The article substantiates the role of innovation as one of the key drivers of Ukraine’s economic development in the new conditions dictated by the war and integration with the EU. Based on a review of leading international ratings, the author analyses the state of Ukraine’s innovation activity before and during the war. The strengths, weaknesses, threats, and opportunities in Ukraine’s innovation sector are identified. The results showed a deterioration in Ukraine’s innovative position in international rankings, mainly under the influence of the war. The changes in the key indicators of innovation activity in Ukraine from 2010-2021 are analysed. The results show a downward trend in most of Ukraine’s innovation indicators over the period analysed. The identified problems in Ukraine’s innovation sphere are primarily related to the state’s need for a more effective innovation policy. The main directions for improving Ukraine’s innovation policy in the new conditions are identified based on the obtained results. The author identifies key promising areas for Ukraine’s innovation development in the new conditions.

Key words: innovation; innovation potential; innovation indicators; Ukraine’s economic development; EU integration.
Statement of the problem in a general form and its connection with important scientific or practical tasks. Ukraine’s economic integration into the European Union (EU) is taking place under new and unprecedented conditions, as no member state met the criteria for membership during the war. Thus, Ukraine’s economic development should consider these new conditions, i.e. factors that favour and hinder Ukraine’s economic integration with the EU. This will be challenging due to the prolonged war. The ongoing Russian invasion of Ukraine continues to cause significant economic and social losses due to extensive damage to productive capital and infrastructure, reduced access to markets and dislocation of labour. Even leading international organisations occasionally change their economic and social forecasts about the impact of the war on the whole world, including Ukraine. Therefore, an important task is to identify and preliminarily analyse the key factors that favour and hinder Ukraine’s economic development, considering the new conditions.

Analysis of the latest studies and publications, which the author relies on, which consider this problem and approaches to its solution. Economic growth and development factors are the mechanisms and forces in the socioeconomic system that significantly affect the country’s economic growth and development. There are four classic drivers of economic growth: labour supply, capital (physical, financial and human), natural resources and technology [1]. Each of these forces plays an essential role in economic development, but access and ability to use them change significantly under war conditions.

Under the new conditions, the main factors influencing Ukraine’s economic development, including its integration into the EU, will be human capital, innovation potential, financial capital and natural resources. Under the conditions of a protracted war, the impact of human capital (excluding labour displacement), financial capital (excluding foreign funds) and natural resources (excluding the location of active hostilities) on Ukraine’s economic development is difficult to assess. Therefore, at this stage, it seems reasonable to pay attention to Ukraine’s innovation potential as one of the key factors in the country’s economic growth in the new conditions.

The impact of innovation on national economic development has been the subject of research by many authors. However, few publications consider the effects of this factor on the country’s economic growth under new conditions related, firstly, to the ongoing war and its aftermath and, secondly, to the country’s integration into the EU [2-5]. However, all authors demonstrate in their works [2-5] the relevance of innovation development in Ukraine, which will become one of the key instruments of the country’s post-war reconstruction and integration with the EU.

Using econometric modelling, Zayats O., Yarema T. & Pryiatelchuk O. found that in the context of integration with the EU, the key factors for Ukraine’s innovative development are the share of R&D costs, the volume of innovative products sold, and the commercialisation of R&D, particularly patenting. Despite Ukraine’s significant innovation potential, the main obstacles to the country’s innovative development are the high costs of research and development, the low level of commercialisation of inventions and the imperfection of the state’s innovation policy. In the authors’ opinion, in the context of integration with the EU, one of the key vectors for developing Ukraine’s innovation activities should be the development of green technologies in line with the European Green Course [2].

Kosovych B. emphasises the need to develop innovative activities in Ukraine’s military-industrial complex for national defence and security. The author points out that during the war, new types of weapons were produced and successfully used by Ukrainian soldiers. The development of innovations in this field is necessary to adapt the Ukrainian military-industrial complex to NATO standards [3].

Syrteva S., Ivaniuk U., Fedotova I., Hurina O., Dovzhyk O., & Nazarenko O. argue the importance of developing the innovation activities of small and medium-sized enterprises (SMEs), which account for around 60% of the EU’s gross domestic product. The authors believe the SME sector is characterised by increasing output, responsiveness to innovation and consumer demand [4].

In the paper [5], Jones S.G., McCabe R., & Palmer A. point to Ukraine’s innovative potential, which allowed it to achieve good results in the war against the much larger and initially better-equipped Russian military.

Formulation of the goals of the article (statement of the task). The article aims to analyse the changes in innovation in Ukraine as one of the main factors of the country’s economic growth in the new conditions.

Presentation of the main research material. In the new conditions that Ukraine faces, one of the main drivers of the development of the Ukrainian economy, including its integration into the EU, will be Ukraine’s innovation potential. According to 2021 data, Ukraine, the second largest country on the European continent, is rapidly emerging as an exciting and innovative destination for international business investment [6]. This begs the question: How will the war affect Ukraine’s further development of innovative activity? Although there is still not much data on Ukraine’s innovation development during the war, we will look at it and assess the changes in
The assessment of market differentiation in Ukraine was particularly unfavourable. As a result, Ukraine ranks 104th out of the 132 countries assessed. Such a low position is mainly due to low levels of investment and credit.

The next European Innovation Ranking [8] assesses a country’s innovation behind human resources, attractive research systems, digitalisation, finance and support, firm investments, use of information technologies, innovators, linkages, intellectual assets, employment impacts, sales impacts, and environmental sustainability. According to the 2023 ranking above, Ukraine is in the group of emerging innovators, the weakest group. In 2023, Ukraine reaches 31% of the EU average, a decrease of 0.7% compared to 2022 and a decrease of 0.2% compared to 2016. Such a result is below the average for emerging innovators, and Ukraine’s performance gap with the EU is widening. Compared to 2022, Ukraine’s performance in human resources, employment impacts, environmental sustainability, innovators, use of information technologies, and firm investments has declined significantly.

The creators of the European Innovation Ranking [8] consider Ukraine’s main strengths to be: knowledge-intensive services exports, environment-related technologies, employment in knowledge-intensive activities, venture capital expenditures, non-R&D innovation expenditures. However, areas such as product innovators, design applications, sales of innovative products, international scientific co-publications, R&D expenditures in the public sector were rated negatively. Significant increases in Ukraine in 2023 compared to the previous year occurred in knowledge-intensive services exports, venture capital expenditures, and most cited publications. In contrast, the most significant decreases in Ukraine compared to 2022 are in medium and high-tech goods exports, product innovators, PCT patent applications.

Although Ukraine has a well-developed technology sector, employing more than 182,000 skilled technicians and generating $5 billion in annual exports, the country lacks an adequate legal and legislative system. It has low purchasing power, meaning local technology companies must sell their products and services abroad, where they are in demand [9].

According to the 2021 Bloomberg Innovation Index ranking [10], Ukraine ranks 58th among the 60 most innovative economies in the world. In 2020, the country was ranked 56th, in 2019 - 53rd, and 2018 - 46th, which means that the level of innovation in Ukraine has been declining in recent years. For the ninth consecutive year, Bloomberg collected data from more than 200 global economies and ranked them on a scale of [0-100] in seven key innovation indicators before and during the war.

The Global Innovation Index [7] comprehensively assesses innovation in different countries worldwide by seven key pillars (institutions, human capital and research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs, creative outputs). According to the Global Innovation Index report, in 2023, Ukraine was ranked 55th out of 132 countries assessed, while in 2022, Ukraine was ranked 57th, 2021 - 49th, and 2020 - 45th. From this information, we can already see the negative impact of the war on the state of innovation in the country. In 2023, Ukraine has slightly improved its ranking compared to the previous year (up two places), but it is still far below its pre-war positions (e.g. down ten places compared to 2020).

According to the 2023 Global Innovation Index report [7], the highest-rated pillar was creative outputs, which placed Ukraine 37th out of the 132 countries surveyed. This represents an increase of 26 positions over the previous year. Ukraine’s strengths in this category are trademarks by origin, industrial designs by origin and mobile application development. However, regarding knowledge and technology outputs, Ukraine ranked 45th in 2023, down nine from the previous year. While in 2022, there were no weaknesses in this category, in 2023, according to the Global Innovation Index [7], Ukraine’s position in labour productivity growth and unicorn valuation deteriorated significantly.

Despite the full-scale war that has been raging in the country for almost two years, Ukraine has managed to maintain its position in the human capital and research pillar. In 2023, Ukraine is ranked 47th in this category, up two positions from the previous year. Ukraine’s strength is its high level of education, while the main problem remains the low level of foreign investment in research and development.

Regarding R&D expenditure, Ukraine ranks 76th among the 132 countries assessed in the 2023 Global Innovation Index [7], down eight positions from the previous year. The decline in R&D expenditure is closely linked to the impact of the war. In the category of business sophistication, Ukraine was ranked 48th in 2023, mainly due to its high level of employment of women with tertiary education. The main problem in this area is the low level of venture capital transactions.

Regarding innovation infrastructure in 2023, Ukraine ranked 77th in the Global Innovation Index [7]. The main weaknesses the ranking compilers identified were the high energy consumption level of GDP and the low level of investment. Ukraine, affected by military aggression and political instability, ranks 100th in the institutions category in 2023, down three places from the previous year.
categories, including the quality of a country's higher education, spending on R&D centres and the number of public technology companies per capita. In the 2021 report, Ukraine scored 47.5, indicating that the country's performance in the areas above is inadequate.

Table 1 shows Ukraine’s key innovation indicators from 2011 to 2021, that reflect trends in innovation activity in the pre-war period. Analysing these indicators allows us to explore Ukraine’s innovation potential and identify the problems in the innovation sphere that existed before the war.

**Table 1**

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</tr>
</thead>
<tbody>
<tr>
<td>Research and development expenditure, % of GDP</td>
<td>0.71</td>
<td>0.72</td>
<td>0.73</td>
<td>0.65</td>
<td>0.61</td>
<td>0.48</td>
<td>0.45</td>
<td>0.47</td>
<td>0.43</td>
<td>0.41</td>
<td>0.33</td>
</tr>
<tr>
<td>Researchers in R&amp;D (per million people)</td>
<td>1,257.9</td>
<td>1,231.0</td>
<td>1,162.0</td>
<td>1,023.9</td>
<td>1,006.0</td>
<td>1,037.2</td>
<td>994.1</td>
<td>988.1</td>
<td>880.6</td>
<td>846.2</td>
<td>587.5</td>
</tr>
<tr>
<td>Patent applications, residents</td>
<td>2,649</td>
<td>2,491</td>
<td>2,856</td>
<td>2,457</td>
<td>2,271</td>
<td>2,233</td>
<td>2,283</td>
<td>2,107</td>
<td>2,097</td>
<td>1,361</td>
<td>1,302</td>
</tr>
<tr>
<td>Industrial design applications, resident, by count</td>
<td>3,445</td>
<td>3,480</td>
<td>8,087</td>
<td>4,962</td>
<td>4,294</td>
<td>5,382</td>
<td>4,954</td>
<td>5,261</td>
<td>4,660</td>
<td>3,228</td>
<td>3,526</td>
</tr>
<tr>
<td>Trademark applications, resident, by count</td>
<td>28,515</td>
<td>30,406</td>
<td>32,896</td>
<td>25,355</td>
<td>36,339</td>
<td>45,880</td>
<td>47,531</td>
<td>51,195</td>
<td>54,298</td>
<td>38,496</td>
<td>44,202</td>
</tr>
</tbody>
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Table 1 shows a significant decline in the key indicators of Ukraine’s innovation activity in 2011-2021. Over the period analysed, R&D expenditure fell by 54%, the number of researchers in R&D by 53% and the number of patent applications by 51%. The number of industrial design applications remained virtually unchanged. The only positive trend is in the number of trademark applications, which increased by 55% over the period.

Another way of measuring a country’s innovation level is to assess the changes in the number of innovation-active enterprises (Figure 1) and the number of enterprises implementing innovations (Figure 2) in the pre-war period.

![Graph](image)

**Fig. 1. Shares of the number of innovation-active enterprises in the total number of industrial enterprises in Ukraine, 2010-2020**

*Source: State Statistics Service of Ukraine [12]*

As Figure 1 shows, between 2010 and 2016, the share of innovation-active enterprises in the total number of industrial enterprises in Ukraine increased by almost 37%, while between 2016 and 2020, we can see a decrease in this indicator by 11%. Although Ukraine has managed to increase
the share of innovation-active enterprises in the total number of industrial enterprises by almost 22% between 2010 and 2020, the trend is still somewhat unstable.

**Fig. 2. Shares of the number of enterprises implementing innovations in the total number of industrial enterprises in Ukraine, 2010-2020**

*Source: State Statistics Service of Ukraine [12]*

Figure 2 shows a similar trend to Figure 1. Between 2010 and 2016, the share of enterprises implementing innovations (products and technological processes) in the total number of industrial enterprises in Ukraine increased by almost 45%, while between 2016 and 2020, we can see a decrease in this indicator by 10%. Figure 2 shows that between 2010 and 2020, the share of enterprises implementing innovations in the total number of industrial enterprises in Ukraine increased by almost 30%.

According to the results of the analysis of changes in Ukraine’s key innovation indicators (Table 1, Figure 1-2), it was found that in the pre-war period, the main problem in Ukraine’s innovation sector was a decrease in research and development costs, the number of researchers in R&D, and the number of patent applications. According to the literature [1-5] review results, innovation potential will be one of the key drivers of Ukraine’s economic development. In the context of Ukraine’s post-war reconstruction and integration into the EU, Ukraine is expected to receive significant foreign investment [4]. Therefore, the government’s innovation policy should aim to increase expenditure on research and development, encourage companies to develop and implement innovations by creating favourable and profitable conditions, attract and motivate researchers in R&D, promote the return of refugees from abroad who have acquired new knowledge and skills, develop innovation cooperation with international partners, etc.

An essential task of Ukraine’s innovation policy is to stimulate enterprises to carry out innovative activities in promising areas that will ensure a high level of development of the military-industrial complex, the post-war reconstruction of the country and its successful integration into the EU.

In recent years, Ukraine has become known for the products and services of innovative companies and entrepreneurs within its high-tech industrial base and fast-growing IT and digital services sector. Ukraine’s technology sector proved to be the most resilient part of the Ukrainian economy during the war and could be the future engine of post-war economic recovery [13].

According to forecasts, the sectors in which innovations from Ukrainian companies will be most in demand are defence and cybersecurity, construction and infrastructure, health and medicine, educational projects, agriculture and green technologies [2-5; 13].

Nearly 30% of all new Ukrainian Startup Fund grant programme applications are military technology projects. These are startups that make drones, software, and cybersecurity products. Given the massive damage to residential buildings and civilian infrastructure as a result of Russian aggression, new construction technologies will undoubtedly be in demand in Ukraine in the coming years. Even before the war, the country saw rapid development of HealthTech at the intersection of technology, medicine and pharmaceuticals [3; 5; 13].

Technology also helps the agricultural sector work more efficiently, and in times of crisis, its value only increases. Artificial intelligence, biotechnology, cloud technologies, big data, and drones are the most popular in this sector. Given the growing risks to food security, AgTech and FoodTech startups will continue to be in demand. Regarding Ukraine’s integration into the EU, the importance of ‘green’...
start-ups focused on environmental friendliness and climate protection also increases [2; 13].

The uncertainty of the educational process for students and the high demand for new skills among adults, which started during the COVID-19 pandemic and the war, impeded the development of numerous Ukrainian EdTech startups [13].

Conclusions from this study and prospects for further research in this direction. Based on the analysis of the state and trends of changes in Ukraine’s innovation activity before and during the war, the following conclusions are drawn. First, it should be noted that Ukraine did not occupy a leading position in international rankings even before the war. The war’s effects have also negatively impacted Ukraine’s innovation development, as evidenced by its falling position in the rankings. In addition, key innovation indicators for Ukraine, such as R&D expenditure, the number of researchers in R&D and the number of patent applications, showed a downward trend from 2011 to 2021. Many problems in the innovation sphere are related to the need for an effective public innovation policy. However, the new conditions associated with the ongoing war and Ukraine’s European integration and reconstruction require changing the government’s priorities in the innovation sector. After all, innovation is the key to successful military results in an unequal struggle, effective integration of the country into the EU, and rapid reconstruction of the state. Improving the state’s innovation policy will make it possible to use Ukraine’s innovation potential as a driving force for its economic development in the new environment.

REFERENCES:


