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ABOUT SOME FACTORS INFLUENCING THE IMPROVEMENT OF THE FIELD OF COMBAT UNMANNED AVIATION IN THE REPUBLIC OF KAZAKHSTAN, INCLUDING THE DEVELOPMENT OF BARRAGE AMMUNITION (KAMIKAZE DRONES)

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Abstract: Combat unmanned aircraft belongs to the science-intensive, high-tech, most promising and rapidly developing aviation sector. Barrage munitions or kamikaze drones can be considered among the most popular combat unmanned aerial vehicles (UAVs) in modern military conflicts, therefore the results of this study are quite relevant.

The article deals with the issues of global growth in defense spending until 2029, the dynamics of regional defense spending in the Asian part of the continent, the states of Transcaucasia and Central Asia in 2023-2024, the development of global and regional drone markets until 2033. Some issues of the development of the global and regional markets for military drones are highlighted, a brief analysis of the global and regional markets for military drones until 2030, the use of military drones, including kamikaze drones in modern military conflicts by the countries of the region is carried out.

Examples of the economic effectiveness of the use of barrage ammunition in modern military conflicts are reviewed, taking into account the comparison of the damage caused to the opposing side and the cost of weapons systems that are targets for kamikaze drones.

In this study, an expert assessment of some factors related to the peculiarities of conducting military operations with the use of combat UAVs in modern military conflicts, the peculiarities of the economy of the country producing unmanned aircraft were carried out. According to the results of the assessment, the conclusions of national experts on the development and use of military UAVs, including kamikaze drones, are reflected. The study focuses on certain issues of classification of combat UAVs and barrage ammunition in the Republic of Kazakhstan.

During the preparation of information on the research topic, a review analysis of domestic and foreign literature, a comparative analysis of the data obtained, methods of logical constructions, analogy, comparison, generalizations, system and situational analysis were applied.

Keywords: global and regional growth in defense spending; development and production of UAVs; barrage ammunition; kamikaze drone.

1. Introduction

The experience of military conflicts that occurred after the end of the cold war demonstrates the rapid evolution of high-tech technologies used in the development and introduction of new types of weapons. In this aspect, it is necessary to highlight the field of combat unmanned aircraft, which has undergone significant quantitative and qualitative changes over several decades.

In the Republic of Kazakhstan, especially after the assessment of the use of military drones in modern military conflicts, the development of this area is the most urgent. Its development is influenced by many factors, some of which are reflected in this study.

During the literature review in section 2, the following:

1) a brief analysis of global and regional defense spending until 2029, where the regions under consideration are the states surrounding the Republic of Kazakhstan, which have the highest defense spending in the Asian part of the continent, as well as countries related to modern military conflicts or located in conflict potential zones;

2) a brief analysis of the global and regional drone markets until 2033, reflecting several key factors influencing the growth of the global UAV market;

3) a brief analysis of global and regional military drone markets up to 2030, which reflects some of the factors contributing to the growth of these markets;

4) a brief analysis of the leading manufacturers of military drones, including kamikaze drones, indicating the projected market volume by 2030;

5) a brief analysis of the use of kamikaze drones in modern military conflicts by the countries of the region, including in Nagorno-Karabakh (2020, 2023) and Ukraine (from 2022);

6) a brief analysis of the economic efficiency of the use of kamikaze drones in modern military conflicts by the countries of the region, which provides comparative characteristics of the cost of some kamikaze drones (barrage ammunition (BA)), as well as the cost of some weapons lost by the parties during conflicts when using kamikaze drones.

The improvement of the field of combat unmanned aviation in the Republic of Kazakhstan is influenced by a number of factors, some of which have been proposed for assessment by the degree of importance to domestic experts in the field of development and application of UAVs. In this study, factors related to the peculiarities of conducting military operations using UAVs in modern military conflicts, and the peculiarities of the economy of the country producing combat unmanned systems are selected as the object of assessment. The results of the assessment are reflected in section 5.1.

Section 5.2 of the article will present the conclusions of domestic experts on the further development of the field of combat unmanned aircraft in the Republic of Kazakhstan.

In addition, the development of technologies and the mass production of UAVs, the intensification of their use in modern combat, the expansion of the range of tasks performed by combat unmanned aircraft, the growth of its capabilities in flight, determine the development of existing and the search for new signs of classification of combat unmanned aircraft, including kamikaze drones. The results of the development of classification features are reflected in section 5.3.

2. Literature review and problem statement.

2.1. A brief analysis of global and regional defense spending

Total global defense spending from 2022 to 2023 grew at the fastest pace in the last decade, as the governments of militarily leading States quickly responded to emerging hotbeds of tension in the world and regions.

Total military spending in 2023 increased by 10.4% due to strong growth in defense spending in almost all major countries, as a result of which the total global amount for defense exceeded 2 trillion US dollars for the first time [1]. The dynamics of total military expenditures up to 2029 is shown in Figure 1 (the figures are not adjusted for inflation; the levels of 2024-2028 are forecasts).

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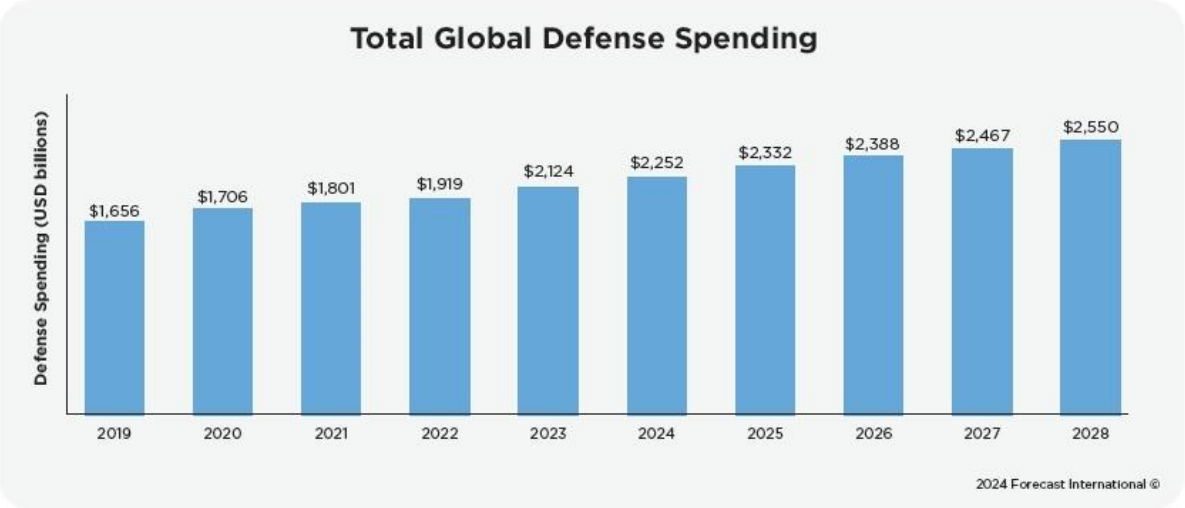
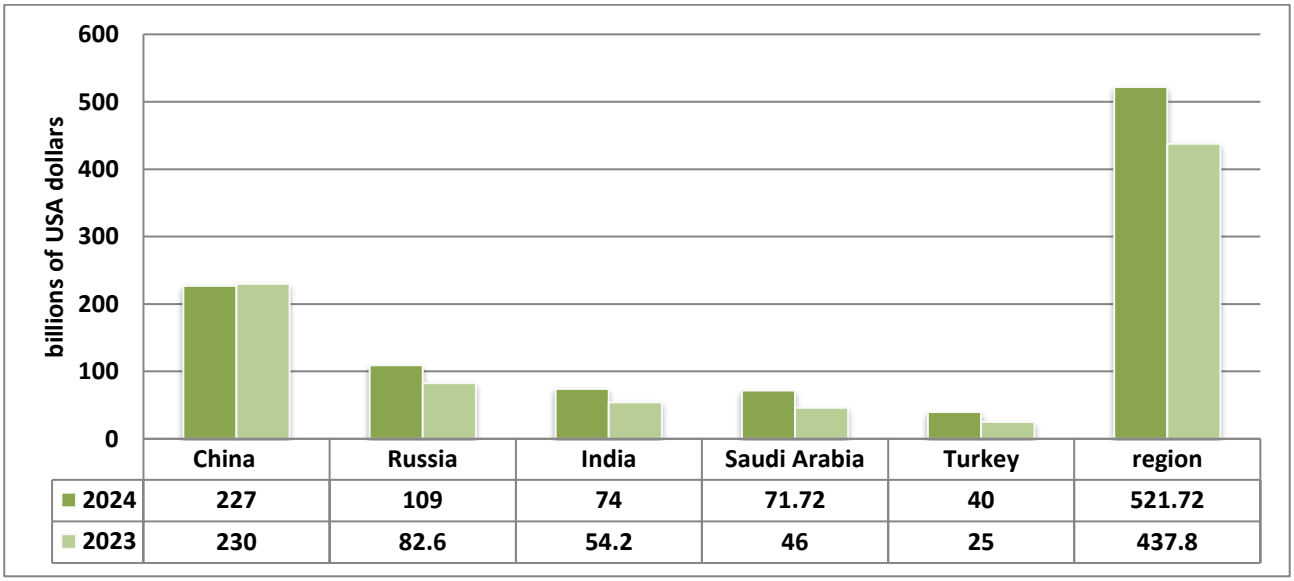


Figure 1 – Dynamics of total military expenditures until 2029

The increase in global military spending is due, among other things, to the growth of regional ones. According to Global Firepower, a regional comparative analysis of defense spending for 2023-2024 was conducted [2]. Figure 1 presents a comparative analysis of the dynamics of the defense budgets of the states with the largest defense expenditures in the Asian part of the continent. These countries include: China (2nd place in the world ranking of defense spending after the United States), Russia (3rd place), India (4th place), Saudi Arabia (5th place) and Turkey (13th place).

As can be seen from the diagram, these states have total defense spending of 521.72 billion US dollars in 2024, which, taking into account global spending (2.252 trillion US dollars), is more than 23% of global defense spending.

Compared to 2023, all states in the region have increased their military budgets, with the exception of China. Turkey (+60%), Saudi Arabia (+56%) showed the greatest dynamics of budget growth, while India (+37%) and Russia (+32%) showed slightly lower growth. The total annual regional growth in defense spending was almost 20%.



	China	Russia	India	Saudi Arabia	Turkey	region
2024	227	109	74	71.72	40	521.72
2023	230	82.6	54.2	46	25	437.8

Diagram 1 – Comparative defense budget of the states with the largest defense expenditures for 2023-2024 in the Asian part of the continent (in billions of US dollars)

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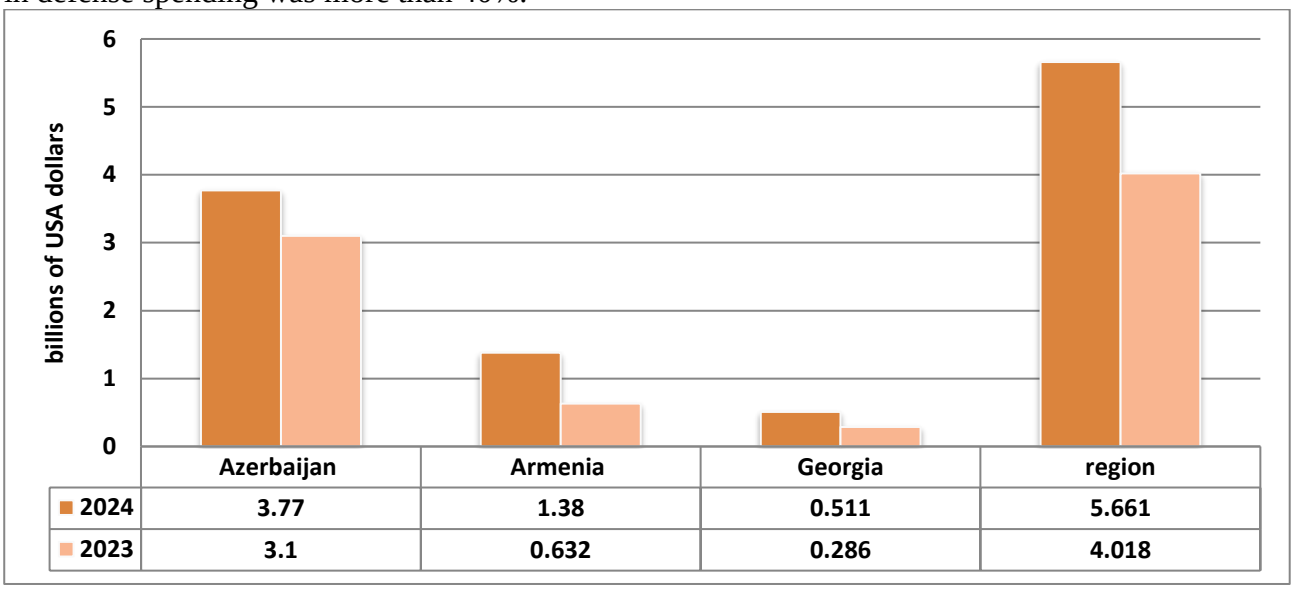
China is on track to become the world's largest economy by 2030, which is likely to further narrow the gap between the United States and China in military power [3].

Separately, we will consider the military expenditures allocated by the states of two Asian regions – Transcaucasia and Central Asia. The first region was chosen because of the conflict in Nagorno-Karabakh that took place in 2020 and 2023, as well as the existing tension in the region. The second region includes five Central Asian countries, including Kazakhstan, which is also of interest for assessing the dynamics of growth in defense spending.

Diagram 2 shows a comparative analysis of the defense budgets of the Transcaucasian states for 2023-2024. These states include: Azerbaijan (57th place in the world ranking of defense spending), Armenia (81st place) and Georgia (105th place) [4].

As can be seen from the diagram, these states in 2024 have a total defense spending of 5.661 billion US dollars, which, taking into account global spending (2.252 trillion US dollars), is about 0.25% of global defense spending.

In comparison with 2023, all states in the region have increased their military budget. Armenia (2.2 times) and Georgia (+79%) showed the greatest dynamics of budget growth. Azerbaijan is the region's leader in defense spending and the growth rate was (+22%). The total annual regional growth in defense spending was more than 40%.



	Azerbaijan	Armenia	Georgia	region
2024	3.77	1.38	0.511	5.661
2023	3.1	0.632	0.286	4.018

Diagram 2 – Comparative defense budget of the Transcaucasian States for 2023-2024 (in billions of US dollars)

Diagram 3 presents a comparative analysis of the dynamics of the defense budgets of the Central Asian states for 2023-2024. These states include: Kazakhstan (42nd place in the world ranking of defense spending), Turkmenistan (94th place), Uzbekistan (96th place), Kyrgyzstan (130th place) and Tajikistan (136th place) [5].

As can be seen from the diagram, these states have total defense spending of 9.416 billion US dollars in 2024, which, taking into account global spending (2.252 trillion US dollars), is about 0.42% of global defense spending.

In comparison with 2023, all states in the region have increased their military budget. Kazakhstan is the leader of the region in defense spending and the growth dynamics was (2.9 times), Turkmenistan (2.1 times), Kyrgyzstan (+42%) also showed the highest budget growth dynamics, slightly lower growth in Uzbekistan (+15%), Tajikistan's spending growth was (+7%). The total annual regional growth in defense spending has more than doubled and among the regions considered it occupies a leading position in terms of military spending growth.

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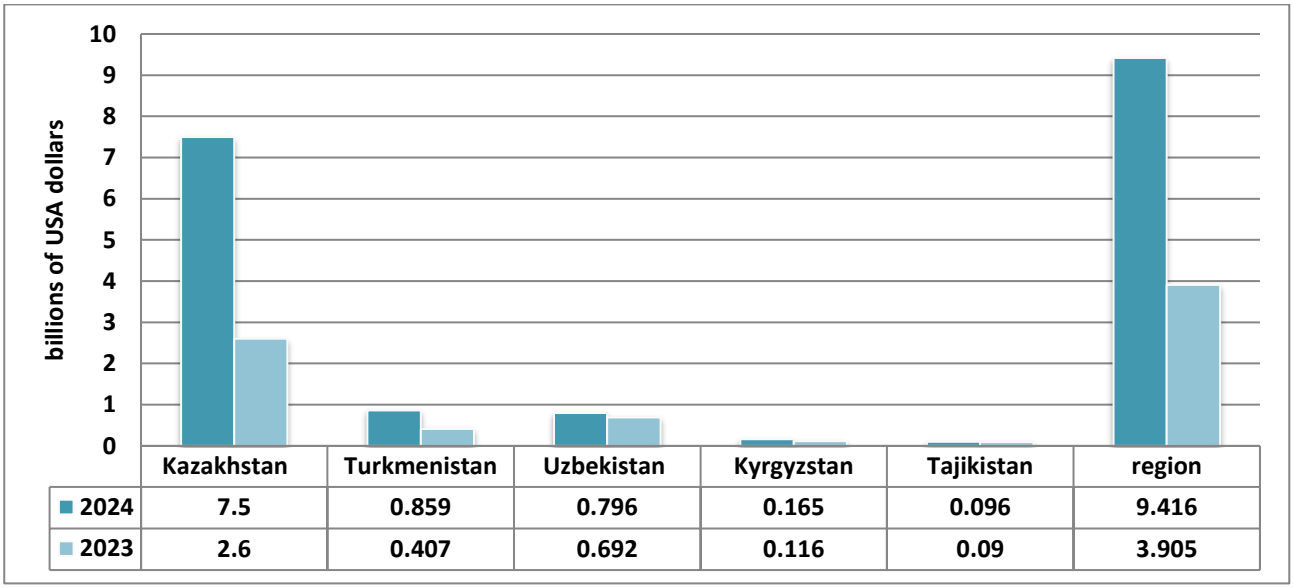

	Kazakhstan	Turkmenistan	Uzbekistan	Kyrgyzstan	Tajikistan	region
2024	7.5	0.859	0.796	0.165	0.096	9.416
2023	2.6	0.407	0.692	0.116	0.09	3.905

Diagram 3 – Comparative defense budget of the Central Asian States for 2023-2024 (in billions of US dollars)

A brief analysis showed that all the regions discussed above have a positive growth trend in defense spending compared to 2023. The dynamics of the growth of defense spending in the regions for 2023-2024 may be based on several factors:

1. Geopolitical tensions and security threats.

For example, in the regions under consideration there have been (2023, Nagorno-Karabakh) or real hostilities are underway (in Ukraine), there are points of geopolitical tension in the Middle East, the border areas of the states of the regions.

2. Foreign policy strategies.

Countries, especially those with advanced economic development, can use increased defense spending to strengthen their influence in the region or on the world stage. This may be due to the peculiarities of foreign policy, the strategy of geopolitical presence or influence.

3. Modernization of armaments and development (purchase) of new military equipment.

Regional states can increase their defense spending to modernize existing types of weapons, develop the military-industrial complex in order to create new military equipment. In this case, technical superiority in the defense sector is considered as one of the key factors in ensuring national and military security.

4. Economic factors.

Regional states may decide to increase defense spending in response to economic factors such as inflation or economic growth. An increase in the country's income, economic growth and inflationary processes can contribute to an increase in the defense budget.

Thus, with regard to the research topic, it can be concluded that with the rapid growth of defense budgets in the states of the region, taking into account foreign policy relations, the experience of modern military conflicts, various basic economic capabilities of states and the military-industrial complex, conditions can be created in the countries under consideration for further development of production or purchase of unmanned aerial vehicles military use of various classes.

2.2. A brief analysis of global and regional drone markets

The dynamics of the development of regional markets for civilian drones reflects the growth of the economic and technological capabilities of the regions in their development and production. Various open analytical sources contain projected volumes of the drone market until 2025-2033.

In 2020, Drone Industry Insights prepared a five-year forecast (shown in Figure 2), in which the drone market is estimated at 42.8 billion US dollars by 2025 with a cumulative annual growth rate (CAGR) of 13.8% [6].

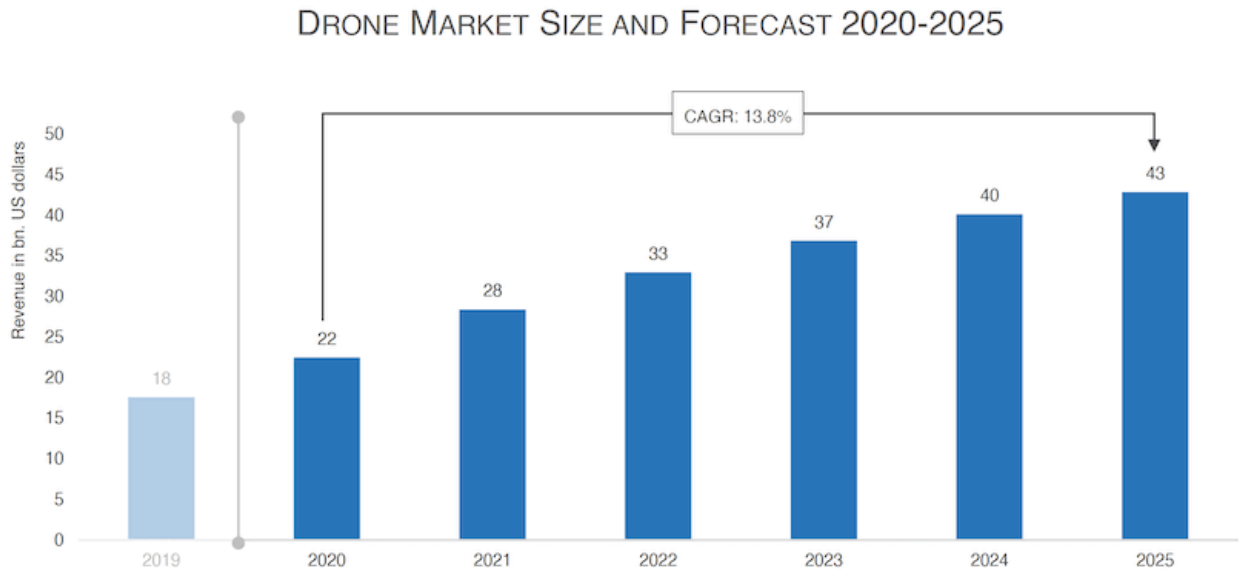

Figure 2 – Global drone Market Forecast to 2025 (USD billion)

According to Drone Industry Insights, the North American market (6.89 – 11.82 billion US dollars), the European market (5.19 – 9.86 billion US dollars) and the Asian market leading in terms of growth (8.62 – 17.89 billion US dollars) are projected to be the most rapidly developing regional drone markets by 2025 (shown in Figure 3) [6].

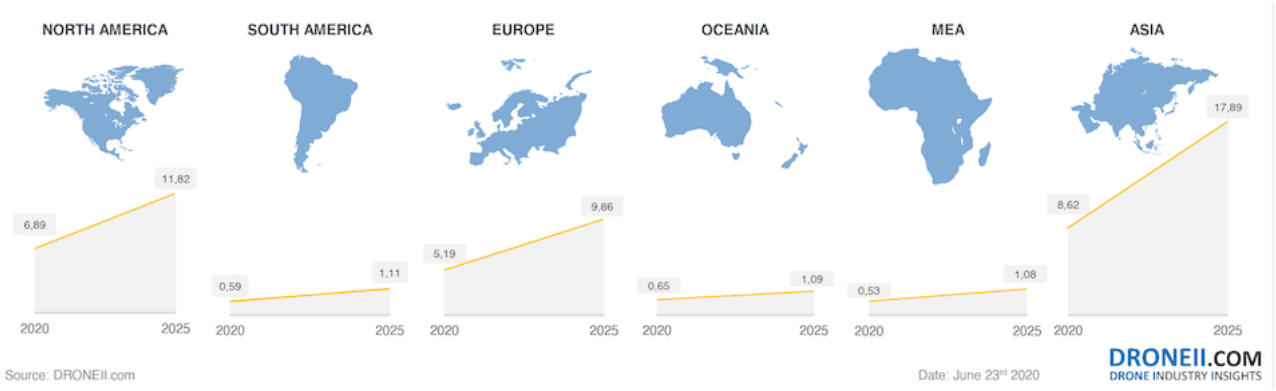

Figure 3 – Forecast of regional drone markets until 2025
(billions of US dollars)

According to the analytical assessment ResearchAndMarkets.com The global unmanned aircraft systems (UAS) market will grow from $18.1 billion in 2023 to $72.42 billion by 2033. In the global and Asia-Pacific markets, UAS is the leader in the commercial application segment, whose share in 2022 was 98.11% [7].

A brief analysis of global and regional drone markets has shown that the global drone market has a steady growth trend, especially in the Asia-Pacific region, which is home to several of the world's leading economies (China, Japan, India, South Korea).

The growth of the global UAV market is driven by several key factors, which include:

1. Technological progress.

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Unmanned technologies continue to develop, including improving the quality and capacity of power supplies for electric power plants, creating new composite materials, improving the reliability of sensors and control and monitoring systems, and the payload of UAVs. This improves the technical characteristics of drones, makes them efficient, safe and accessible for solving a wide range of tasks.

2. Reducing the cost of drone production.

With the development of technology and the scaling of production, the cost of unmanned aerial vehicles is decreasing. This makes them more accessible for use in various sectors of the state's economy.

3. Improving safety for people's lives.

Modern UAVs can perform tasks that were previously performed exclusively on manned aircraft and helicopters. The use of drones reduces the risks to human life in dangerous environments and in emergency situations.

4. Environmental benefits.

Currently, a large number of drones use electric motors, which helps to reduce the impact on the environment through the use of environmentally friendly energy sources.

There are a number of factors that can negatively affect the drone markets. These include government regulation (multiple restrictions) on the use of civilian drones, ensuring security in airspace, cybersecurity of control systems and ethical issues of drone use, which may also affect the global or regional UAV market.

With regard to the research topic, it can be concluded that every year in the world and regions, technological and economic opportunities for the production of civilian drones are increasing, and the costs of their production are decreasing. If necessary, the production lines created for the manufacture of civilian drones can be set up as soon as possible for the production of dual-use drones, and in the future, for military purposes.

2.3. A brief analysis of global and regional military drone markets

The dynamics of the development of regional markets for military drones also reflects the global and regional growth of economic and technological opportunities for their development and production. Open analytical sources contain projected volumes of the military drone market until 2028-2030.

According to the Military Drone Market, in the period from 2023 to 2028, with a cumulative annual growth rate (CAGR) of 7.0%, the military drone market (shown in Fig.4) it will grow from 13.0 billion US dollars to 18.2 billion US dollars [8].

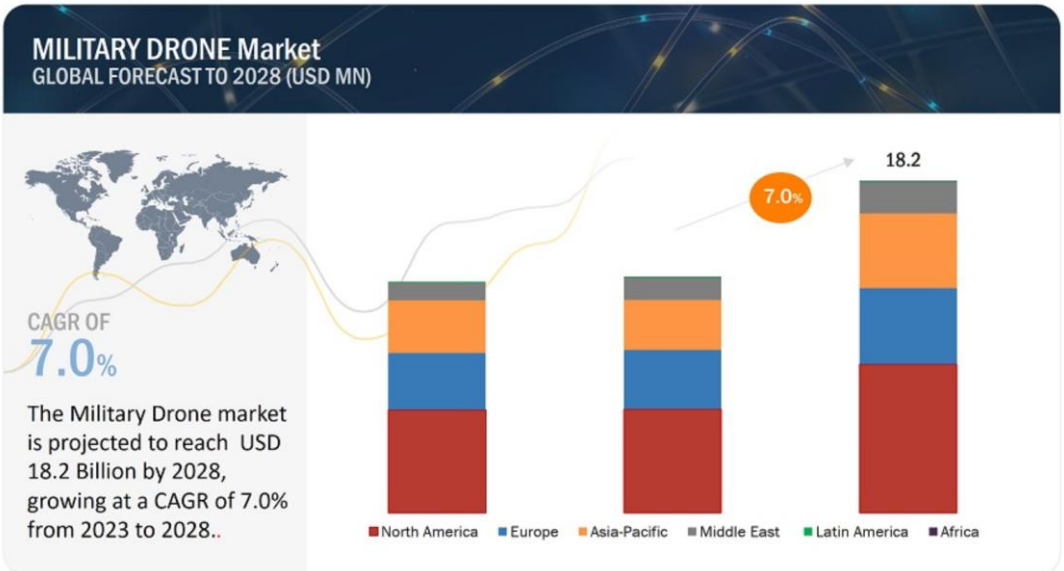

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Figure 4 – Forecast of regional military drone markets until 2028
(billions of US dollars)

According to Fortune Business Insights, the global market for military drones in 2023 reached 14.14 billion US dollars, which is 1.59 billion. It is more than the indicator of 2022, and by 2030 the market volume may reach 35.6 billion US dollars [9].

One of the main factors contributing to the growth of global and regional markets for military drones until 2030 is the increased need for unmanned military systems to ensure the national security of States and improve the efficiency of modern military operations.

Another important factor is technological progress and the reduction in the cost of production of combat unmanned systems, which makes them available for use not only in economically developed countries, but also in developing economies.

It is also worth noting the increase in global and regional military spending (discussed above), which also contributes to the growth of the military drone market. Many countries of the world are striving to modernize their armed forces, introduce new military technologies, including unmanned systems, to increase their defense capabilities.

In addition, the demand for military drones is also stimulated by the growth of potential threats, which include conducting military operations in various regions of the world and the fight against terrorism.

Thus, the growth of global and regional markets for military drones until 2030 will be determined by the increasing need for modern military technologies, technological progress, increased military spending and rapidly changing challenges in the field of national security and defense.

2.4. A brief analysis of the leading manufacturers of military drones, including kamikaze drones

The leading companies in the global market of military unmanned aerial vehicles are: Airbus, AeroVironment, Aeryon, BAE Systems, Boeing, DJI, Elbit Systems, Flir, Israel Aerospace Industries, Leonardo, Lockheed Martin, Northrop Grumman, Saab, Yuneec [10].

The main players in the global military drone market in 2023 were Israel (34% of military drones produced), China (31%), the United States (25%), and Turkey (6%). In Russia, with the projected annual growth of the military drone market by 20-25%, by 2030 the total volume of drones produced will reach 2.5% of the global market [11].

Thus, the market for military drones has a steady upward trend. Taking into account the continuing pace of production of military UAVs in China, Turkey and Russia, by 2030, the region will produce up to 40% of the global military drone market.

The war in Ukraine has further accelerated the development of the military drone market in the world. More and more defense companies are repurposing and launching a new line of weapons, as drones will become a decisive factor in the wars of the future. The advantage will be on the side of the army that will have high-tech and multifunctional drones or will prevail in them quantitatively [12].

2.5. A brief analysis of the use of kamikaze drones in modern military conflicts by the countries of the region

Of the countries in the region discussed above, kamikaze drones (barrage ammunition) were used in the military conflict in Nagorno-Karabakh (2020, 2023) and in Ukraine (since 2022).

The defining feature of barrage ammunition is the ability to be above targets in a given area, deliver explosives to targets beyond the line of sight. The most significant examples of this type of weapon used in armed conflicts of the last decade are: Harop, Harpy, Mini Harpy and Sky Striker

(Israel); Kargu and Alpaga (Turkey); Shahed-136 (Iran); Lancet (Russian Federation) and others. In fact, all these kamikaze drones have similar basic characteristics and are designed to destroy firepower, protected fortifications, strong points, as well as to suppress enemy air defenses and perform many other airs support tasks [13].

Such military drones (used in Ukraine) include the American Switchblade 300, the heavier Switchblade 600, as well as the Russian "CUBE-UAV"[14].

The Switchblade-300, the smaller of the two available variants, which weighs about 2.5 kg, carries a fragmentation warhead, has a range of 10 km and a flight duration of 15 minutes. In March 2022, the United States announced that 100 Switchblade-300 drones would be part of a military assistance package for Ukraine [15].

The capabilities of Russian kamikaze drones were enhanced by the supply of Shahed-136 and Shahed-131 drones from Iran [16].

Shahed-136 (Geran-2) drones were often used by groups to break through Ukraine's air defense system and strike critical infrastructure facilities. They carry a warhead of up to 50 kg, their flight range exceeds 700 km, and the guidance system is inertial or satellite [17].

Shahed-136 is considered to be a new generation of drones developed during the second phase of the Iranian drone program, which took place in the mid-2000s, when Iran simultaneously introduced a large group of reconnaissance, attack drones and kamikaze drones [18].

It can be said that Russia's war with Ukraine also provided a testing ground for foreign drone powers such as Turkey, the United States and Iran, which further accelerated the spread of drones [19].

Indeed, the successful use of drones, including in Nagorno-Karabakh and, to a certain extent, in Ukraine, has highlighted their potential for a radical transformation of approaches to warfare. At the same time, the above-mentioned examples have shown States and other international actors that still do not possess drones, and that they will be at a disadvantage if they do not [20].

The conflicts in Nagorno-Karabakh and Ukraine allow us to conclude that the widespread use of drones on the battlefield has become a common reality, drones demonstrate their versatility by performing not only surveillance and reconnaissance tasks, but also performing shock, transport, search and rescue tasks and many others. The production costs of most drones are very low, but their effectiveness is significant for the successful destruction of expensive facilities and military targets [21].

2.6. A brief analysis of the economic efficiency of the use of kamikaze drones in modern military conflicts by the countries of the region

Open sources have repeatedly discussed the economic feasibility of using kamikaze drones in modern military conflicts.

However, given the conduct of information wars by the parties to the conflict, contradictory information is found in these sources. Each side seeks to understate its losses and exaggerate the losses of the opposing side.

For the objectivity of the assessment, Table 1 shows the comparative characteristics of the cost (from open sources) of some kamikaze drones (barrage ammunition (BB)) previously used in the military conflict zone in Nagorno-Karabakh and currently in Ukraine.

Table 1 – The cost of some barrage ammunition

Country of origin	Kamikaze Drone Type (BA)	The cost of a kamikaze drone (BA)
US	Switchblade-300	6 thousand US dollars
Israel	Harpy	about 70 thousand US dollars

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Israel	Sky Striker	200-250 thousand US dollars
Iran	Shahed-131	20-30 thousand US dollars
Iran	Shahed-136	20-50 thousand euros
Russia	Lancet-1	about 32 thousand US dollars
Russia	Lancet-3	35 thousand US dollars

Note: the table is based on open-source data.

The cost of some weapons lost by the parties during the conflicts during the use of kamikaze drones (barrage ammunition) is estimated in millions of US dollars. For example, the facts of the defeat of the French self–propelled gun "Caesar" in the conflict in Ukraine are confirmed in open sources, the cost of self-propelled guns varies from 5 to 6 million US dollars, the Leopard II tank (Germany) costs about 11 million US dollars, the Abrams tank - about 13 million US dollars, the SAM-300 (Russia) about 160 million US dollars, the Patriot air defense system (USA) – about 1 billion US dollars.

As can be seen from Table 1, the cost of kamikaze drones is hundreds, and sometimes thousands of times less than the cost of targets. Of course, it is necessary to take into account the probability of defeat, as well as the ability of drones to cause specified damage. However, even the disabling of a modern anti-aircraft missile system (SAM) with a total cost of hundreds of millions of US dollars (for example, the defeat of the system's command post, detection station or launcher) with just two hits of a kamikaze drone worth up to 100 thousand US dollars, will cause significant and disproportionate damage to the opposing side.

3. The purpose and objectives of the study

The purpose of this study is to assess some factors influencing the improvement of the field of combat unmanned aircraft in the Republic of Kazakhstan, including the development of barrage ammunition (kamikaze drones).

The main objectives of the study are:

analysis of available information on global and regional military expenditures, the volume of growth of civilian and military drone markets, the use and effectiveness of military drones, including kamikaze drones in modern military conflicts by the countries of the region; development on its basis of the main factors, including those affecting the field of combat unmanned aviation in the Republic of Kazakhstan;

expert assessment of some factors related to the peculiarities of conducting military operations using combat UAVs in modern military conflicts, the peculiarities of the economy of the country producing unmanned aircraft;

conclusions of experts on certain issues of the development of the field of combat unmanned aircraft in the Republic of Kazakhstan, including barrage ammunition, discussion of their classification.

4. Materials and methods of research

During the preparation of information on the topic of the article, a review analysis of foreign and domestic literature was carried out, a comparative analysis of the data obtained was carried out. To collect data from primary sources, we used: a quantitative method of obtaining data in descriptive studies, the instrument of which is a Delphi survey for experts engaged in research and development in the field of combat unmanned aircraft; a direct qualitative method of obtaining data in search studies, the instrument of which is an in-depth interview with experts. To collect data from secondary sources, we used: a qualitative method of obtaining data in search studies, the tool of which is desk research.

In the course of this study, methods of generalization, system and situational analysis, logical constructions, analogy, and comparison were used.

5. Results

5.1 Expert assessment of some factors influencing the improvement of the field of combat unmanned aircraft in the Republic of Kazakhstan.

The assessment was carried out on a 10-point scale: the entire scale from 1 to 10 is consistently used, where 10 is the highest degree of significance, 1 is the lowest degree of significance.

As factors influencing the improvement of combat unmanned aircraft related to **the peculiarities of conducting military operations using UAVs in modern military conflicts**, the following were proposed for expert evaluation:

A1 High speed and maneuverability of unmanned systems for effective response to changes in the battlefield situation.

B1 The possibility of a long stay in a combat zone without the need for crew rest and expensive maintenance.

C1 High accuracy and targeting when using weapons, reducing the likelihood of collateral damage and losses.

D1 The ability to perform tasks in life-threatening situations, which reduces losses among military personnel.

E1 The possibility of using multiple unmanned systems together to achieve collective goals.

F1 Flexibility and adaptability of combat unmanned systems for use in various conditions and conflicts.

G1 Improved communications and the ability to quickly transfer information from remotely controlled or autonomous systems.

H1 The possibility of creating a permanent surveillance system to ensure security and control over large areas.

I1 Expanding the range of applications of combat capabilities of drones, for example, blocking or electronic suppression of enemy systems.

J1 The desire to create unmanned systems with improved performance in order to gain advantages over the enemy.

The results of the expert assessment are shown in Diagram 4.

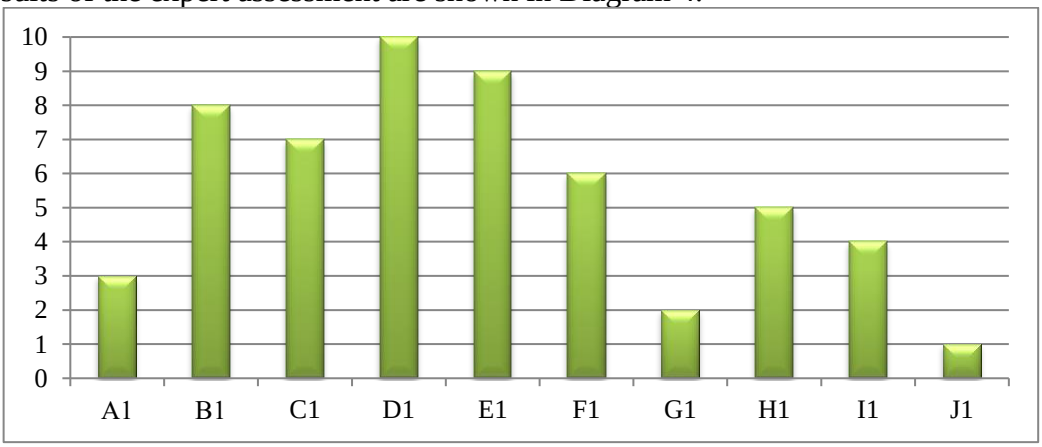

Diagram 4 – Assessment of the importance of some factors related to the peculiarities of conducting military operations using UAVs in modern military conflicts

As factors influencing the improvement of combat unmanned aircraft related to the peculiarities of the economy of the manufacturing country, the following were proposed for expert evaluation:

A2 The impact of the production and export of unmanned combat systems on the economic prosperity of the country.

B2 The cost of research and development of unmanned systems to ensure competitiveness in the market.

C2 Employment growth and the development of the high-tech sector.

D2 Creating new jobs and supporting industries related to the production and maintenance of unmanned systems.

E2 The impact of budget financing on the development and production of unmanned systems.

F2 Potential for attracting investments and developing the country's export potential.

G2 Creation of competitive advantages and development of the domestic market.

H2 The impact on the balance of foreign trade and the inclusion of unmanned combat systems in the list of exports.

I2 The possibility of using dual-use unmanned systems for commercial purposes.

J2 Legislative regulation of the export of unmanned systems and control over their use by other countries.

The results of the expert assessment are shown in Diagram 5.

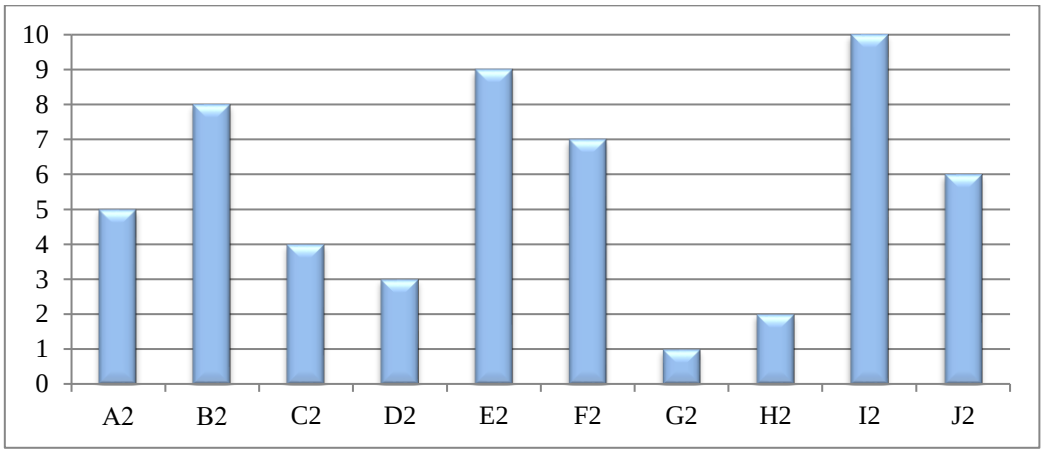

Diagram 5 – Assessment of the degree of importance of some factors influencing the formation of signs of classification of combat unmanned aircraft related to the peculiarities of the economy of the manufacturing country

5.2 Conclusions of domestic experts on the further development of the field of combat unmanned aircraft, including kamikaze drones, in the Republic of Kazakhstan

1. It is necessary to increase public and external investments in the development of combat unmanned aircraft in Kazakhstan to increase the country's defense capability and security.

2. Creation and improvement of domestic production lines for the production of combat unmanned aerial vehicles in order to reduce dependence on imports.

3. Conducting training and training of specialists in the field of development and production of combat unmanned aircraft, in order to provide this area with qualified personnel.

4. Development of new and improvement of current legislation and regulations governing the use and development of unmanned aircraft in the country.

5. Improvement of domestic systems and technologies for the management and control of combat unmanned aerial vehicles to ensure their safe operation.

6. Development of military-technical cooperation with international partners in the field of combat unmanned aircraft for the exchange of experience, technologies and new developments.

7. Promoting the export of Kazakhstani developments and technologies in the field of combat unmanned aircraft to the world market to increase the economic efficiency of the development of this area.

5.3 The results of the development of signs of classification of barrage ammunition

As part of the scientific program «Development and creation of a prototype of a high-security combat strike unmanned aerial vehicle with high-precision ammunition» (contractor «R&D Center «Kazakhstan Engineering», Astana, Kazakhstan, IRN BR185068/0222), an improved classification of combat UAVs has been developed. For this classification, which includes more than 30 main features, a certificate was received on entering information into the state register of rights to objects protected by copyright (dated 03/23/2023 No. 34085).

Taking into account the fact that kamikaze drones have their own characteristic classification features, the authors received a certificate of entry into the state register of rights to copyrighted objects (dated 03/30/2023 No. 34168) «Classification of combat strike unmanned aerial vehicles (barrage ammunition)».

6. Discussion of the results

An expert assessment of some of the factors affecting the improvement of the field of combat unmanned aviation in the Republic of Kazakhstan has shown that the most significant factors affecting the improvement of combat unmanned aviation are:

1) the features of conducting military operations using UAVs in modern military conflicts include the following:

performing tasks in life-threatening situations, which reduces losses among military personnel;

the joint use of multiple unmanned systems to achieve collective goals;

long-term stay in the combat zone without the need for crew rest and expensive maintenance.

2) the peculiarities of the economy of the producing country include:

the possibility of using dual-use unmanned systems for commercial purposes;

the impact of budget financing on the development and production of unmanned systems;

the cost of research and development of unmanned systems to ensure competitiveness in the market.

In addition to the formulated conclusions of domestic experts on the further development of the field of combat unmanned aviation in the Republic of Kazakhstan, it should be noted that today unmanned aviation is one of the fastest growing areas in the aviation industry of all states in the region.

Not much time has passed since the appearance of the first unmanned aerial vehicles (UAVs), significant improvements, but already now we are seeing huge potential and prospects for the development of this area.

One of the main directions of the development of combat unmanned aircraft is to increase the efficiency and productivity of combat UAVs being developed. Modern unmanned vehicles still have limitations in payload and flight range. It is important to develop and implement new technologies to increase the flight time of UAVs and increase the payload, including for kamikaze drones.

An important aspect of the development of combat unmanned aircraft is the improvement of autonomous control systems. Of course, the successful operation of a UAV requires a high degree of autonomy and the ability to make decisions independently. However, it is important to develop algorithms that will ensure maximum accuracy and reliability of such solutions. Moreover, autonomous UAV control systems should be able to adapt to complex and unexpected situations in order to minimize the likelihood of errors.

It is also very important to develop new sensor systems for combat unmanned aircraft. Modern UAVs have a wide range of sensor devices, such as radars, optical and infrared cameras, as well as

sensors of various physical parameters. However, these systems require constant improvement and improvement. It is important to develop sensor systems that allow UAVs to effectively detect and identify targets, as well as reduce the likelihood of errors when performing combat missions.

Another area of development is the creation and use of new types of weapons for combat unmanned aircraft. Currently, there is a wide range of weapons that can be mounted on UAVs, such as missiles, bombs, as well as laser and electromagnetic systems. However, it is important to develop new and more effective types of weapons that will allow UAVs to successfully cope with various types of threats and increase their combat capability.

The next aspect that needs to be improved is the protection and confidentiality of combat drones. The further they develop, the more likely it is that the enemy will be able to hack control systems, interfere with communications or use cyber-attacks. Therefore, the safety of UAVs should be a priority, and it is important to take all measures to protect these systems from possible threats.

It is also necessary to take into account the legal and ethical aspects of the development of combat unmanned aircraft. Issues related to the use of such systems in military operations can cause counter-reversals and disputes. It is important to develop international standards and agreements that regulate the use of combat unmanned aircraft in order to avoid unintended or illegal actions.

7. Financing

The study was conducted within the framework of the scientific program «Development and creation of a prototype of a high-security combat strike unmanned aerial vehicle with high-precision ammunition» (contractor «R&D Center «Kazakhstan Engineering», Astana, Kazakhstan, IRN BR185068/0222). The financing of the scientific program is carried out at the expense of the Ministry of Science and Higher Education of the Republic of Kazakhstan (within the framework of funds allocated for the competition for program-targeted financing).

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Conclusion.

Taking into account the analysis carried out and the expert survey of specialists, it should be assumed that the trend towards intensive development of the field of combat unmanned aircraft will continue. This development is part of the transformation of approaches to the management of modern military conflicts, the reduction of the role of manned aviation in airspace, as well as the general improvement of existing unmanned technologies.

Creating conditions for the formation of a domestic cluster of developers of combat unmanned systems, a scientific and production base for these purposes is one of the priorities in the Republic of Kazakhstan.

It is considered advisable to continue scientific work on the development of domestic combat UAVs, including the most demanded high–precision weapons in the tactical link today - kamikaze combat drones.

The results of the study were used, among other things, in the scientific program «Development and creation of a prototype combat strike unmanned aerial vehicle with high-precision ammunition» (contractor «R&D Center «Kazakhstan Engineering», Astana, Kazakhstan, IRN BR185068/0222).

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