LOGI – Scientific Journal on Transport and Logistics
Vol. 14 No. 1 2023 DOI: 10.2478/logi-2023-0006
© 2023 J. Soviar *et al.* This is an open access article licensed under the Creative Commons Attribution-NonCommercial-NoDerivs License (http://creativecommons.org/licenses/by-nc-nd/3.0/).

Market Analysis of Drones for Civil Use

Paula Höhrová[1], Jakub Soviar[1*] and Włodzimierz Sroka[2]

[1]*University of Žilina, Faculty of management science and informatics, Univerzitná 8215/1, 010 26 Žilina, Slovak Republic; Email: hohrova@stud.uniza.sk, jakub.soviar@fri.uniza.sk*
[2]*WSB University, ul. Cieplaka 1C 41-300 Dąbrowa Górnicza, Poland; Email: wsroka@wsb.edu.pl*

***Corresponding Author:** Jakub Soviar

Received: 14 December 2022; Revised: 3 January 2023; Accepted: 20 March 2023; Published: 30 March 2023

Abstract: This paper deals with the topic of market analysis of drones (or UAVs) for civil use. This is an analytical overview study. In the introduction, we offer an overview of the main historical milestones on the topic of drones. We then provide a classification and explanation of the main types of drones. The main part of the article contains structured information about the drone market, its status in terms of market shares and relative market shares. For a structured view of this market, we used the BCG method: we calculated the market growth and relative market shares. This market is dynamic and growing gradually. Established brands forming a strong competitive environment. In the photo-video segment, the Chinese brand DJI has a strong and dominant position. Demand on the consumer side is also growing, as is the reputation of the most used product brands.

Keywords: Drones, drone market, market share, relative market share, civil use

1. Introduction

The paper discusses the basic characteristics of drones, their evolution in a historical context and provides their basic division. The primary focus is on the civilian use of drones. In addition, a closer look at past developments and future predictions in the drone market is provided.

Drones, unmanned aerial vehicles (UAV), are described as aircrafts capable of flying without a pilot. [1,2] Although drones are associated with the idea of the most advanced technology of our time, their history goes far back in time, to 1783. In December of that year, the French brothers Joseph-Michel and Jacques-Étienne Montgolfie realised the first flight of a device that did not require a pilot: a hot-air balloon. [3,4] Since then, the understanding of drones has gradually taken shape, as has their use. The first use is described as the invention and use of the self-steering balloon bomb in 1849 by Lieutenant Franz von Uchatius, used in the Republic of Venice. [5] A significant landmark was the first photograph taken from an unmanned aircraft, attributed to Gasper Felix Tournachon in 1858. It

was a photograph of France that has not been preserved. The first surviving photograph from a UAV is attributed to James Wallace Black, who captured Boston from a balloon and can be seen in Figure 1. [6]



Fig. 1 The first ever surviving photograph taken from a drone. Source: [7]

The next step in the development was to place the camera on a UAV device and take a photo with it. This was achieved by the world-famous inventor Alfred Nobel, who did not get to see the first photograph taken in this way, as it was not developed until shortly after his death in 1897. [5] The photos taken can be seen in Figure 2.



Fig. 2 Photos from a mounted camera on the drone. Source: [8,6]

The Queen Bee, a low-cost, radio-controlled aircraft created for artillery training in 1935, is considered the first modern drone. [3,9] Historically, drones have had uses mainly in the military, and the first civilian use of a drone took place in 2006 after the USA Federal Aviation Administration

granted permission for post-hurricane relief through, for example, mapping or border surveillance. Since then, commercial drone use has skyrocketed. [3,10,11] However, 2013 was a significant year when Amazon.com, Inc. announced its plans to deliver goods via drones, which piqued people's interest and spurred the growth of the commercial drone market. [10,3]

Nowadays drones are used in various civil situations: market, delivery, surveillance, photo-video documentation, scanning, etc. The main challenges here are route optimizations, energy consumption, security, transportation interoperability, functioning as part of wider cooperation systems and user-friendliness. [12-18]

2. Methodology

This paper has been drafted as an analytical review study. We have used relevant sources on the issue. Methodologically, it was a focused search for data and information on the UAVs market, and also on the main historical context. For the classification of UAVs, we used a targeted search of relevant sources. We present the results in a structured form. Methodologically it is a synthesis of information. We followed a similar approach to analyze the state of the market for UAVs. We performed the analysis of the competitive environment using the BCG method. Here we calculated the market growth rate and relative market shares according to the available data. The aim of the paper is to present relevant findings on the state of the UAV market in a structured form. For this reason, we have prepared an overview classification of UAVs (Chapter 3). This is the starting point for the presentation of the findings considering the market situation.

3. Classification of Drones

We can classify drones in terms of their use and also in terms of their structural construction. Classification based on use can be divided into recreational drones and commercial drones, whose use can also be understood in terms of area of use, such as drones for [19]: photography, shooting videos, mapping, observation and surveillance, spraying, and delivery.

In terms of structural construction, there are 2 main groups of drones, namely fixed-wing drones and propeller drones. Overall, they can be divided into 4 categories [19]: drones with fixed wings, multi-propeller drones, single-propeller helicopters, and hybrid helicopters.

The different types differ in their flight and movement characteristics, which is why they have different uses. Fixed-wing drones are characterized by their aircraft-like appearance and their important attribute is their long endurance and high flight speeds due to the use of airflow and a suitable aerodynamic structure, thus reducing the energy requirements for flight. Propellant-powered drones are capable of staying airborne for several hours, making them ideal for mapping and patrolling. Their limitation is the difficulty of take-off, which requires either manual ejection (only

feasible for lightweight drones) or a suitable departure runway, as they need to pick up a speed. Equally challenging is their landing, for which suitable mechanisms must also be found. [20,19]

The second group is multi-propeller drones, which are the most widespread and represent the model of what one usually imagines when one says drone. There are different modifications based on the number of propellers, but the most widespread variant is the drone with 4 propellers. The big advantage over fixed-wing drones is their ability to move vertically without making horizontal movements, and the ability to hover stably in one place. They can easily take off and land themselves at a specific location. This advantage is also their weakness, as these operations are very energy-intensive, which significantly limits their range, and, due to the lack of aerodynamics, their flight speed is also limited. [19]

While single-propeller drones are a more efficient version of multi-propeller drones due to their better aerodynamics and stability, they are much more dangerous due to the need for large operational blades. They resemble a small helicopter in appearance and require special pilot training. [19]

The last kind is the hybrid drone combining fixed-wing and multi-propeller drones. This concept represents an interesting solution as it combines the advantages of both types of drones. They are very similar in shape to fixed-wing drones, but also have a design with built-in propellers. Such a drone can also fly vertically and hover in the air, and due to its shape, once it gains speed in the air, it can exploit the aerodynamics of its shape, making flight less energy intensive with faster speeds. [19]

4. The Drones Market

Given the historical context of the use of drones mainly in the military industry and minimal to non-existent commercial use, the drone market has not been very well developed. [21] A significant step in the outbreak of rapid growth was the release in 2016 of a rulebook referred to as "Part 107" by the United States government agency Federal Aviation Administration [22], which established rules for the commercial use of small UAVs and created a space for their regulation and common use. [23]

Drones have caught on in the market due to their advantage of operating virtually anywhere, allowing them to reach inaccessible terrain or health-threatening areas. Their broad potential has also spurred the introduction of drone-friendly regulations by various countries globally, allowing the market to fully develop. [24] The driving force behind the development is the need to obtain qualitative data across different industries, as well as to create solutions for different specific needs. On the other hand, safety concerns and a lack of trained operators are a hindering force. [25]

In 2018, the market reached a value of approximately €3.7 billion, and according to analyses by the world's largest market research organization, Research and Markets [26], the market will reach a value of up to €53.1 billion by 2025. [27] The forecast published in their report corresponds to a 55.9% compound annual growth rate ("CAGR": The unit of investment representing the most

accurate way of calculating return, which indicates the rate at which an investment would grow if its growth were the same each year and the profits were reinvested at the end of the year. [28]) and the largest market share is projected for North America. [27] Business Insider Intelligence forecasts the commercial market to grow at a 51% CAGR to reach 805,000 drone deliveries in 2021. [29] The longer-term forecast for the global commercial drone market from Fortune Business Insight indicates a 25.07% CAGR growth from 2019 (€1.33 billion) to 2027 (€7.11 billion). The commercial market growth for North America is shown in Figure 3, where the values are in millions of dollars. [30]

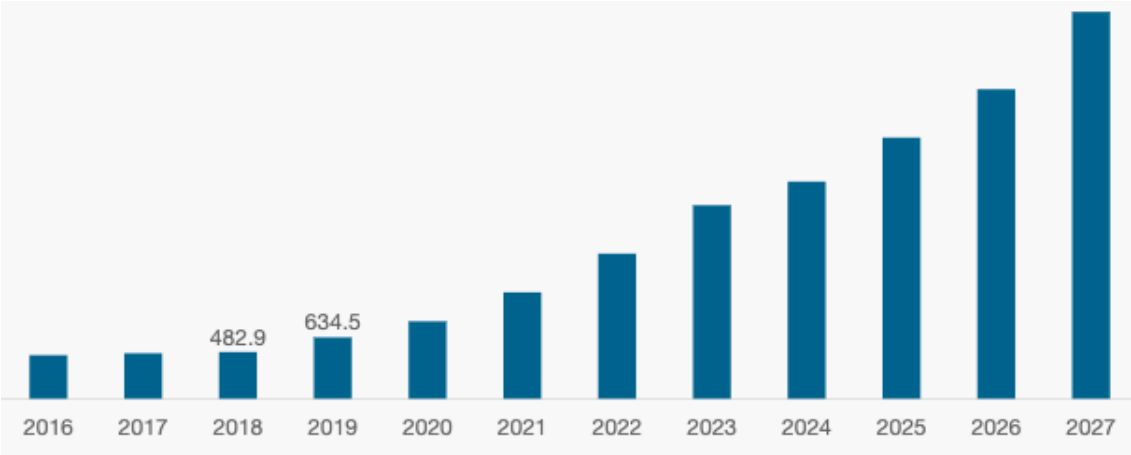


Fig. 3 Development of the commercial drone market in North America, 2016-2027. Source: [30]

In terms of segment, aerial photography and remote sensing have the most potential in various fields such as infrastructure, architecture, construction, and oil and gas industries. Drones will represent data collectors in response to increasing digitalization in these fields. [27] Business Insider, Inc. lists its assumptions in Figure 4. [29] The greatest potential for innovation appears to be in agriculture, where the use of drones is expected to grow significantly to reduce costs. [30]

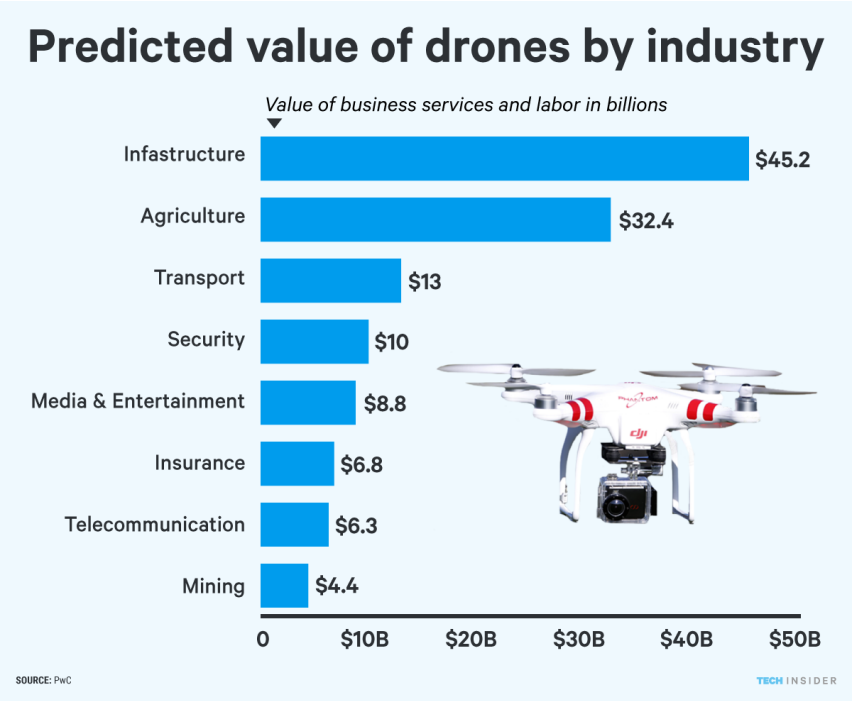


Fig. 4 Predicted value of drones by industry. Source: [29]

The market in terms of the types of drones used, according to Fortune Business Insight, is mainly characterized by the use of propeller drones with a 62.6% share of total sales. This is followed by fixed-wing drones, and the smallest market share is held by hybrid drones, which are, however, expected to grow due to their flight capabilities. [30]

Data on the commercial drone market in the USA as of 2019 was used to analyze the competitive landscape. The following variables were selected as evaluation variables: market growth rate and relative market share.

The growth rate of the commercial drone market has been calculated at 31.4%, a value that represents a very rapid growth of the market, based on the views of the authors of the Boston Portfolio Growth Matrix (BCG matrix), who consider a value in excess of 10% to be a rapid growth of the market. [31]

We made the calculation based on data from Fortune Business Insight. Data from the US market was used for its availability and relevance. It is also one of the most developed drone markets in the world. The size of the commercial market in North America was approximately €402.9 million in 2018 and approximately €529.4 million in 2019. [30] The market growth rate was then calculated as the ratio of the difference between the present value and the past value multiplied by 100 as follows:

$$Market\ growth\ rate = \frac{Market\ size\ 2019 - Market\ size\ 2018}{Market\ Size\ 2018} * 100 \quad (1)$$

After addition, the formula looks like this:

$$Market\ growth\ rate = \frac{529\ 367\ 595{,}53 - 402\ 886\ 701{,}15}{402\ 886\ 701{,}15} * 100 \cong 31.4\% \quad (2)$$

The growth rate of the commercial market in North America has therefore been calculated to be approximately 31.4%.

The relative market shares ("Rms". The market share is compared to that of the largest competitor, where the largest competitor is compared to the second largest competitor and represents the largest competitor for all remaining companies.) of the selected largest companies were calculated separately from the market shares and started at 0.019 and ended at 20.757 (Table 1). These were the 6 largest producers available in the U.S. market [32]:

- SZ DJI Technology Co., Ltd,
- Intel Corporation,
- Yuneec International,
- Parrot SA,
- GoPro, Inc.,
- 3D Robotics.

The relative market share was calculated separately for each producer according to the following formula:

$$Relative\ market\ share = \frac{market\ share\ of\ the\ company}{market\ share\ of\ competition} \quad (3)$$

After adding the values, the calculations looked as follows:

$$\mathrm{Rms(DJI)} = \frac{76,8}{3,7} \cong 20.757 \quad (4)$$

$$\mathrm{Rms(Intel)} = \frac{3,7}{76,8} \cong 0.048$$

$$\mathrm{Rms(Yuneec)} = \frac{3,1}{76,8} \cong 0.04$$

$$\mathrm{Rms(Parrot)} = \frac{2,2}{76,8} \cong 0.029$$

$$\mathrm{Rms(GoPro)} = \frac{1,8}{76,8} \cong 0.023$$

$$\mathrm{Rms(3DR)} = \frac{1,5}{76,8} \cong 0.019$$

Table 1. Market share and relative market share of drone manufacturers in the US. Source: Own elaboration according to [32]

Manufacturer	Market share	Relative market share
SZ DJI Technology Co., Ltd.	76.8%	20.757
Intel Corporation	3.7%	0.048
Yuneec International	3.1%	0.04
Parrot SA	2.2%	0.029
GoPro, Inc.	1.8%	0.023
3D Robotics	1.5%	0.019

SZ DJI Technology Co., Ltd. ("DJI") had a dominant position due to its market share of 76.8% [32]. The value of its relative market share is more than 20 times higher than the closest competitor, Intel Corporation. Thus, DJI's leadership is clearly visible and the remaining 5 included competitors are at the very tail, reaching values not exceeding 0.05.

5. Conclusion

The drone market is growing. This is mainly driven by demand from private individuals for normal recreational purposes. In the corporate sphere, the use of drones, e.g., for documentary or photographic work, is considered to be a common standard. The growth in demand is also reinforced by the offer of increasingly cheaper products. They are increasingly popular among private individuals and in the corporate sector. Mass production in Asia using standardized parts and

procedures is very likely to contribute to the further spread of this technology. We can conclude that these are attractive products. Their attractiveness is influenced by the increase in visual communication on social networks, whether for personal or promotional purposes, or a combination of both. Drone manufacturers are trying to present their products as necessary accessories for professionals and enthusiastic amateurs alike. They emphasize accessibility, ease of use and, most importantly, the ability to create very attractive visual imagery. The market reaction so far has been very positive. The attractiveness of drones for mainstream consumer segments (private individuals and companies) can be considered a current trend.

In terms of offerings, the dominance of the Chinese brand DJI is clear in the photo-video segment. They offer a wide portfolio of products in different price ranges for diverse customer segments. Efficient production and mass sales have enabled them to set relatively low prices compared to their competitors. They have already established themselves as a well-known and often recommended brand among consumers. This can again be seen as a current market trend.

The overall market situation may potentially be negatively affected by the current economic recession and inflation. Ordinary consumers and companies find these products attractive, but with a decline in disposable incomes, it is likely that they will not purchase them to the same extent as before 2022. Other major challenges here are operational safety, legislative regulations, or their enforcement in practice and, last but not least, the experience and responsibility of the users. Drones are used very frequently, which can cause safety problems. Compliance or non-compliance with aviation legislation also plays a significant role here. A limiting factor for the boom of drones and the possibility of a large number of drones flying simultaneously is the difficulty of a flight policy that would ensure that drones do not collide with each other. This is due to the problems with centralized control of their flight. . The challenge is mainly that the 3D dimension and all 3 axes need to be taken into account in the air.

In this article, we have deliberately not dealt with drones for military, security or industrial use. Still, the current security situation creates a real demand for drones for military and security purposes in particular.

Drones are now commonly used for documentation purposes. They have become a common part of the equipment of professional photo-video creators and private individuals. However, the attractiveness and potential of this technology are still considerable, both in terms of technological innovation and from a documentary-artistic point of view.

Acknowledgments

This publication was realized with the support of the Operational Programme Integrated Infrastructure as part of the project: Intelligent systems for UAV real-time operation and data

processing, code ITMS2014+: 313011V422 and co-financed by the European Regional Development Found.

References

[1] Unmanned aircraft flight operations. (2019). The Transport Authority issue. Decision No 2 2019 of 14 November 2019. On determination of conditions for unmanned aircraft flight operations and restriction of specific categories aircrafts flight operations in the airspace of the Slovak Republic.

[2] Act No. 143/1998 Coll. on Civil Aviation. (1998). Aviation Act and on Amendments and Additions to Certain Acts. Ministry of Transport and Construction of the Slovak Republic (Zákon č. 143/1998 Z. z. o civilnom letectve (letecký zákon) a o zmene a doplnení niektorých zákonov. Ministerstvo dopravy a výstavby Slovenskej republiky, 2019.)

[3] Daly, D. (2021). A Not-So-Short History of Unmanned Aerial Vehicles (UAV). Consortiq. Retrieved February 28, 2023, from https://consortiq.com/short-history-unmanned-aerial-vehicles-uavs/

[4] Encyclopedia Britannica. (2018). Joseph-Michel and Jacques-Étienne Montgolfier: French aviators. Encyclopedia Britannica. Retrieved February 28, 2023, from https://www.britannica.com/biography/Montgolfier-brothers

[5] Holman, B. (2009, August). The first air bomb: Venice, 15 July 1849. Airminded, Airpower and British society, 1908-1941. Retrieved March 1, 2023, from https://airminded.org/2009/08/22/the-first-air-bomb-venice-15-july-1849/

[6] Skoog, A.I. (2010). The Alfred Nobel rocket camera. An early aerial photography attempt. Acta Astronautica, Elsevier 2010, 624-635. DOI: 10.1016/j.actaastro.2009.06.011.

[7] Gilman Collection. (2005). Boston, as the Eagle and the Wild Goose See It: 1860. The Metropolitan Museum of Art. Retrieved February 28, 2023, from https://www.metmuseum.org/art/collection/search/283189

[8] Reichhardt, T. (2009). Alfred Nobel's rocket camera. Air & Space/Smithsonian. Airspacemag. Retrieved February 28, 2023, from https://www.smithsonianmag.com/air-space-magazine/alfred-nobels-rocket-camera-117825125/

[9] Awange, J. & Kiema, J. (2019). Unmanned Aircraft Vehicles. In Environmental Science and Engineering, 265 – 289. DOI: 10.1007/978-3-030-03017-9_20.

[10] Alkobi, J. (2019). The Evolution of Drones: From Military to Hobby & Commercial. Percepto, 2019. Retrieved February 28, 2023, from https://percepto.co/the-evolution-of-drones-from-military-to-hobby-commercial/

[11] Dronethusiast. (2019). The History of Drones: Drone History Timeline From 1849 To 2019. Retrieved February 28, 2023, from https://www.dronethusiast.com/history-of-drones/

[12] Bubelíny, O., Kubina, M. & Varmus, M. (2021). Railway stations as part of mobility in the smart city concept. Transportation Research Procedia 53, 274-281. DOI: 10.1016/j.trpro.2021.02.039.

[13] Holubčik, M., Bubelíny, O. & Kubina, M. (2020). A study of the impacts of technological innovations on cooperation cases. Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering 332 LNICST, 296-303. DOI: 10.1007/978-3-030-60036-5_22.

[14] Kampf, R., Hlatká, M. & Gross, P. (2021). Optimisation of distribution routes: A case study. Communications - Scientific Letters of the University of Žilina 23 (1), A62 - A73. DOI: 10.26552/COM.C.2021.1.A62-A73.

[15] Kampf, R., Kubina, M., Bartuska, L. & Soviar, J. (2022). Use of Unmanned Aerial Vehicles for Traffic Surveys. LOGI - Scientific Journal on Transport and Logistics 13 (1), 163 – 173. DOI: 10.2478/logi-2022-0015.

[16] Wu, J., Li, R., Li, J., Zou, M. & Huang, Z. (2023). Cooperative unmanned surface vehicles and unmanned aerial vehicles platform as a tool for coastal monitoring activities. Ocean and Coastal Management 232, 106421. DOI: 10.1016/j.ocecoaman.2022.106421.

[17] Jiang, S., Wu, Y. & Zhang, J. (2023). Bridge coating inspection based on two-stage automatic method and collision-tolerant unmanned aerial system. Automation in Construction 146, 104685. DOI: 10.1016/j.autcon.2022.104685.

[18] Lu, S.-H., Kuo, R.J., Ho, Y.-T. & Nguyen, A.-T. (2022). Improving the efficiency of last-mile delivery with the flexible drones traveling salesman problem. Expert Systems with Applications 209, 118351. DOI: 10.1016/j.eswa.2022.118351.

[19] Circuitstoday. (2017). Types of Drones: Explore the Different Models of UAV's. CircuitsToday. Retrieved February 28, 2023, from https://www.circuitstoday.com/types-of-drones

[20] Tichý, T. & Karas, J. (2016). Drones („Drony" in Czech). Computer Press, 2016, 264.

[21] Insiderintelligence. (2023). Drone market outlook in 2021: industry growth trends, market stats and forecast. Insider Intelligence, 2021. Retrieved February 28, 2023, from https://www.businessinsider.com/drone-industry-analysis-market-trends-growth-forecasts

[22] Federal Aviation Administration. (2021). Certificated Remote Pilots including Commercial Operators. U.S. Department of Transportation Federal Aviation Administration. Retrieved February 28, 2023, from https://www.faa.gov/uas/commercial_operators/

[23] Small Unmanned Aircraft Systems (UAS) Regulations Part 107. (2020). Department of Transportation Federal Aviation Administration, Washington, DC: U.S. Retrieved February 28, 2023, from https://www.faa.gov/newsroom/small-unmanned-aircraft-systems-uas-regulations-part-107

[24] Grand View Research. (2019). Commercial Drone Market Size, Share & Trends Analysis Report by Application (Filming & Photography, Inspection & Maintenance), by Product (Fixed-wing, Rotary Blade Hybrid), by End Use, And Segment Forecasts, 2019 - 2025. Grand View Research, 2019, 120. Report ID: 978-1-68038-482-6. Retrieved February 28, 2023, from https://www.grandviewresearch.com/industry-analysis/global-commercial-drones-market

[25] Market Insider. (2019). Global Drone Service Market Report 2019: Market is Expected to Grow from USD 4.4 Billion in 2018 to USD 63.6 Billion by 2025, at a CAGR of 55.9%. Insider, 2019. Retrieved February 28, 2023, from

https://markets.businessinsider.com/news/stocks/global-drone-service-market-report-2019-market-is-expected-to-grow-from-usd-4-4-billion-in-2018-to-usd-63-6-billion-by-2025-at-a-cagr-of-55-9-1028147695

[26] The World's Largest Market Research Store. Research and Markets. (2021). Retrieved February 28, 2023, from https://www.researchandmarkets.com/

[27] Research and markets. (2019). Drone Service Market Application (Aerial Photography, Data Acquisition, Analytics), Industry (Infrastructure, Media & Entertainment, Agriculture), Type (Drone Platform Service, Drone MRO, Drone Training, Solution, Region) - Global Forecast to 2025. Research and Markets 2019, 175. Report ID: 4763830. Retrieved February 28, 2023, from www.researchandmarkets.com/reports/5441269/drone-services-market-by-type-platform-service

[28] Fernando, J. (2021). Compound Annual Growth Rate (CAGR). Investopedia, 2021. Retrieved February 28, 2023, from https://www.investopedia.com/terms/c/cagr.asp

[29] Insider Intelligence. (2020). Commercial Unmanned Aerial Vehicle (UAV) Market Analysis – Industry trends, forecasts and companies. Insider Intelligence, Insider, Inc. Retrieved February 28, 2023, from https://www.businessinsider.com/commercial-uav-market-analysis

[30] Fortune Business Insights. (2020). Commercial Drone Market Size, Share & COVID-19 Impact Analysis, By Product (Fixed-wing, Rotary Wing and Hybrid Multi-rotor), By Technology (Remotely Operated, Semi-autonomous, and Fully-autonomous), By System (Airframe, Payloads, Avionics, Propulsion, and Software), By Application (Aerial Photography, Agriculture, Disaster Relief & Management, Logistics, Surveillance & Inspection, Remote Sensing & Mapping) and Regional Forecasts, 2020-2027. Report ID: FBI102171. Retrieved February 28, 2023, from https://www.fortunebusinessinsights.com/commercial-drone-market-102171

[31] Strišš, J., Vodák, J., Kubina, M. Jankal, R. & Soviar, J. (2009). Marketing management („Marketingové riadenie" in Slovak), (pp 120-122). Žilina: EDIS (Žilinská univerzita v Žiline).

[32] French, S. (2019). New data proves what we already knew: the DJI 2019 market share is giant. The drone girl, 2019. Retrieved February 28, 2023, from https://www.thedronegirl.com/2019/10/20/dji-2019-market-share/