100% Natural Intelligence
SATURDAY TEAM

RESEARCH ON COOPERATION BETWEEN SCIENCE AND BUSINESS IN UKRAINE

SCIENCE & SATURDAY TEAM

CONTENTS:

COMMERCIALIZATION OF SCIENCE AND KNOWLEDGE-INTENSIVE INNOVATIONS

With increasing competition in global markets, an increasing number of corporations are looking for ways to differentiate themselves from their competitors in order to remain competitive. **Corporate innovations** allow not only to maintain their market share, but also to expand their business, gaining advantages and sustainable development, and to adapt to new conditions of changing markets. One of the sources of corporate innovations **is knowledge-intensive innovations**, which derive their ideas from scientific institutions, laboratories, universities, and research centers where research is conducted. However, a significant number of developments remain unused due to the inefficient system of **science commercialization**, which is designed to turn ideas into profitable products.

Corporate innovations

Corporate innovation is a method for a corporation to maintain its market share for a long time by improving products and services, introducing new technologies, and ideas that come from outside or inside the company. Mergers and acquisitions are a common practice for rapid innovation in companies.

Types of corporate innovations:

- **Closed**: the source of new ideas is internal. Closed innovation models are characterized by employee search programs, innovation teams, and corporate accelerator programs.
- **Open:** involving third parties for new ideas and products, competitions, hackathons. For open models, innovation outposts, external corporate accelerators, investments and acquisitions, hackathons, and pitch competitions are often used to attract corporate innovation.

Commercialization of science

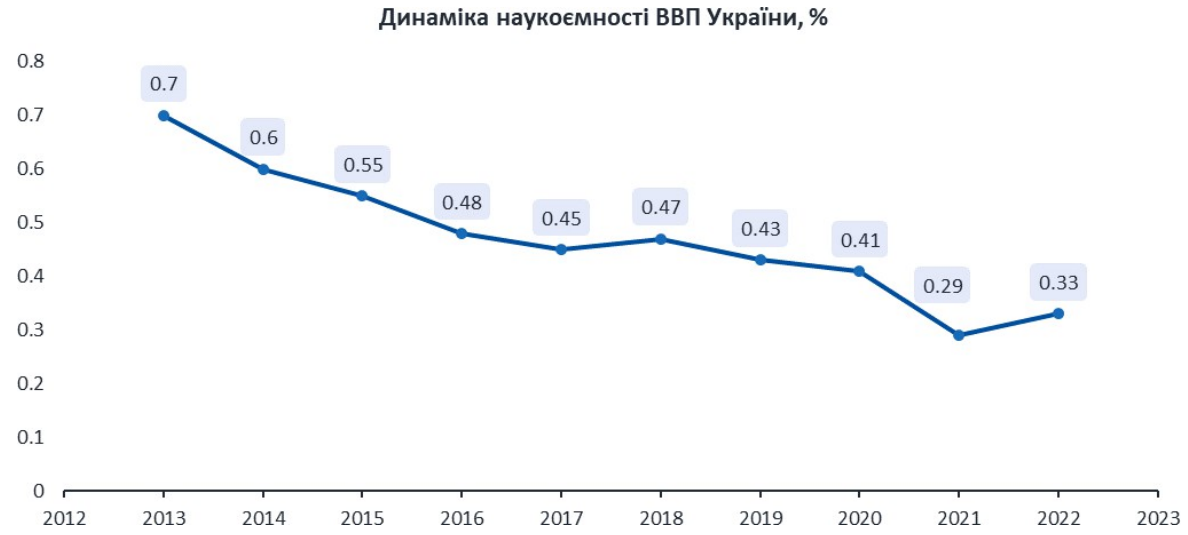
The concept of commercialization of science is the use of scientific ideas to create specific technological products that can eventually be implemented in the market. Commercialization is a key stage of the innovation process that takes a potentially useful product beyond the boundaries of research centers. In the course of commercialization of science, problems often arise in which the practical use of scientific developments and inventions in the production of goods and services for commercial purposes is inefficient. Many scientific projects are underestimated and remain in research centers due to the difficulty of preliminary assessment of their commercial effect, lack of commercialization of science in national laboratories and universities, inefficient distribution of research funding, lack of proper communication between institutions, low culture of public acceptance of technological developments, and the need to obtain permission for new technologies. In the past, funding for some developments may have been considered effective due to global threats and the need for

technological products, for example, during World War II. However, one should take into account the concept of biased survival, in which only those technologies that have come down to us are known, while the rest potentially remained in laboratories even at that time.

Source: Statista

Positive examples of cooperation between science and business include increased interest of universities in research projects, knowledge exchange forums, and entrepreneurs' perception of the benefits of ties with universities.

As of 2022**, South Korea has the largest amount of domestic research spending, 5% of GDP**, while the United States has 3.5% of GDP and Belgium in Europe has 3.4% of GDP.



In 2022, the ratio of research and development (R&D) expenditures to Ukraine's GDP was 0.33%, which is half as much as in 2013. The reasons for this include

knowledge intensity is decreasing, scientists during in-depth interviews noted: focus on the raw materials business, outdated scientific infrastructure, responsibility
policy makers, lack of understanding on the part of the state and society of the role of science (the situation was also aggravated by anti-scientific and anti-academic campaigns). On the other hand, it was noted
the effectiveness of Ukrainian science in terms of low funding.

The US remains the dominant market with the largest number of startups (~77 thousand).

There are about 1,500 active **startups** in Ukraine, with a total value of €23.3 billion. Since 2017, this figure has increased 9 times.

Trends in the development of knowledge-intensive innovations 2023-2024

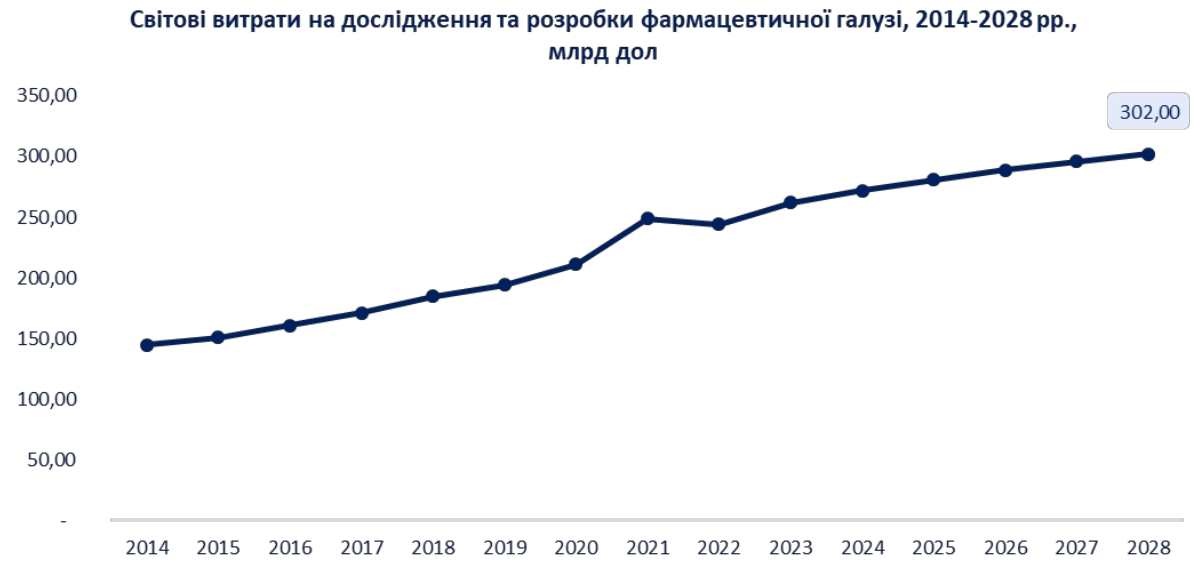
Applied artificial intelligence. In 2023, artificial intelligence (AI) continues to be the main trend of Deep Tech in the world. The AI market is expected to reach USD 305.90 billion in 2024. And the annual growth rate for the period 2024-2030 will be characterized by a CAGR of 15.83%, which will more than double the market growth compared to 2024: USD 738.80 billion by 2030.

The largest market size as of the end of 2024 is projected for the United States at USD 106.50 billion.

The use of artificial intelligence has made significant progress in healthcare (automated diagnostics and prescription verification, early detection medical imaging, accelerated drug discovery, and evaluation of the effectiveness of medicines), education (anti-plagiarism through AI detectors, development of virtual reality training), and law (reducing judicial errors in litigation forecasting and contract analysis).

Source: Statista

Spending on general pharmaceutical research. From 2014 to 2024, total pharmaceutical research spending almost doubled. They are projected to reach $302 billion by 2028.



Source: Statista

Internet of Things. The Internet of Things as a communication that enables data transfer to other devices in a system or to other systems via the Internet is gaining popularity. According to the latest data, the number of devices connected to the Internet of Things is 14 billion, which is more than the world's population. In addition, the number of connected devices is expected to double by 2030, driven by more powerful technologies and 5G.

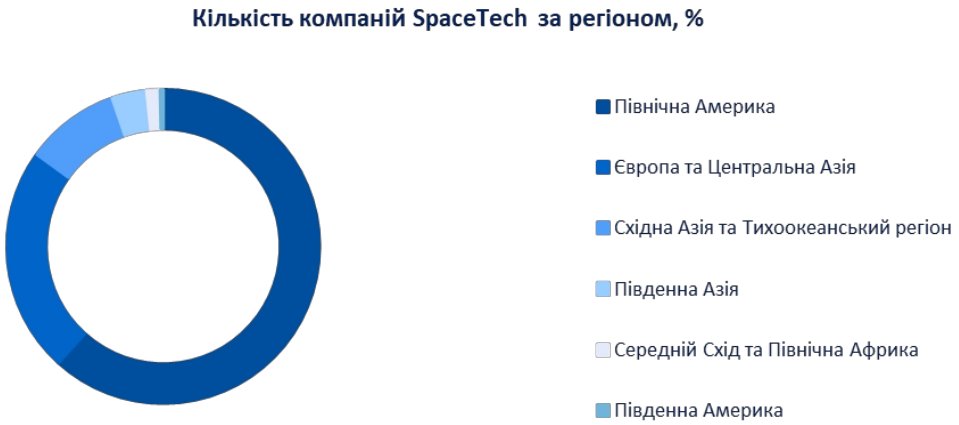
Source: IOT Analytics

Renewable energy and fuels. The decline in Covid-19 cases and the fight against global warming have accelerated the sustainable energy market and increased the number of investments in clean energy and fuels. As of 2023, investments in clean energy amounted to $1,740 billion, and in fossil fuels to $1,050 billion.

Source: IEA

Space technologies. In 2022, the global space technology market was estimated at $420 billion. It is projected to grow by 7.5% annually from 2023 to 2030, driven by technological advances, growing government initiatives, and private sector participation.

In terms of the number of companies and investments in this industry, the United States and Canada are the leaders in 2023.



Source: SpaceTech Analytics Industry Overview

INTERACTION BUSINESS AND SCIENCE: FORMS, ECOSYSTEMS, INNOVATIVE INTERMEDIARIES

An ecosystem is an interaction between two or more entities that creates more value than any individual participant could create on its own.
definition by EY

Innovative intermediaries

Formats	Specifics	The face of business and science cooperation	Examples
Technology transfer offices (OTT)	Located in universities	They collaborate with business partners, manage intellectual property, and provide advice and support to startups.	TUM ForTe, MIT Technology Licensing Office and Stanford Office of Technology Licensing, UP Manila Office of Technology Transfer and Business Development (Philippines), Centrum Transferu Technologii Uniwersytetu Jagiellońskiego (Poland), Center for Knowledge and Technology Transfer at Charles University
Science parks	Located in universities or research institutions	They accept and promote the development of companies based there through technology transfer and open innovation.	Stanford Science Park, Qatar Science & Technology Park, Hoa Lak High Technology Park (Vietnam), Igor Sikorsky Kyiv Polytechnic Institute Science Park, Kraków Technology Park (Poland)
National research agencies	A national research funding and coordination body independent of the relevant ministries.	- Financing of Innovations - Ensuring Technology Transfer - Creating Innovative Collaborative Projects - Human Resources Development - Formation of Innovation Clusters	NSF (USA), NIH (USA) , UKRI (UK), DFG (Germany), ANR (France), SFN (Switzerland), AEI (Spain), NRFU (Ukraine)
Innovation laboratories	Created by the companies themselves	Conduct market research, track potential disruptors, and support faculty and students in	Google[x], Amazon Lab126, Volkswagen Automative Innovation Lab, Coca-Cola's KOLab, InnoLab Asia (Vietnam), laboratories

		all stages of the technology transfer process.	Farmak R&D Center (Ukraine)
Innovation hubs	Bringing together startups, businesses, and investors to foster an innovative environment and collaborative work.	Financial support for startups, providing access to promising ideas and opportunities for cooperation with other companies.	"1871" in Chicago, Co-creation Hub, Saigon Innovation Hub (Vietnam), AI and Robotics Estonia (EDIH), Jagiellońskie Centrum Innowacji (Poland)
Incubators/ Accelerators	Established by the companies themselves or are independent organizations	They support startups and entrepreneurs using modern technologies by providing services such as training, mediation, and financing.	Microsoft Accelerator, Google Launchpad Accelerator, Y Combinator, Techstars, and 500 Startups, Hoa Lac High-Tech Business Incubator (Vietnam), Inkubator Innowacyjności 4.0 (Poland)
Makerspaces	Located in schools, libraries and public/private institutions	They create a platform for generating, learning, and sharing ideas using a variety of tools, from high-tech to non-tech.	SpaceShop Rapid Prototyping Lab at NASA Ames Research Center, i3Detroit
Innovation and fundraising clusters	They bring together businesses, scientists, and investors to work together on innovative projects, share ideas and resources.	Working together on innovative projects, exchanging ideas and resources, and increasing competitiveness in their industry.	Research Triangle Park (RTP) in North Carolina, USA, Tokyo-Yokohama, Klaster LifeScience Kraków (Poland)
Competence centers	Specialized institutions or organizations that bring together experts for	Access to experts and technological developments, which allows us to improve products and innovations.	The MIT Media Lab is a center of excellence that brings together scientists, engineers, and artists to innovate in media and technology.

	development		
	specific technologies .		

Other important formats of cooperation are:

- **Scientific conferences:** promote cooperation in the innovation system, generate networking and build social ties between scientists and businessmen, which leads to the exchange of ideas and joint cooperation.

Examples**:** AACR conference - American Association for Cancer Research

- **Symposia, seminars:** small events, in-depth discussions and workshops. Examples**:** CLS (Center for Scientific Studies) seminar, SCWIST (Society for Canadian Women in Science and Technology) annual symposium, or ASCB (American Society for Cell Biology) symposia on "New Therapies in Genetic and Cellular Technologies".

- **Technology exhibitions:** a place for vendors (manufacturers) to demonstrate their products

Examples**:** Exhibition ASHG - American Society of Human during their annual conference.

Model of the innovation ecosystem

Infrastructure elements (organizations and institutions) responsible for innovation development are divided into 4 zones that form a complete innovation cycle.

Source: Innovative ecosystem Industry 4.0 in Ukraine. The model and current status.

- An innovation zone usually includes universities, research laboratories, design offices, research institutes, or startups.
- The incubation zone includes organizations that create opportunities for the development and acceleration of innovators. Incubators and accelerators, business angels, various foundations, donor organizations, etc. - without them, it is impossible to move from
  of an innovative idea to the prototype stage.
- The experience and testing zone contains elements that allow you to test the viability of an innovation. This zone is the last one for rapid testing and market entry.

Other examples of innovative intermediaries:

- Venture Capital Funds: raise money from various investors to finance promising startups, develop and scale them, and provide opportunities for consulting and mentoring from industry professionals.

Examples: Sequoia Capital, USA

- Business angels: individuals who invest their own money in startups in exchange for their own shares in the company.

Examples: Paul Graham is the founder of Y Combinator, an active business angel and investor in promising startups.

- Brokers: individuals or companies that help organize and facilitate financial or business transactions between different parties. Brokers can conduct financial transactions, make investments, and help scientists conclude licensing, commercialization, and technology transfer agreements.

Examples: Goldman Sachs is a global financial company that acts as a broker in financial transactions and other services, Ocean Tomo, IPVision

- Investment agencies: organizations that provide investment attraction services, financial and infrastructure support for research.

Examples: Invest in the USA (SelectUSA) is an agency for attracting foreign investment in the United States.

- State Funds: provide state support and funding for research, development and innovation.

Examples: ARPA-E (Advanced Research Projects Agency-Energy), USA

- Government agencies: intermediary in the transfer of technology between academic institutions and businesses. This can include licensing patents created by universities or research institutes, setting norms and standards that govern research and development activities.

Example: The National Aeronautics and Space Administration (NASA) in the United States.

- Development agencies and regional development agencies: agencies aimed at stimulating economic growth and social development in general or in a specific region. They provide financial support for infrastructure development and business opportunities.

Examples: Appalachian Regional Commission (ARC) in the USA, Economic Development Administration (EDA) in the USA

DEEP TECH DEVELOPMENT

Deep Tech is a classification of institutions, organizations or startups that are deeply technological, change human experience and realize ideas that were potentially considered impossible before, and often contribute to solving social problems. These technologies are created using scientific achievements and discoveries, engineering innovations that are applied as a product for the first time.

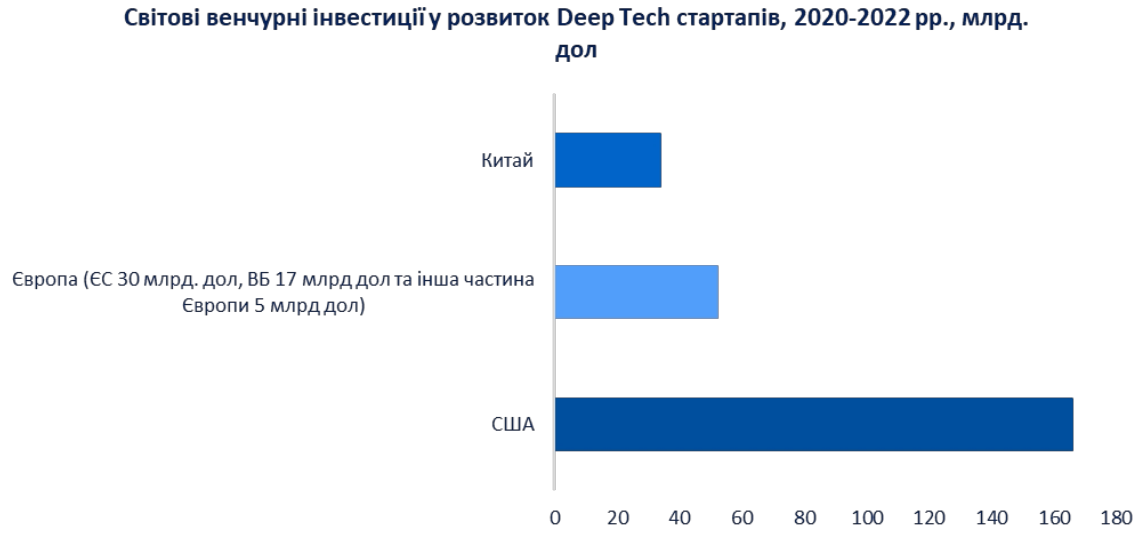
The trends of Deep Tech 2023 are AI, with a global added value of USD 17 to 26 trillion, the Internet of Things, blockchain, space technologies, advanced materials research, and industrial machine learning, which is projected to grow to more than USD 200 billion by 2030, with a CAGR of 36.2%.

Among the **new areas of Deep Tech**, such as the latest artificial intelligence, the future of computing, new energy and space technologies, in 2022, Europe attracted funding of $4.4 billion, in 2021 - $3.7 billion, and in 2020 - $2.1 billion. In addition, financing for new energy in 2022 accounted for the largest share - about 35%.

Science hubs create a favorable environment for science and business interaction, which can facilitate the creation and development of startups. **The top 5 ecosystems of science hubs** (networks of research centers, institutions, laboratories, technology parks, universities that cooperate and share knowledge for the development of science and technology) include: **Bay Area, Boston, Cambridge in the UK, San Diego, and Oxford.**

Source: DealRoom, The European Deep Tech Report 2023

In terms of investment, the United States far outweighs the rest of the world, while China invests more than the entire European Union combined. Nevertheless, investment in Deep Tech is critical to Europe's security if it wants to control the latest technologies and become the third world pole.



Source: DealRoom, The Europe Deep Tech Report 2023

In 2022, $18 billion of venture capital was invested in Deep Tech startups in Europe. The UK, France, and Germany are among the largest investors. Over the period 2017-2023, the UK invested $26.6 billion in Deep Tech, France - $16.5 billion, and Germany - $13.08 billion.

Deep Tech clusters in Europe

These clusters are shown on the basis of benchmarking by patents, creation of Deep Tech startups, and funding at different stages - from early to unicorn.

Source: Dealroom.co;

A Deep Tech ecosystem is a set of companies and researchers in a single region that work together on the same idea, solve complex problems, and create innovative solutions. The largest European Deep Tech ecosystems are the United Kingdom, Germany, France, and Sweden, which are also the largest investors in Deep Tech. And Switzerland, Sweden, Finland, and Norway are t h e most Deep Tech-oriented ecosystems.

Deep Tech in Europe has strong public support:

Source: DealRoom, The Europe Deep Tech Report 2023

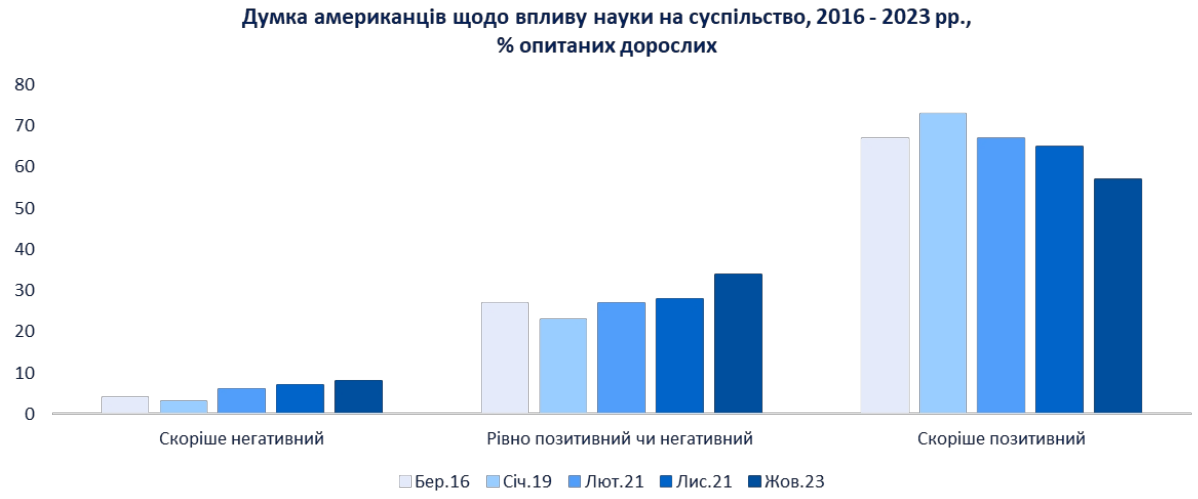
GLOBAL EXPERIENCE: OVERVIEW OF REGIONS AND COUNTRIES

North America (USA, Canada)

Source: Zippia Outlook, Statista, Pew Research Center Report

In 2022, gross domestic expenditures on research and development in the United States amounted to 3.46% of GDP. The number of degrees awarded to students has increased more than 8 times since 1950. At the same time, as of 2023, there are 893 thousand people employed in the field of research and development, which indicates an average growth of 2.7% over the past 5 years. In addition, the demand for researchers is also expected to grow, by 17% between 2018 and 2028. As of 2021, there were about 31 thousand vacancies in this field. It is worth noting that the average R&D company in the United States employs about 8.7 people.

Regarding public opinion of science, a study by the Pew Research Center indicates that there has been a decline in American trust in scientists, as well as an increase in the tendency to believe that scientists do not act in the best interests of society. In 2019, 73% of respondents claimed that science had a more positive impact, while in 2023, only 57% shared this opinion. The pandemic was one of the reasons for the change in views, as some respondents criticized the country's response to the coronavirus outbreak, while others believed that health officials and their personal views had too much influence on policy



Source: Pew Research Center Report

Nevertheless, despite the decline in the number of people who consider the impact of science to be rather positive on society, the latest survey conducted in September-October 2023 among 8,842 American adults shows that respect for scientists and medical scientists remains significant among other well-known groups in society (very or fairly trusted medical scientists (77%), military (74%), and scientists (73%),

police officers (69%), public school principals (65%), religious leaders (53%), and a lower level of trust in journalists, business leaders, and elected officials).

Canada is at the forefront of AI research and development, particularly in Toronto, Montreal, and Edmonton. The country has a strong ecosystem of AI startups, higher education institutions, and government support, leading to advances in machine learning and computer vision.

Latin America

Source: Eos.org, Gfmag.com, Academic.oup.com

In Latin America, investment in R&D is low, with 85% of investment concentrated in Argentina, Brazil, and Mexico. A prominent example of successful innovation is the Argentine company MercadoLibre, the region's largest online commercial ecosystem with a market capitalization of $62.3 billion as of 2023. The main obstacles to scientific cooperation with Europe include communication (58% of respondents), planning (39%), funding (16%), and bureaucracy (16%).

Different Latin American countries allocate different percentages of their GDP to research and development (R&D), with Brazil leading the way with 1.17% of GDP. Argentina has the highest number of researchers per 1000 inhabitants, but invests less per researcher compared to Colombia.

Investment in R&D determines the region's potential for technological development and competitiveness in the global market. Despite the differences in investment levels, Latin American countries are striving to develop their research and innovation sectors to stimulate economic growth and improve living standards

Asia:

Source: NikkeiAsia,

Asian countries account for 42% of global R&D spending. The region is actively adapting its scientific and research systems to advanced fields such as molecular biology, nanotechnology, and materials science, with an emphasis on collaboration between academia and industry.

China, Japan, India, and South Korea are among the world leaders in terms of R&D spending, and leading Asian companies in the electronics and automotive industries, such as Huawei, Samsung, Toyota, and Honda, allocate significant resources to research and development.

In the Pacific, renewable energy is receiving a lot of attention, with a significant percentage of use (30-60%) in Vanuatu, Samoa, Fiji, and Papua New Guinea, and Tokelau, which was the first country to go fully renewable. Malaysia, for example, is focusing its efforts on developing a skilled workforce and value-added services sector.

Reducing dependence on raw materials and encouraging private sector investment in R&D are key for many economies. Maintaining public investment in research and attracting qualified research personnel will determine the success of these efforts.

Europe:

European initiatives emphasize the importance of cooperation to support innovative growth, in particular, initiatives such as the Green Deal Industrial Plan and the New European Innovation Agenda, which are aimed at achieving climate neutrality, technological leadership and are the main areas of development and research identified by the European Commission. European and American companies are leaders in high-value patents, especially in the areas of green technologies and circular economy. Such patents are highly valued due to the uniqueness and practicality of the idea and the possibility of successful commercialization. Contribution to technological progress also plays an important role in ensuring the efficient use of property in business.

"Green Deal Industrial Plan: Focuses on zero-emission industry, critical raw materials, and the transition to climate neutrality, offering support in the form of a regulatory environment, access to finance, skills development, and open trade.

"The New European Innovation Agenda focuses on supporting Europe as a leader in deep technology and innovation for startups, including improving access to finance and mobilizing private capital. The Agenda includes 25 actions in the areas of financing, experimentation, development of regional innovation valleys, talent attraction and improved decision-making. It also contributes to the integration of the EU's internal market, providing the protection needed to spur innovation and support the transition to a green and digital economy.

The key sectors contributing to R&D activities in the EU include aerospace, defense, chemicals, automotive, information and communications technology, and life sciences. The EU's main initiatives focus on industrial growth, climate neutrality, innovation finance, development of technology champions, materials for green and digital transitions, and international partnerships and trade.

The European Innovation Council (EIC) provides funding for the development of breakthrough technologies through its Pathfinder, Transition and Accelerator programs. The European Institute of Innovation and Technology (EIT) promotes cooperation between business, education and research through Knowledge and Innovation Communities (KICs) that develop innovative products and services, create new companies and train a new generation of entrepreneurs.

Since the signing of the Association Agreement with the EU, Ukraine has been gradually integrating into the European research and innovation space. As a member of the Horizon Europe research and innovation framework program, Ukraine has access to the European Institute of Innovation and Technology (EIT), European Innovation Council (EIC), European Innovation Ecosystems (EIE)) - Innovative Europe; European Research Council (ERC), Marie Skłodowska-Curie Action Program, research infrastructures - Advanced Science. Ukraine also participates in the European Cooperation in Science and Technology (COST) programs,
Euroatom, LIFE, and the European Innovation Science and Technology Program EUREKA.

A positive trend is also the accession to the Digital Europe program, the opening of the EIT hub in Kyiv, the launch of the EIC Seeds of Bravery project, and the opening of the Horizon Europe office in Ukraine. At the end of 2023, the national selection process for the creation of European Digital Innovation Hubs began.

The European Institute of Innovation and Technology (EIT**)** brings together entrepreneurs, educators and researchers and fosters innovation by developing entrepreneurial talent and
supporting new ideas. The EIT's competencies include: strengthening sustainable innovation ecosystems; developing entrepreneurial and innovation skills and supporting the entrepreneurial transformation of EU universities; and bringing new solutions to the market for global challenges;

The European Innovation Council (EIC) promotes disruptive innovations with the potential to global expansion. It funds research in the field of breakthrough technologies (Pathfinder program), transformation of research results into innovations (Transition program), startups and SMEs that develop and scale innovations that have
potential for creating new markets (Acceleration program).

The European Research Council (ERC) is the main European organization that funds cutting-edge research.

Marie Skłodowska-Curie Actions (MSCA) is an EU program for doctoral and postdoctoral students that provides researchers with new knowledge and skills through cross-border mobility and exposure to different sectors and disciplines.

Euratom's research and training program funds nuclear research and innovation

The **LIFE** program funds projects aimed at protecting the environment and climate action.

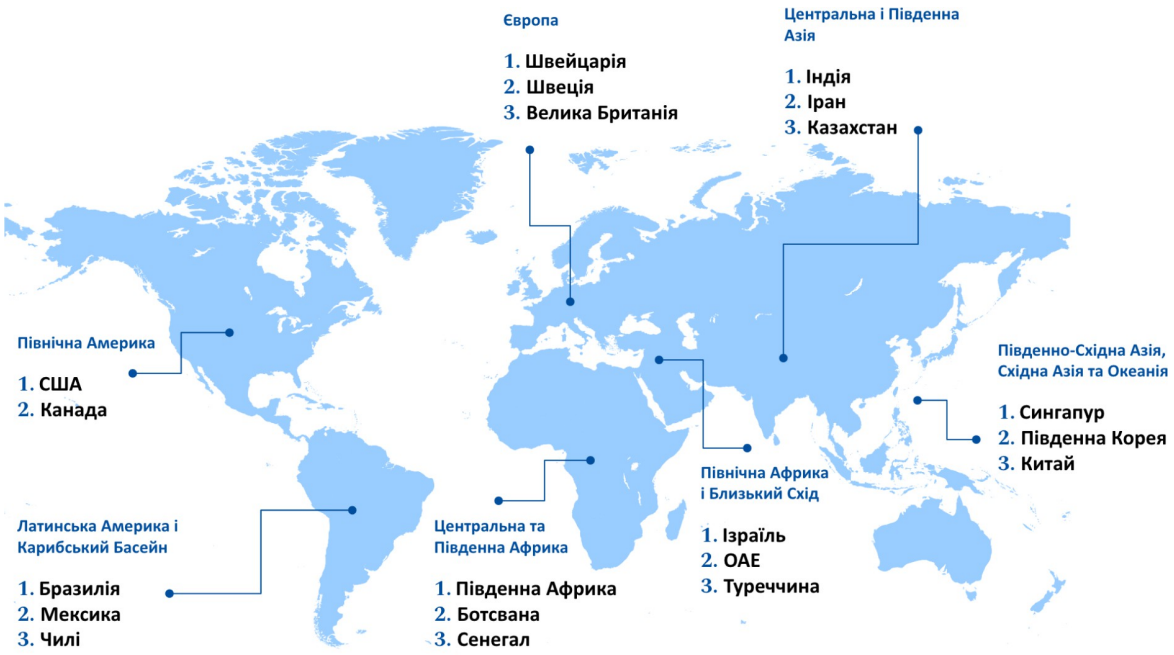
The European Cooperation in Science and Technology (COST) funds research and innovation networks.

The European Research and Development Program **EUREKA** is an open platform for international cooperation in the field of innovation.

In 2022, the European Commission adopted the New European Innovation Agenda. The document aims to ensure that Europe leads a new wave of deep-tech innovations, i.e. those that require breakthrough research and development and significant capital investment to solve urgent social problems. The agenda
The day offers 25 events in 5 key areas: financing for deep-tech scaling; fostering deep-tech innovation through experimental spaces and public procurement; accelerating and strengthening innovation in European innovation ecosystems; developing, attracting and retaining deep-tech talent; and
improving policy-making tools.

INTERNATIONAL INNOVATION RANKINGS

Top 3 innovative economies in each region



Source: Global Innovation Index 2023 - main report.

Switzerland, Sweden, the United States, the United Kingdom, and Singapore are the world's most innovative economies in 2023, according to the World Intellectual Property Organization's (WIPO) Global Innovation Index (GII). A group of middle-income economies won the title of fastest growing over the past decade.

Global Innovation Index 2023 rankings: (international research of the Global Innovation Index 2023)

Country.	Place in the innovation ranking	General R&D expenditures, billion USD	General R&D expenses, % of GDP	General education costs, % OF GDP	Evaluation of cooperation between universities and businesses (rating)
Switzerland	1	19 886	3.4	5.1	3
Sweden	2	18 504	3.4	7.6	11
USA	3	709 713	3.5	5	2
United Kingdom	4	83 707	2.9	5.2	12
Singapore	5	11 436	2.2	2.5	8

Finland	6	7 607	3	6.4	14
Netherlands	7	21 651	2.3	5.2	4
Germany	8	129 348	3.1	5.1	17
Denmark	9	8 818	2.8	6.9	13
Korea	10	110 148	4.9	4.7	21
France	11	63 752	2.2	5.4	38
China	12	620 103	2.55	3.5	6
Japan	13	172 062	3.3	3.2	28
Israel	14	21 032	5.6	6.1	1
Canada	15	29 314	1.6	4.8	7
Estonia	16	848	1.8	5.3	44
Austria	18	14 885	3.3	5.2	26
Australia	24	21 739	1.8	5.1	24
Italy	26	33 136	1.5	4.1	19
Lithuania	34	1 146	1.1	4	29
Latvia	37	420.1	0.74	4.4	68
India	40	65 200	0.64	4.6	66
Poland	41	18 310	1.4	4.7	97
Vietnam	46	4 500	0.55	3	27
Ukraine	**55**	**486**	**0.3**	**5.6**	**63**

Source: Global Innovation Index 2023 - main report.

*Taiwan is not included in the World Intellectual Property Organization's Global Innovation Index, as the island is not a recognized member of the United Nations. Nevertheless, the country has a developed innovation and statistics from the National Science and Technology Council of Taiwan (NSTC) indicate that the country-wide R&D expenditure was NT$898 billion (US$27.8 billion) in 2022, accounting for 3.96 percent of Taiwan's GDP.

INTERACTION OF BUSINESS AND SCIENCE IN UKRAINE

Since the creation of the National Research Foundation and the Ministry of Digital Transformation, Ukraine has been paying more attention to creating and implementing innovations. Russia's full-scale invasion damaged or destroyed a number of elements of the innovation system. On the other hand, the need to repel the enemy has given impetus to the creation of new solutions in military technology, medicine, agriculture and other areas.

Ukraine's innovation system consists of a number of players:

- Government and public institutions
- Higher education institutions (HEIs) and research institutions
- Innovation, science, technology and industrial parks
- Business incubators and accelerators, venture capital funds
- Startups
- Small, medium and large enterprises
- Innovation clusters
- Technology and innovation support centers, technology transfer offices
- Programs to support innovation

The sector is legally regulated by the Strategy for the Development of the Innovation Sector until 2030 (2019), the National Economic Strategy 2030 (2021), and a number of laws: "On Innovation Activity", "On Priority Areas of Innovation Activity in Ukraine", "On the Special Regime of Innovation Activity of Technology Parks", "On Industrial Parks", "On Scientific and Scientific-Technical Activity", "On Priority Areas of Science and Technology Development", "On the Basic Principles of Formation and Implementation of Priority Areas of Scientific, Scientific-Technical and Innovation Activity in Ukraine".

Ukraine lacks a coherent ecosystem that would allow for the effective implementation of new ideas. There is no single central body responsible for innovation. This function is shared by 4 ministries: The Ministry of Education and Science, the Ministry of Digital Transformation, the Ministry of Economy, and the Ministry of Strategy and Industry. Important state institutions that support research and innovation activities are the National Research Foundation (NRF), the Innovation Development Fund, the Ukrainian National Office of Intellectual Property and Innovation (UKIPI), the Ukrainian Institute of Scientific and Technical Expertise and Information (UkrISTEI), and the National Council of Ukraine for the Development of Science and Technology. According to the draft Innovation Development Strategy, the State Agency for Innovation under the Ministry of Digital Transformation should become the main body in the implementation of innovations.

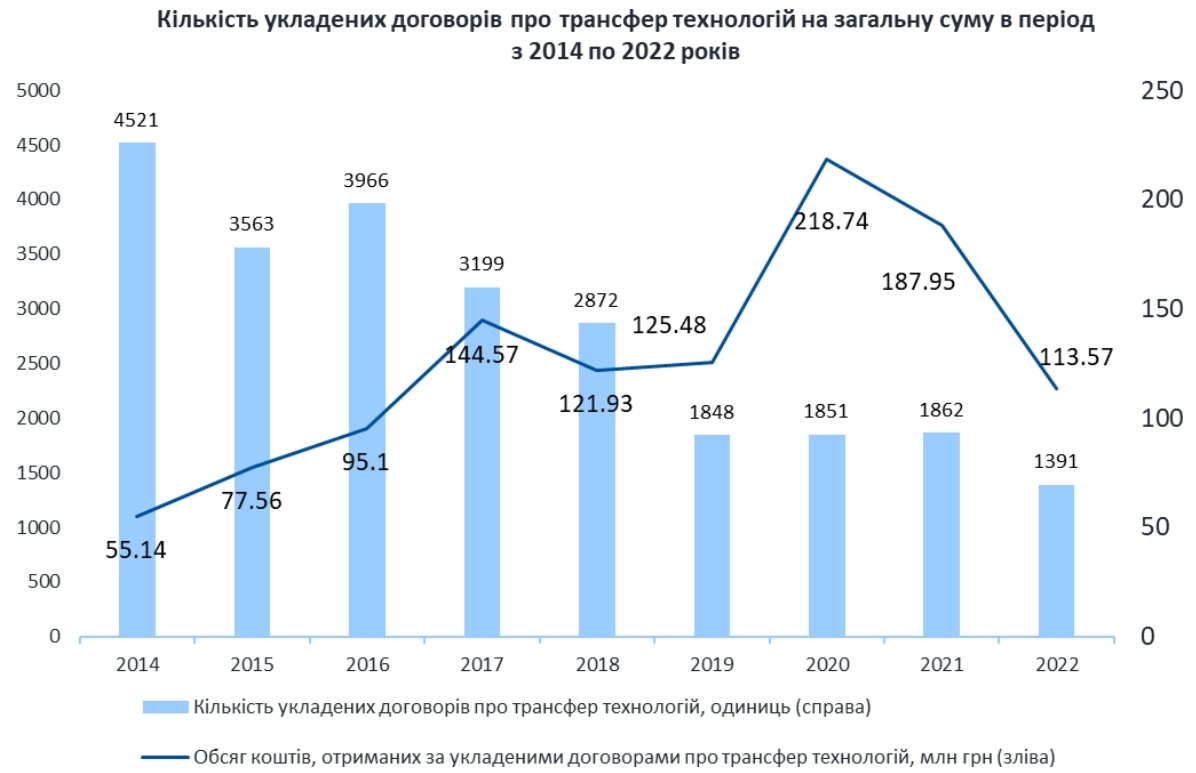
At the end of 2023, UKRNOVI presented the **National IP&Innovations Hub**, a future center that will support research, development, commercialization of intellectual property rights and technology transfer. The Hub has already implemented the Lab2Market program, which develops entrepreneurial skills among scientists in cooperation with technology transfer managers.

The NRFU provides grants for basic and applied research, development of international cooperation and research infrastructure. In 2023, the NRFU opened a competition for projects aimed at strengthening the country's defense capabilities. From 2020 to 2023, the Foundation supported 357 projects, 153 of which continued to be implemented in 2023. Since October 17, 2023, the Horizon Europe Office has been operating on the basis of the NRFU, providing information and legal assistance to Ukrainian organizations that want to participate in Horizon Europe competitions.

The Innovation Development Fund, also known as the Ukrainian Startup Fund (USF), helps startups raise funds and launch their projects. Tools: acceleration programs, grant support, innovation vouchers. Since the beginning of the full-scale invasion, the Fund has been supporting defense tech and deep tech projects. The Foundation also hosts the Brave1 defense technology cluster, which accelerates the commissioning of military developments. The Foundation is a partner of the European Innovation Council (EIC), a member of the InterHEI EIT Food & Health consortium and the Govtech4all incubator. In total, USF has funded more than 380 teams for $8.7 million

Higher education and research institutions. There are 256 higher education institutions in Ukraine (172 public and 84 private). 86 higher education institutions participated in the dual education project along with 600 enterprises. Students had the opportunity to combine their studies at a university with on-the-job training at a company or enterprise

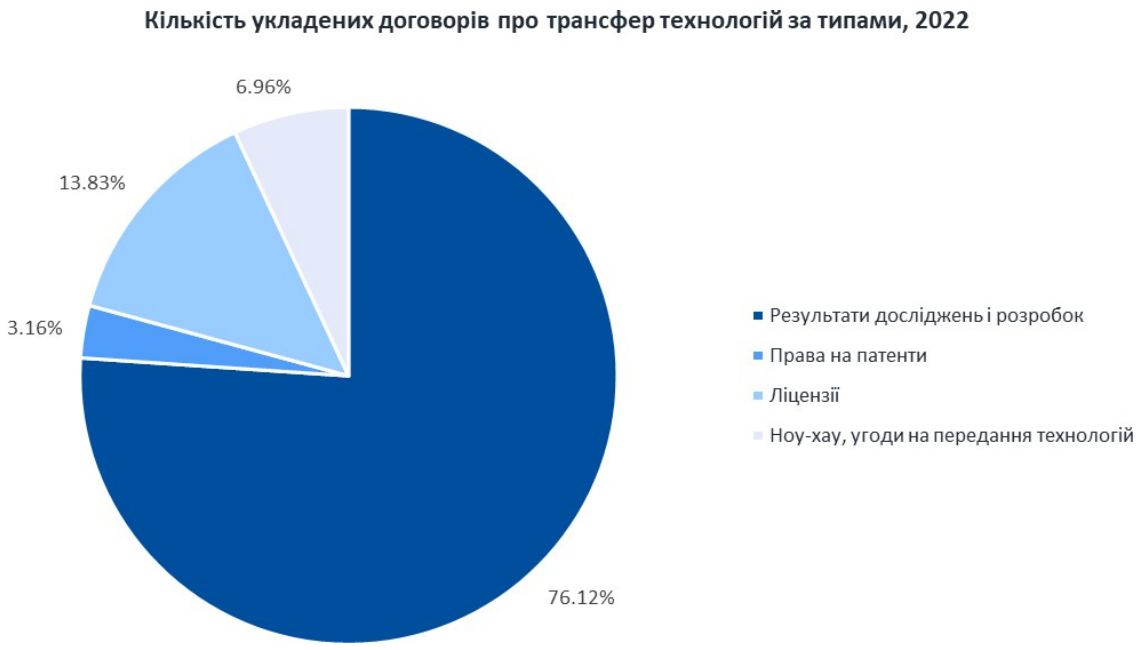
Since 2014, there has been a downward trend in **technology transfer** among higher education institutions and state research institutions. In 2022, 1391 technology transfer agreements were concluded (worth UAH 106 million) and 1766 technologies were transferred. This is 25% and 52% less than last year. The following institutions received the most revenue under technology transfer agreements: The National Academy of Agrarian Sciences (UAH 63 million), the Ministry of Education and Science, the National Academy of Sciences, and the National Academy of Medical Sciences. On the other hand, the average cost of one technology transfer agreement is growing.



Source: Information and analytical note on the use of funds received as a result of technology transfer, created at the expense of the state budget in 2022 and in the period 2014-2022

The following types of technology transfer agreements are distinguished: transfer of research and development results, transfer of patent rights (a document of ownership of an invention), transfer of know-how (technical information useful for the production of products), transfer of technology, licenses to use inventions, industrial designs, utility models (permission to use inventions).

Most of the transfers are not of finished technologies, but rather of research and development results - 76.12% or UAH 72.92 million. Patent rights accounted for the least amount of revenue (3.16% or UAH 3.03 million) and know-how and technology transfer agreements (6.96% or UAH 6.67 million). Revenues from licenses amounted to 13.83% or UAH 13.24 million.



Source: Information and Analytical Note on the Impact of Technology Transfer Activities on the Financial Condition of Enterprises, Institutions and Organizations in 2022

According to the audit of technologies and scientific and technical developments ready for implementation, among the 14 thousand results of scientific and technical activities, there are 2217 technologies and 8602 results of scientific and technical activities (RSTA) for which property rights have been registered. In terms of readiness, most of the R&D results correspond to IRL2-IRL5 / TRL2-TRL5.

Advanced research centers will be created on the basis of 4 universities in Lviv, Kharkiv, and Kyiv. There are also 18 educational programs in the field of artificial intelligence.

Among **the innovation centers**: 75 industrial (active: Bila Tserkva, Vinnytsia, Lviv), 40 scientific (active: KPI, KNU, Lviv Polytechnic, OPU), 16 technological (no active) and up to 10 innovation (active: Unit.City, Promprylad).

There are 70 registered **business** incubators in Ukraine, of which up to 10 are operating (YEP, Ukrainian Future, 1991 Open Data Incubator). There is also an insufficient number of accelerators and venture capital funds: only 12 **accelerators** are listed on the Ukrainian Tech Ecosystem Overview platform. Among the well-known **venture** capital **funds** are SMRK, Horizon Capital, U.Ventures, TA Ventures, Flyer One Ventures, and N1 Investment Fund. There are also **startup schools** in 24 universities based on the Sikorsky Challenge, and in Lviv there are startup schools from Lviv Tech Startup School, Startup Depot

There are about 1,500 active **startups** with a total value of €23.3 billion. Since 2017, this figure has increased 9 times. Also, more than 600 startups were founded in Ukraine or by Ukrainian teams.

In 2021, the number of innovation-active **enterprises** decreased by 59% to 329, and the share of enterprises that implemented innovations tripled to 5.8%. The leaders include pharmaceutical companies, computer and vehicle manufacturers.

Source: Roadmap for harnessing science, technology and innovation to achieve the Sustainable Development Goals

During 2010-2021, the share of industrial expenditures on innovation in GDP decreased from 0.75% in 2010 to 0.17% in 2021.

The cluster movement brings together 120 organizations that cooperate with each other in a particular area and territory for the purpose of economic development. The most developed are IT clusters: Kyiv, Kharkiv, Lviv, Dnipro, and Odesa. After the start of the full-scale invasion, the Brave1 defense cluster emerged, bringing together security and defense forces, the government, investors, and charitable foundations to develop defense technologies.

The network of **Technology and Innovation Support Centers** (TISCs) includes 15 regional offices, and entrepreneur support centers Diia.Business in 12 cities. Technology transfer offices operate in Odesa, Kyiv, and Kharkiv, though only Odesa has a full-fledged one. There are also 2 Industry 4.0 Centers (KPI, KhAI) and 3 digital innovation hubs (KPI, KAU, LP).

Since 2010, there has been a downward trend in the knowledge intensity of the economy and the number of researchers. In 2022, the ratio of research and development (R&D) expenditures to GDP was 0.33%, which is half as much as in 2013. Between 2010 and 2022, the number of researchers decreased by 74% to 35,000. Despite the large number of people with higher education, Ukraine's labor productivity is 25% of the OECD level. Since 2022, Russian military aggression has damaged 1443 buildings

of scientific institutions, and the total cost of restoring the state scientific infrastructure is estimated at USD 1.26 billion.

Source: Scientific and Technical Activities in Ukraine in 2022

A positive trend is Ukraine's integration into the European research and innovation space: joining the Horizon Europe and Digital Europe programs, opening the EIT hub in Kyiv, and launching the EIC Seeds of Bravery project. At the end of 2023, the national selection process for the creation of European Digital Innovation Hubs began.

Formats of cooperation between business, science and education

Cooperation in the field of research and development (R&D)	Cooperation includes joint R&D activities, contract research, R&D consulting, innovation cooperation, informal and personal networks, joint publications, joint supervision of scientific works (bachelor's, master's, PhD), student projects in cooperation with business.
Academic mobility	Temporary or permanent transfer of faculty or researchers from HEIs to businesses, as well as employees, managers and business researchers to universities.
Student mobility	Temporary or permanent transfer of students from universities to businesses.
Commercialization research and development results	Commercialization of research and development results with business through the creation of spin-off companies, disclosure of inventions, patenting or licensing.
Development and implementation of training programs	This includes the development of course programs, modules, specialties, and guest lectures as part of bachelor's programs,

	Master's and PhD programs or through further professional education.
Lifelong learning	Providing education for adults.
Entrepreneurship	Creation of new companies and development of an innovative culture within higher education institutions.
Governance	Cooperation at the level of university and company management. It includes Involvement of business leaders in decision-making in HEIs or on HEI boards, as well as involvement at the level of faculty leadership. Also includes academics who participate in decision-making or sit on boards directors of companies.

Source:

According to a business survey in 2023, 36.8% of companies interacted with universities in the form of student internships, 10% had joint initiatives, and 0.7% acquired licenses to use patents.

The survey of young scientists showed a similar trend: 61.2% of respondents had no experience of cooperation with business, and 78.1% had no experience of entrepreneurship. The reasons include lack of financial resources, poor infrastructure, and low motivation. 89.3% have no experience in commercialization, and 4.8% have experience in the field of education. Also, 71% of respondents do not have any patents.

Deep tech

A number of deep tech areas are being developed in Ukraine: artificial intelligence, machine learning, biotechnology, blockchain, robots, photonics, space, electronics, cybersecurity, quantum computing, nanotechnology, and green technologies. The most articulated topic is artificial intelligence.

In 2020, a concept for the development of artificial intelligence until 2030 was adopted, covering 9 sectors: education and science, cybersecurity, information security, defense, economy, public administration, legal regulation and justice

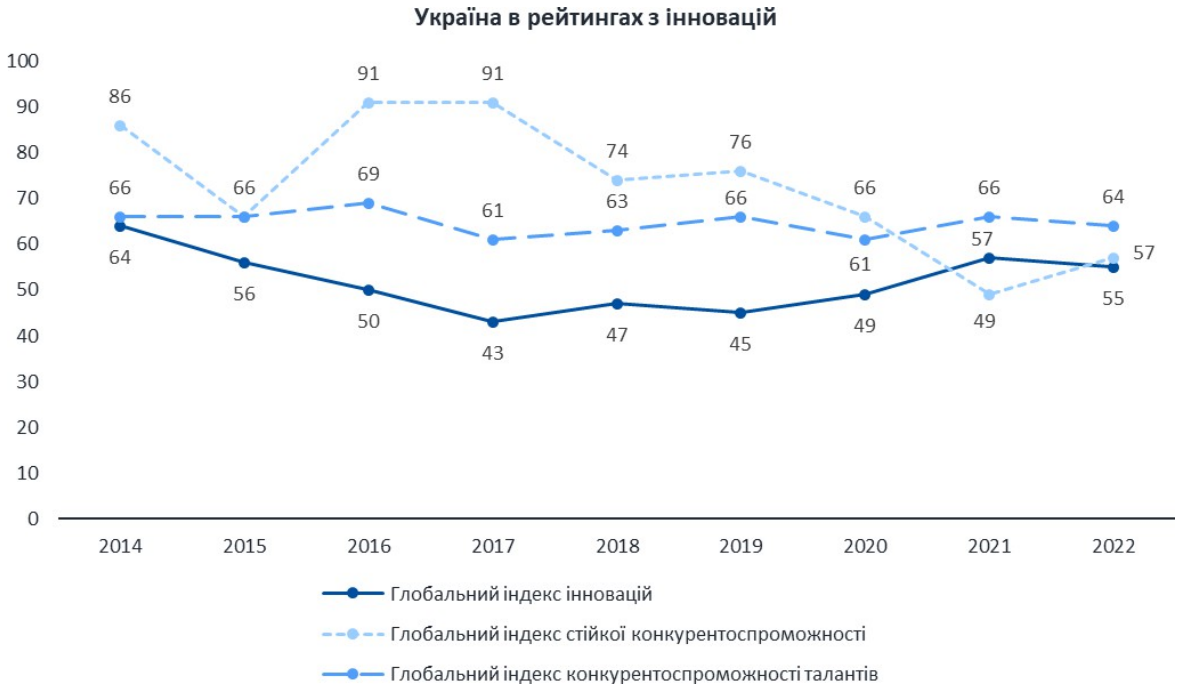
In 2023, the Ministry of Digital Transformation presented a roadmap for the regulation of artificial intelligence in Ukraine and a draft White Paper. This should help companies prepare for the adoption of the Ukrainian equivalent of the European Union's AI Act. AI is also one of the priorities in the new draft Strategy for the Development of Innovative Activities of Ukraine until 2023.

Since the start of the full-scale invasion, the drone manufacturing industry has been actively developing. The USF, together with the Army of Drones, has launched a program of rapid production and

commissioning (fast track). Drone manufacturers can also use the Diia.City mode. It is planned to produce 1 million drones by 2024.

Among the positive trends are specialized competitions and hackathons. In 2022, CfE held an acceleration program for deep tech startups. The European Council for Innovation's Seeds of Bravery project will support 200 deep tech startups with up to €60 thousand for each project. the total funding for the competition is €20 million. In addition, the Vacuum Deep Tech Acceleration will hold a hackathon "Innovations in the field of deep technologies" in March. The winners will take part in acceleration programs
"Science Intensive Innovation" and "Development and Renovation".

Ukraine in innovation rankings



Sources: The Global Talent Competitiveness Index 2023, Global Innovation Index 2023, The Global Sustainable Competitiveness Index 2023

The Global Innovation Index is an annual ranking of countries based on their potential and success in innovation published by the World Intellectual Property Organization.

The Global Sustainable Competitiveness Index is a ranking of countries' competitiveness based on 190 quantitative indicators obtained from international organizations.

The Global Talent Competitiveness Index is a comprehensive annual report that measures how countries and cities develop, attract and retain talent.

Ukraine ranks between 50 and 70 in global innovation rankings: 55 - Global Innovation Index, 57 - Global Sustainability Index.

competitiveness, 64 - Global Talent Competitiveness Index. With the exception of the Sustainable Competitiveness Index, Ukraine has moved up two positions in the rankings compared to 2021.

According to the GII, the country's greatest strengths are creative potential (number of trademarks and industrial designs by origin, creation of mobile applications), knowledge and technological potential (number of utility models by origin, software expenditures, exports of IT services), human capital (education expenditures), and business development (number of employees with higher education). Weaknesses include institutions, market development and infrastructure, and low productivity.

The GTCI has a similar trend: education and technology adoption are ranked high and regulatory mechanisms are ranked low. The situation with the GSCI is almost identical: natural, social and intellectual capital is high; effective resource management and good governance are low.

Ukraine's position in other indices:

- The European Innovation Index is 31% of the EU average. Strengths: employment, environmental sustainability; weaknesses: attractive research systems, intellectual property
- The index of readiness for advanced technologies ranks 58th. Strengths: skills, R&D; weaknesses: access to finance, state of the industry
- The global patent index ranks 47th.
- Human capital index - 63% out of 100%
- E-Governance Development Index - 46th place
- GovTech Maturity Index - 77% out of 100%
- Startup Ecosystem Index - 49th place

Draft Strategy of Innovation Activities of Ukraine until 2030

The Ministry of Digital Transformation has developed a new draft to replace the current Innovation Development Strategy. The document envisages an economic leap through innovative products, which should account for at least 15-20% of GDP. It is noteworthy that the current document was developed by the Ministry of Education and Science, while this project was developed by the Ministry of Digital Transformation.

Proposals of the Strategy:

- Establishment of the State Agency for Innovation
- Main areas of innovation activity: defense-tech, medtech, govtech, agritech, greentech, biotech, edtech, economy without borders, artificial intelligence, cybersecurity, virtual reality, semiconductors, smart cities
- Defense-tech projects: network of defense tech centers, creation of a qualified customer for military-technical innovations, creation of a developer of advanced defense technologies, loan program for the defense sector, interagency working group for policy improvement

- Medtech projects: local production of prostheses, production of products for the treatment of burns and wounds, application of immersive technologies for mental health
- Agritech projects: reaching 55%-65% of processed products in agricultural exports; use of automated harvesters; creation of a market for mine action; sustainable recreation of degraded and infertile agricultural land
- Projects in the field of semiconductors: the specialized law CHIPS Act UA, the first chip factory
- Cybersecurity projects: nationwide integrated
  an ecosystem for encouraging and supporting civilian participation in the country's cyber defenses
- Greentech projects: a competence center for the use of artificial intelligence for energy security, efficient dispatching, and the development of digital grids;
  production of power electronics and semiconductors; a digital program to prevent energy poverty and monetize subsidies; attracting R&D centers of the world's leading developers in the field of green technologies to Ukraine
- Biotech projects: biocluster, competence centers, biotech university
- Projects in the field of economy without borders: acceleration and incubation program; arbitration for dispute resolution; LinkedIn for gig workers
- Projects in the field of artificial intelligence: an international cluster for sharing experience and developing advanced AI solutions for government/local authorities; a system based on Big Data and AI for making informed management decisions; a sandbox for AI + WEB3 and other innovative industries
- Establishment of Center of Excellence for R&D and technology transfer in each priority sector
- Creating clusters using the Brave1 format
- Creating the Science.City mode
- Development of the Ukrainian investor
- Establishment of a fund within the national innovation agency

RESULTS OF IN-DEPTH INTERVIEWS WITH SCIENTISTS

In Ukraine, the formats of cooperation differ depending on whether it is a higher education institution or a research institution. Internships and practice, dual education and its elements, business involvement in the development and implementation of curricula, development of business incubators and accelerators, purchase of laboratory equipment are common in universities; to a lesser extent, cooperation in R&D and commercialization of R&D results are common. At the same time, scientific institutions place greater emphasis on research and development, contract research (including in the form of business contracts), R&D consulting, and patenting.

Legally, the relationship is formalized through agreements and memorandums of cooperation in science and education. A common practice is not to sign legal documents, i.e., cooperation is carried out directly with the scientist.

Barriers to business and science cooperation in the opinion of Ukrainian scientists

From the side of scientists	From the business side	Nationwide	Other
• Lack of resources • Teaching workload • The slowness of Ukrainian science • Lack of entrepreneurial education and culture • Insufficient science funding • Traveling abroad • Abandonment scientific institutions, outdated equipment • Long anti-academic campaign • State institutions are in a worse situation than businesses • Lack of innovative intermediaries (grant office, project office)	• Lack of understanding of when it will pay off business innovation • Lack of business interest in investing in science and lack of incentives • Insufficient quantity innovative business in Ukraine • Business in Ukraine does not consider universities as partners with whom you can do research • Short-term planning	• Legislative gaps (overregulation, intellectual property issues, technology transfer, attracting extra-budgetary funds) • Financial overregulation of state scientific institutions (high tax burden on scientists, public procurement, slow movement of accounts) • Lack of adaptation of control bodies to business processes	• Communication (difficult to achieve agreements, lack of information about each other's needs) • Interaction of business and science is not put on a stream • Lack of understanding that in the field of cooperation business and science need to move faster

	business		
● It all depends on the charisma and enthusiasm of the scientist		● The factor of war and destruction infrastructures	

Among the benefits of such cooperation, the scientists noted the practical application of knowledge, career growth and financial rewards, relevance of educational programs to business needs, and market connection. Among the disadvantages: the complexity of project administration.

Suggestions for solving barriers

- Changes in the work of controlling bodies
- Teaching scientists how to cooperate with business
- Holding special competitions for scientists and business
- Audit of scientific institutions
- Legislative changes (intellectual property issues, overregulation of the NPFU)
- Fiscal incentives for businesses to invest in research and development
- Create a separate Innovation Fund for entrepreneurs to invest in
- Reducing the teaching load of scientists
- Shared infrastructure and laboratories

- Introduction of a special regime for Science. City

Examples of cooperation:

- KNU has a cooperation agreement with Enamin. The company sponsors research, scholarships, and the purchase of reagents and equipment, including a laboratory at the Institute of High Technologies. Biopharma has also equipped two training laboratories at its facility.
- The highest level of cooperation at UCU is strategic partnership (Softserve, Elleks). This means that the company determines the research topics and allocates funds for them. The result of the cooperation is prototypes (hypothesis validation) and scientific publications.
  Other formats include teaching and curriculum development, mentoring, and scholarships.
- Establishment of higher education institutions. In 2020, Metinvest founded Metinvest Polytechnic, a non-state mining and metallurgical university, and Dobrobut Academy, a chain of medical clinics.
- In 2023, Sumy State University fulfilled 745 research contracts for the following scientific research, creation of scientific and technical products and provision of services in the field of scientific and scientific and technical activities (international agreements, international grants, government grants, business contracts). Among the preliminary
  projects implemented: a three-year contract worth $5 million, cooperation with defense companies Yuzhnoye Design Bureau and Luch Design Bureau

	Condition.	Suggestions for solving problems
Infrastructure	Mostly outdated equipment; insufficient financing; the possibility of acquiring a new equipment only at the expense of grants; the need for to update the centers of collective use of scientific equipment; availability of specialized laboratories, including isolated examples of prototyping and 3D printing centers, laboratories with artificial intelligence and machine learning. On the good side, 4 German-Ukrainian centers of excellence.	Integration into the European space and conglomeration with European research infrastructures; Increasing funding for infrastructure; creation of a map of the research infrastructures
Innovation centers and Intermediary organizations in technology transfer	Insufficient number of innovation centers, business incubators and accelerators, grant and project offices; few relevant specialists with a solid education; very slow progress	The need to create more intermediary organizations in technology transfer: transfer offices technologies and intellectual property, and innovation centers; development of an innovation ecosystem from school; creating platforms where scientists can share experiences.
The difficulty of popularizing scientific developments	The complexity of working with biomedical developments	The need to tell success stories, organize events and establish new contacts; understanding

		how to communicate your development
Commercialization process	A particular challenge technology transfer for certain industries (biotech); lack of powerful of patent departments; lack of understanding of intellectual property	Patenting inventions is important, but it is expensive, especially abroad
Research funding	Insufficient funding for research, but you can apply for grants (Ukrainian and international), to cooperate with business; "the state will never have enough money to to support so many scientists"	The need to develop a competitive culture of getting money

Opinions were divided on the adequacy of the number of scientists in the country. Everyone agreed that the number of scientists is decreasing, especially young scientists, and another problem is the aging of the average scientist. Ukraine has a lower number of scientists compared to European countries. Among the reasons for the decline are scientists: low salaries, lack of prestige. In some areas, there are enough scientists, but one expert (Nana Voitenko) believes that the total number of scientists in Ukraine should be lower.

Examples of innovative intermediaries:

- Research part of Sumy State University
- Innovation ecosystem of KAU: Laboratory of open innovation, innovation center, grant office, digital innovation hub, Academ.City science and technology park, technology transfer office, startup support office
- Sikorsky Challenge Innovation Ecosystem: Sikorsky Challenge Startup School, Sikorsky Challenge Festival of Innovative Projects, and a business incubator "Sikorsky Challenge; Sikorsky Lab, an innovative technological environment; Intellectual Property Center; Sikorsky Challenge Venture Fund.

- UCU's innovation ecosystem: Center for Entrepreneurship, CfE accelerator, Angel One venture fund
- Ecosystem of Lviv Polytechnic: Tech Startup School (training programs: Creative Spark, Startup Breakthrough, Technology of startup elaboration; R&D laboratories, prototyping lab), SID City Science Park (center of independent expertise and testing, incubation programs, Tech Acceleration program, AsolutionHub market place for startups, Tech Business School), industrial park

RESULTS OF IN-DEPTH BUSINESS INTERVIEWS

Main formats of business and science cooperation in Ukraine

Based on the results of the interviews, the main formats of business cooperation with scientists were identified:

1. **Joint research projects:** Business and science join forces to develop new technologies or products, often with the use of grants or special funding. This format of cooperation is typical for large businesses that already have a large partner network and established cooperation with universities or research institutions.
2. **R&D centers within companies:** Some businesses set up their own research centers or laboratories, involving scientists in the development of innovations. In such R&D centers, scientists are mostly hired on a full-time basis, as full involvement in the process is required. In addition, the secrecy of developments and NDAs oblige many scientists to work full time in the field of biotechnology and bioenergy.
3. **Internships and mentoring programs:** Students and young scientists get the opportunity to work on real projects under the guidance of experienced professionals in companies. Companies organize hackathons,
4. **Cooperation with universities:** Companies cooperate with higher education institutions to conduct joint research, develop courses, and fund research.

Involvement of scientists:
The process of involving scientists depends on the specific needs of the business and the specifics of the project. The main selection criteria include:

- **Professional knowledge** in a particular area.
- **Experience** with specific technologies or research methodologies.
- **Ability to innovate** and solve complex problems.
- **Flexibility** and willingness to learn.

Benefits for businesses:

1. **Product innovation and improvement:** Collaboration with scientists allows us to develop the latest solutions that can improve the company's products.
2. **Access to the latest research:** Companies get access to the latest scientific developments and research.
3. **Improving reputation:** Engaging with academia can have a positive impact on a company's image and social responsibility.

Cooperation between business and academia requires large investments in innovation, ranging from the latest technologies to the development of biotech startups. For example, Verge Genomics uses artificial intelligence to develop

drugs against incurable diseases by working closely with academic institutions to analyze genomes. This collaboration demonstrates the high integration of academic research into commercial projects.

Deusrobotics, on the other hand, specializes in developing robotic systems for automating warehouse operations, using artificial intelligence and machine learning research developed in its own research laboratory.

Another example is Esper Bionics, a company that develops innovative electronic prostheses that incorporate design and robotics, showing the importance of multidisciplinary research for practical applications.

These examples show that the formats of cooperation can be varied: from joint research projects and product development to the creation of joint R&D centers and laboratories. Such cooperation contributes to the introduction of innovations, the development of high-tech business and the competitiveness of the national economy.

The main barriers to cooperation between science and business in Ukraine

The biggest problems in cooperation with scientists are:

1. **Cultural and operational differences**. Entrepreneurs notice that academically trained scientists may not always be able to match the fast-paced, results-oriented culture of the business environment. This includes a perceived reluctance to commercialize research and a mismatch in the pace of project completion.
2. **Lack of professional skills**: There is a noticeable gap in practical, marketable skills among scientists and researchers, partly due to an education system that focuses more on theoretical knowledge than on practical application and industry needs.
3. **The problem of bureaucracy and efficiency**: Cooperation with state universities is complicated by the lack of effective mechanisms for operational cooperation, including sponsorship of specific groups or projects.
4. **Involve academic teams as separate business units**: academic teams should operate according to business principles to increase efficiency and competitiveness.
5. **Strategic planning of innovations**: Research and development requires long-term planning and investment. Backup projects and contingency planning are also key to ensuring the sustainability and flexibility of innovation processes.
6. **Lack of systemic state support for** innovation and research.
7. **Insufficient legal support** for the commercialization of scientific developments.
8. **Low level of trust** and understanding between scientists and business.

9. **Limited opportunities** for private sector **funding of research**.

Potential solutions to the problems of business and science cooperation in Ukraine

To overcome the barriers to cooperation between business and science and to stimulate such interaction in Ukraine, the following ways can be suggested:

1. **Creation of joint innovation platforms**: Establishing platforms for cooperation where business and academia can jointly develop and implement new technologies. This will combine the resources and expertise of both parties.
2. **Access to European funding** and grants: Increase the amount of funding from the state and the private sector to support research and development that has the potential for commercialization. Introduce grant programs for startups working in collaboration with scientists.
3. **Supporting the startup ecosystem**: Developing infrastructure for startups that would provide them with access to laboratories, equipment, and mentoring from experienced scientists and businesspeople.
4. **Legislative initiatives**: Improving legislation to protect intellectual property, facilitate technology licensing, and simplify bureaucratic procedures for research and development projects.
5. **Education and retraining**: Organizing programs to improve the skills of scientists in the field of business and commercialization of innovations, as well as training businessmen in the basics of scientific research.
6. **Formation of commercial thinking** in the academic environment: Enhancing the entrepreneurial culture: Academic institutions and researchers should be encouraged to adopt more entrepreneurial approaches to research. This includes organizing trainings on entrepreneurship, developing skills in commercializing ideas, and implementing a mentoring program with experienced business people.
7. Another important process is the **integration of practical projects** into curricula: Universities should include projects implemented jointly with industrial partners in their programs to provide students and young scientists with practical experience and an understanding of real business challenges.
8. **Financial initiatives and joint patents**: Economic incentives can encourage deeper and more productive collaboration. It is important to develop models for rewarding joint achievements, including shares in patents and commercial benefits from projects.

The main insights of successful cooperation between business and science

1. **The importance of personality and values**: In addition to professional skills, personal values and motivation of scientists play a significant role in collaboration. Companies.

ask why scientists want to work with them, pointing out the importance of alignment of vision and values.

2. **Evaluation of the success of cooperation**: the success of cooperation with scientists is often measured by the percentage of task completion, with large companies striving for high rates (80% task completion) to consider the partnership successful.
3. **Long-term planning and backup projects**. Long-term planning is vital for deep-tech projects, often extending beyond four to five years to make financial and practical sense. Companies look for backup projects to support their primary goals, recognizing the inherent uncertainty in scientific research.
4. Implementation of these approaches requires **coordination of efforts between the government, the scientific community, and the private sector**. Openness to change and readiness for long-term investment in the country's innovative development are also important.
5. **Strengthening the institutional framework** for cooperation between science and business, including the creation of effective mechanisms for financing and commercialization of scientific research. This requires simplifying the procedure for establishing cooperation between business and universities.
6. **Improving legislation to simplify patenting** and intellectual property protection.
7. Develop **mentoring and internship programs** for scientists in business structures.
8. **Increase the number of joint research and educational projects** through universities and research institutions.

CASES OF SUCCESSFUL COOPERATION BETWEEN SCIENCE AND BUSINESS IN UKRAINE

ECOSOFT

Ecosoft is a company that has been engaged in water treatment in Ukraine for more than 30 years and creates high-quality water treatment equipment for home, commercial and industrial use.

"The company is already thirty years old, so we are not afraid of the duration of research."

History:

- ➢ 1991 - the company was founded, there were 6 water treatment researchers
- ➢ 1996 - establishment of the Research Center and start of cooperation with Dow Chemical, Calgon Carbon, Clack Corporation
- ➢ 2010 - certification according to the international standard ISO 9001:2008
- ➢ 2015 - a new production facility with an area of more than 3000 square meters.
- ➢ 2018 - the company joins BWT (Best Water Technology)
- ➢ 2021 - 50 Ecosoft Clean Water Center branded stores and a network of 1300 water vending machines

"Our founder is a scientist, and she understands that research takes a long time, quality research takes a long time, and a quality product takes a long time."

That's why Ecosoft has a balance of projects: long-term ones, and simple and quick ones. And this balance ensures a constant presence on the market with a high-quality finished product, as well as an understanding that in a certain time, a new product like this will be brought to the market. We will always have a great quality product in our portfolio.

The company was founded by a scientist, so ***Ecosoft was first about science and then about business***. The industry is such that it cannot create new products without science, so for Ecosoft, almost any product is science-intensive. Therefore, cooperation with scientists is a key aspect of the company's success.

"We compare what we are doing with the world around us because it is always a long process and it is important for us to see that we are still moving in the right direction in this long process."

In addition, ***innovations are introduced*** as a result of market analysis and what is happening in the market. If there is a request, Ecosoft starts development in this direction. Another case of starting research is when the company has an idea for a breakthrough revolutionary product that is not yet on the market and the consumer is not yet aware of this possibility. But with a high probability, employees are confident that he or she will

If the customer likes this product and will use it, it will bring value to them. And in such cases, research begins, studying how this product works, what is its efficiency, what is the service life of its replaceable elements, and so on. After that, the technology is turned into a physical product.

Involvement in development. At any time, employees can be involved in development if they have ideas or experience that is needed, as the company has 24 specialists certified by the American Water Quality Association as water treatment specialists. Therefore, even if a person from outside R&D is involved in the research, it is always someone who knows water treatment.

Involvement of scientists and cooperation with universities:

1) *"We invest in education so that graduates will come to work for us*." We recently co-founded the Center for Modern Water Technologies at Igor Sikorsky Kyiv Polytechnic Institute. We provided them with equipment that is demonstrative, but real and working, and students can work on it and study the real world. And in this way we encourage them to stay in this field and then come to work for us.
2) Ordering research in the ion exchange laboratory at Igor Sikorsky Kyiv Polytechnic Institute. The biggest cooperation is with Igor Sikorsky Kyiv Polytechnic Institute.
3) The Center for Modern Water Technologies has a certification program called Water and Modern Water Technologies, where the company is a guest lecturer.
4) Prior to the full-scale invasion, students were doing their internships at Ecosoft. This is now suspended, but there are plans to resume it again over time.
5) Cooperation with WaterNet (a community of water treatment professionals and scientists). Participation in conferences, seminars, both as an invited speaker and as a lecturer.

Grants and financing. Grants are mainly used for the finished product, for example, to buy equipment for production. For development, we try to provide our own funds.

"Science must realize that it is also a business. When science understands that it is a business and can provide services and receive funds for them, we will reach a completely different level of cooperation."

Because, first, by cooperating with business, they will receive investments that they can invest in modern equipment. When they formulate their approach to work, that it is also a business, everything will sparkle with different colors. Plus, if they had a portfolio, it would be very convenient.

Solving potential problems of infrastructure shortages. The company has a separate laboratory based on Ecosoft. In addition, we cooperate with the KPI structure when we lack our own capabilities. If they don't have them, there is an established database of contacts with whom we can interact for certain analyzes if it is really necessary.

"Our value is that we get a new, unique, high-quality product, preferably at a low price."

Always be in the know. Ecosoft became a part of BWT and watches how they work. In addition, they try to regularly attend scientific conferences to understand what is happening in the world. And in order to communicate with the world, Ecosoft publishes articles. And when they want to start something, they turn to what has already been done in the scientific world (analysis of scientific literature) so as not to repeat some aspects and know what to start from. This is probably the kind of cooperation that we have been studying: conferences and monitoring.

Impact of the full-scale invasion. Apart from stopping work for a certain period, the full-scale intrusion had almost no impact on the company's operations.

"Because if we want to keep working, we have to keep working. And R&D is one of them, because the market outside Ukraine has not stopped, it is growing. If we stop, we will leave it completely. We are not interested in that. That's why we keep going."

A way to improve the experience of implementing innovations. Some kind of prototyping center with 3D printers, equipment for working with plastic, metal, and electronics development would be appropriate. Ecosoft always outsources prototypes, and we would like the developers to be able to do it with their own hands, to try and feel.

"To create one prototype, we need to understand what the components of this prototype should be. We need to identify them ourselves from different manufacturers, and then somehow connect them together. It would be much easier, more convenient, and faster if it was in one place with all the necessary equipment."