review research, highlighting a few limitations of this study and future research directions.

## 2. Research Methodology

To evaluate the potential of drones for e-commerce, it is necessary to first understand the existing literature on the topic. The academic scientific community has been discussing the feasibility of using drones for e-commerce for many years. Recently, there have been more studies that focus on the need and benefits of reviewing the scientific literature on this topic. The Web of Science (WoS) database is a good place to start because it includes a large number of journals and other sources that cover a wide range of topics. In this purpose, we have used the Web of Science database for querying the terms "drone* and *commerce", we have not limited our search to a certain publication period and, as a first remark, we have noticed that due to the actuality of the approached subject, the search within the WoS database has returned scientific papers published within the period 2016-2022.

By running the search query on the 5th of September 2022, we have obtained an Initial Pool of Scientific Papers (IPSP) from the literature, consisting of 43 papers. Afterwards, after having filtered the IPSP, 40 papers remained that were further considered in this study, representing the Final Pool of Scientific Papers (FPSP). The above-mentioned filtering process consists of eliminating the irrelevant papers in what concerns each of these criteria: the type of the publication, its title, the abstract, the content.

In the following, we present a series of plots based on the obtained IPSP, plots that we have computed in view of achieving a preliminary image regarding these papers, in what concerns their publication year (Figure 1), their classification (Figure 2), the approached subject area(s) (Figure 3), their corresponding Web of Science Index (Figure 4). Regarding the Figures 3 and 4, one must note that article type document might appear in several categories, this being the reason that the total number of papers depicted in these Figures surpasses 43.[3]

The data retrieved from Clarivate Web of Science and depicted in Figure 1 indicate that the interest for the topic of using drones in e-commerce has increased significantly over the last years. The number of publications has tripled since 2018 (from 5 scientific papers up to 15 papers in 2022). This is a clear indication that the scientific community is interested in the topic and is carrying out research on it.

In Figure 2, we have depicted the number of publications by type on the topic of using drones in e-commerce based on the data retrieved from Clarivate Web of Science. The data reveals that there are a total of 43 (89.58%) article type documents, 4 (8.33%) early access article type documents, and 1 (2.08%) book chapter article type. An early access article is a type of article that is published online in advance of its official publication in a peer-reviewed journal. Early access articles are typically made available as soon as they have been accepted for publication, having undergone complete peer-review, only the date of official publication having not being set for them. Early access articles are relevant for our conducted review study because they provide timely access to new research findings. In addition, early access articles are often free to access, which makes them a very good source of information for our study.

The data retrieved from Clarivate Web of Science and represented in Figure 3 indicates that there is a total of 43 article type documents that have been published on the topic of using drones in e-commerce covering various subject areas. The analysis depicts that the majority of publications on the topic of using drones in e-commerce are in the fields of Management, Operations Research Management Science, and Transportation Science Technology. There are also a significant number of publications in the fields of Computer Science Information Systems, Engineering Multidisciplinary, Engineering Electrical Electronic, Environmental Studies, Telecommunications and Transportation.

[3] Source: The figures were devised based on the official data provided by Clarivate Web of Science on 5th of September 2022.

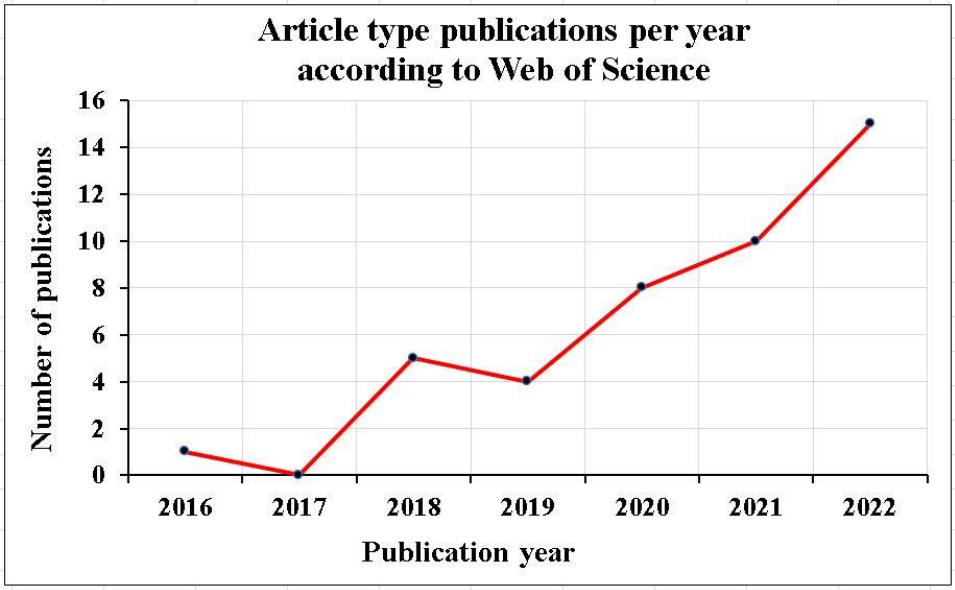


Figure 1. Article type publications per year according to WoS

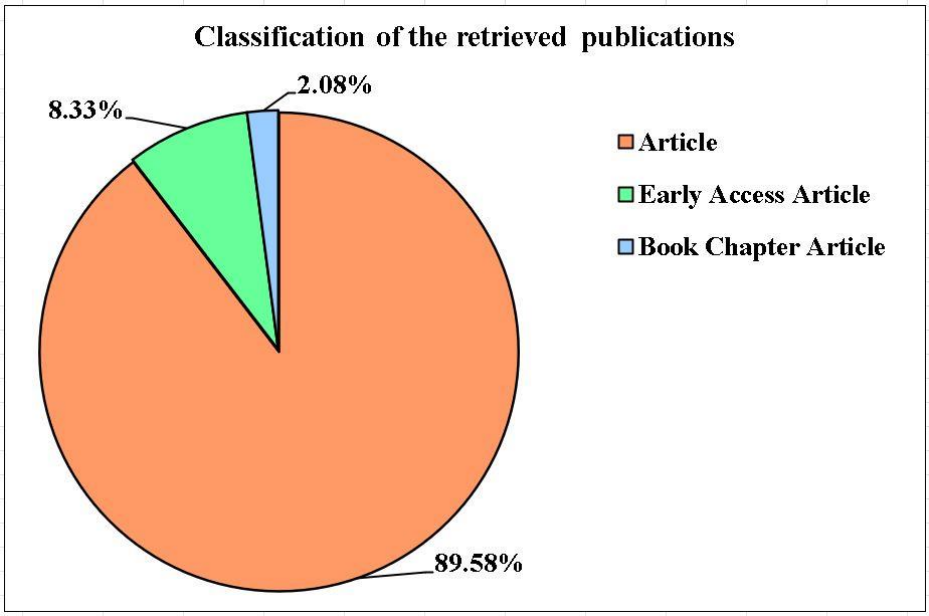


Figure 2. Classification of the retrieved publications

This is to be expected, because these are the fields that are most directly related to the topic, as they deal with the technology and infrastructure that is necessary for the use of drones in e-commerce. Overall, the data indicates that there is a significant amount of interest in

the topic of using drones in e-commerce, this amount being likely to increase in the future, as the use of drones in e-commerce becomes more widespread.

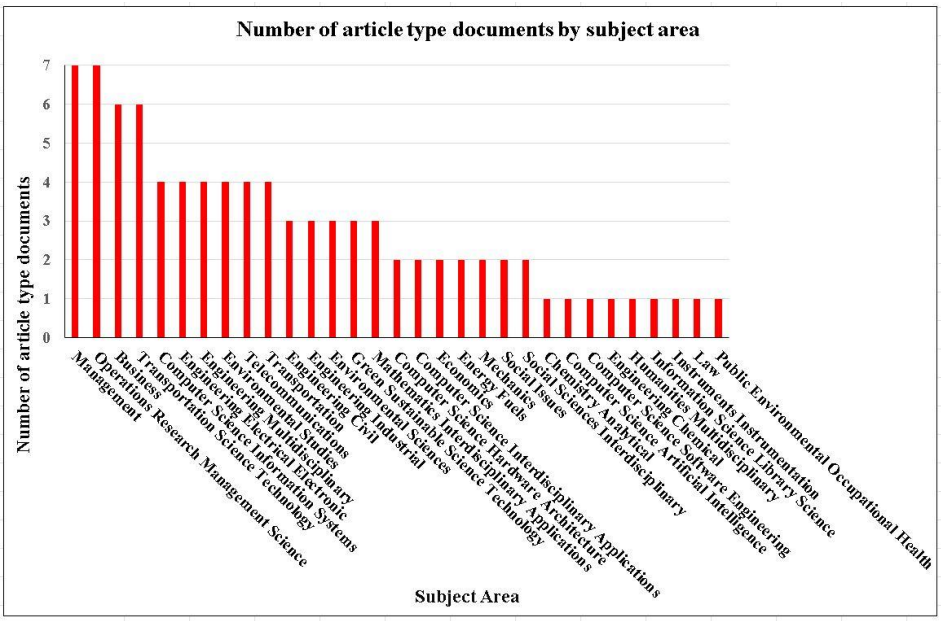


Figure 3. Number of article type documents by subject area

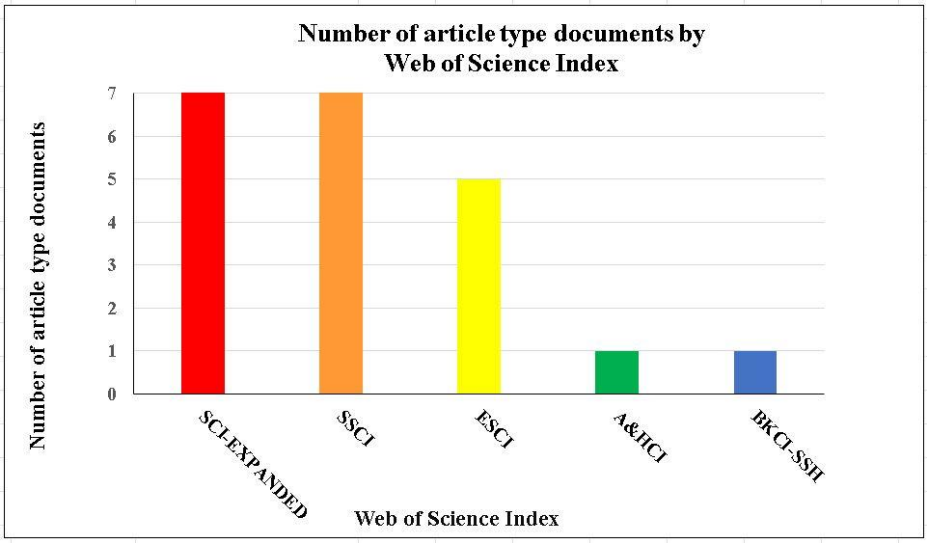


Figure 4. Number of article type documents by WoS index

It is important to analyze the number of publications by Web of Science Index in order to understand the prevalence of the topic referring to the usage of drones in e-commerce. Based on the Clarivate Web of Science data, we have noticed that this topic started to be

researched quite extensively. There are a total of 27 articles indexed in the Science Citation Index Expanded (SCI-EXPANDED), 24 in the Social Sciences Citation Index (SSCI), 5 in the Emerging Sources Citation Index (ESCI), one article in the Book Citation Index - Social Sciences & Humanities (BKCI-SSH), and one in the Arts & Humanities Citation Index (A&HCI) (Figure 4).

For the time being, only the Social Sciences Citation Index (SSCI) and Science Citation Index Expanded (SCI-EXPANDED) have an impact factor. However, this will change starting with 2023 when all journals indexed in the WoS Core Collection will have an impact factor, including the journals indexed in the A&HCI[4]. Overall, this data shows that using drones in e-commerce is a popular topic of research and one that is growing in popularity.

## 3. Results

The studies from the FPSP database cover a wide range of targets, such as: "last mile drone delivery" [6-14], customer acceptance [6, 7, 15-19], delivery optimization [12, 20-27], secure commerce [28-30], environmental impact [8, 12, 14, 23, 31, 32], the usefulness of drones during the pandemic [6-8, 13, 14, 18, 20]. Regarding the devised and implemented approaches, the studies made use of single, stand-alone methods [8, 19, 31, 33-35] or hybrid, combined ones [6, 7, 9, 15-17, 20, 21, 27, 36-38].

Based on the above-mentioned methodology, we have summarized a number of 6 articles from the scientific papers pool that tackle the role of drones in e-commerce, selecting 3 of the most recent along with 3 of the most highly cited papers (Table 1). When we constructed the final pool of scientific papers (FPSP) after devising the search query on the 5th of September 2022, we have identified 3 of the most recently published papers [6], [15] and [33] (published in 2022) and the most highly cited papers, namely [27] (89 citations), [38] (85 citations) and [19] (64 citations).

| No. | The reference number, the publication year | The purpose of the study | The implemented methods | The obtained results |
|---|---|---|---|---|
| 1 | [6] 2022 | analyzing the adoption of drone delivery in Thailand | an online survey combined with specific frameworks (Diffusion of Innovations Theory", "Word-of-Mouth Marketing", | Consumers are willing to accept drone delivery. The intention to adopt such services is strongly influenced by the ease of use and is very little influenced |

[4] Source: https://clarivate.com/news/clarivate-announces-changes-to-the-2023-journal-citation-reports/ (accessed on 25-09-2022).

| | | | | |
|---|---|---|---|---|
| | | | "Technology Acceptance Model") | by the perceived usefulness. |
| 2 | [15] 2022 | identifying the mechanisms that influence the intention of customers to use drone delivery | a survey combined with "structural equation modeling and a consistent partial least squares algorithm" | Customers are satisfied in what concerns the speed of drone delivery and the positive effects on the environment, but the risks related to confidentiality and vulnerability affect their decision to switch to this delivery method. |
| 3 | [33] 2022 | developing a model that enables a drone to store the important data that it requires during its flight within a lightweight blockchain system | "an efficient blockchain model for the Internet of Drones" | The proposed model proves to be more advantageous compared to other Internet of Drones blockchain systems. |
| 4 | [27] 2019 | investigating the possibility of reducing delivery times and costs by using a combination of drones and trucks for last mile delivery | mixed integer programming and heuristic algorithms | The drone delivery system presented a potential operational advantage compared to conventional delivery methods. |
| 5 | [38] 2018 | an investigation into a new type of delivery problem that has arisen from e-commerce and logistics firms attempting to implement drones into their business in order to increase | an iterative algorithm based on a decomposition approach with the intention of minimizing delivery completion time | By comparing the developed algorithm with state-of-the-art implementations, it was found that the solution's times in the case of the developed algorithm are lower. |

| | | | | |
|---|---|---|---|---|
| | | efficiency and reduce delivery times | | |
| 6 | [19] 2018 | analyzing the factors that affect the attitude of consumers regarding the drone delivery service and the intention to adopt it | online survey and its analysis | The analysis of the obtained results highlighted the factors that affect positively (speed of delivery, environmental protection) and negatively (risks of underperformance and security) the adoption of the use of drones for delivery, while the decision to adopt this type of delivery differs depending on the area of residence of the customer. |

**Table 1.** Six scientific articles tackling the role of drones in e-commerce (3 of the most recent along with 3 of the most highly cited)

Examining the 6 papers selected and summarized in Table 1, one can remark that 66,67 % of them approach issues regarding the implementation of drone delivery [6, 15, 19, 38], while the remaining percentage is equally shared by papers that refer to the data stored by drones [33], or to the reduction of the delivery cost by using drones [27].

## 4. Discussion and Conclusions

In recent years, the role of drones in e-commerce activities has been the subject of much debate. The increase in popularity of drones has led to a corresponding increase in the number of scientific papers published on the topic. In order to better understand the role of drones in e-commerce, a review of the scientific literature has been conducted. The Web of Science (WoS) database was used as a starting point for this review due to its prominence, visibility, and accessibility within the scientific community. A custom-tailored search was devised within the WoS database, which allowed for the assessment of the evolution of the targeted subject.

The popularity of drones has increased tremendously in recent years, primarily due to advances in technology that have made them more affordable and easier to use. Drones have a variety of uses, including aerial photography, delivery of goods, and even agricultural applications. With the rise of e-commerce, drones are being used more and more for delivery of goods, raising questions about their efficiency and safety.

There is no doubt that the COVID-19 pandemic has had a profound impact on the way we live and work. One of the most significant changes has been the way in which people all over the world purchase goods and services. While e-commerce was already on the rise prior to the pandemic, the COVID-19 crisis has accelerated its growth. With the rapid growth of e-commerce, there is an increasing need for efficient and cost-effective delivery solutions. This is where drones come in. Drones are already being used by some companies for last-mile delivery, and the pandemic has only increased demand for this type of service [6-8].

There are several potential benefits of using drones for e-commerce delivery, especially during pandemic periods. Firstly, during a pandemic, drones could be used to deliver e-commerce orders in a contactless way. This would minimize human-to-human contact and help prevent the spread of the disease [13, 14]. Secondly, drones can operate 24 hours a day, 7 days a week, meaning that they can provide a more flexible and timely delivery service than traditional delivery methods, with increased efficiency and speed of delivery. This can be beneficial for both businesses and consumers. Businesses can reduce the time it takes to fulfill orders and consumers can receive their orders more quickly. In addition, drones can help reduce congestion because they can deliver items to homes without the need for cars or other vehicles [18, 20]. Thirdly, drones are relatively cheap to operate, meaning that businesses can pass on the savings to consumers in the form of lower prices. Finally, drones can cover a large area in a short amount of time, meaning that they can reach more consumers. Drones could also be used to disinfect public areas, which would further help to reduce the spread of the disease [37].

E-commerce has indisputable advantages when compared to classical purchasing methods [39]. Regarding the delivery method, the current conducted study looked in particular at the use of drones in e-commerce and found that they have a number of advantages over traditional delivery methods. Drones are faster and more efficient than trucks or cars and can be used in a variety of weather conditions. They are also less likely to get lost or stolen and can be tracked more easily. However, there are some challenges that need to be addressed before drones can be widely used for delivery of goods.

One of the biggest challenges is energy consumption. Drones need to be recharged frequently, and battery technology has not yet progressed to the point where they can stay in the air for long periods of time. Another challenge is data transmission security. When sensitive information is being transmitted, there is a risk that it could be intercepted by someone with malicious intent [40]. Finally, there is the issue of delivery security. Drones could be stolen or damaged, and there is also a risk that they could fall out of the sky and injure someone. Additionally, the availability of information contained within our review study is limited in time due to the extremely rapid development of the electronic devices involved, along with the emergent body of knowledge and corresponding scientific literature. Despite the challenges, the use of drones in e-commerce is likely to continue to grow. Some specific directions for future research in this field include drone patents awarded as well as those in the process of being awarded, which address topics related to the development of e-commerce activities using drones.

After having conducted the current review on the topic of the role of drones in e-commerce, we have found relevant aspects that have the potential to shape the face of the future state of knowledge on this topic's evolution. There is a real need for further exploration of the

feasibility and desirability of using drones for e-commerce delivery and improvement of the whole e-commerce sector, for assessing the impact of drones on e-commerce businesses, including how these businesses can use drones to improve efficiency, competitiveness and ultimately, a thorough investigation of the societal and policy implications of widespread use of drones in e-commerce.

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