

UDC 330.34

DOI: 10.57111/econ/4.2023.08

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Analytical support for identification trends and problems in the development of interaction between stakeholders of education, science and business

■ **Abstract.** Ukraine's entry into the path of innovative economic development requires modernisation of the interaction between stakeholders of education, science and business to create a network of cooperation, taking into account the needs of stakeholders due to the situation in Ukraine as of 2023, focusing on changes in the world economy. The purpose of the article was to build a structural and logical scheme of analytical support for identifying trends and problems in the development of interaction between stakeholders in education, science and business. The methodology was based on the use of logical, systemic and comparative analysis. The analysis of budgetary funding for priority areas of innovation activity and sales of innovative products (services) and new technologies by budgetary funds managers showed no trends and priorities for the development of technology transfer and other intellectual property rights carried out by universities, research institutions, enterprises and organisations. The generalisation of changes and prospects of legislative regulation of support for educational, innovative, scientific and technical activities of business focuses on post-war reconstruction, which involves increasing confidence in the educational, scientific and expert activities of institutions for their effective functioning and increasing the volume of research funding. The analysis of the integration aspects of the research and innovation system into the European Research Area and support from international scientific organisations and foreign governments proved the support received from many national scientific communities and international scientific organisations in the creation of the portal for international scientific and technical cooperation and the international consortium for infrastructure and research. The practical significance of the study lies in the proposed directions for improving interaction with business of educational and scientific institutions in the process of implementing innovations separately by stages of interaction with stakeholders (attraction, financing and implementation)

■ **Keywords:** innovation activity; technology transfer; international support; legislative regulation; university; enterprise

Article's History: Received: 20.06.2023; Revised: 07.09.2023; Accepted: 29.11.2023

Suggested Citation:

Siskos, E., Darvidou, K., & Ostapenko, V. (2023). Analytical support for identification trends and problems in the development of interaction between stakeholders of education, science and business. *Economics of Development*, 22(4), 8-22. doi: 10.57111/econ/4.2023.08.

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■ INTRODUCTION

The value of human capital is constantly growing. The development of Industry 4.0 involves training and development of innovation ecosystems, as well as new changes and prospects for cooperation with business (Education 4.0: Ukrainian sunrise, 2022). It is known that the overall effectiveness of the innovation process in a country is determined by the directions and structure of interaction between its participants (Resolution of the..., 2017). The main functional parts of the innovation system are the systems of science, education and business, and the specificity of their structures and functional qualities is a key aspect that determines the range of possible development paths. They are directly involved in the production and commercialization of innovations and knowledge, which makes it possible to use intellectual resources as a factor of economic development (at the macro level) and increase the value of business (at the micro level). The integration processes of business, science and education in Ukraine are manifested within formal and informal structures. However, these manifestations need to be improved and developed in the light of global challenges as well as appropriate government support. The interaction between stakeholders of business, science and education is an important factor in the development of the entire society.

This issue has been studied by various scholars, including N. Radko *et al.* (2023), who tested hypotheses about the role of stakeholders in the entrepreneurial performance of UK universities. The results demonstrate notable differences in the role that stakeholders play in entrepreneurial knowledge dissemination activities at universities, with effects differing between three types of universities. D.J. Wood *et al.* (2021) identified stakeholders, assessed impact and opportunities, illustrated the current state and trajectory of stakeholder identification using qualitative analysis and a quantitative network analysis tool. Researchers S. Du *et al.* (2021) evaluated the issues and prospects for promoting stakeholder involvement in the B2B (business-to-business) innovation process from a systemic and a dynamic process. According to the systemic perspective, the authors review multi-level stakeholder involvement platforms. The dynamic process involves the formation of temporal and relational links to involve both existing and new stakeholders throughout the innovation process. The review by A. Engez & L. Aarikka-Stenroos (2023) identified open issues and topics that require further research/expertise to develop artificial intelligence capabilities and integrate them into business/IT (information technology) strategies to improve various business value streams.

V. Jain *et al.* (2022) presented a narrative about the interaction of stakeholders with higher education in the digital economy. Interaction in the higher education ecosystem involves increasing digital scalability and the processes of humanization of society. O. Melnychenko *et al.* (2021) elaborated a model of interaction management in academic innovative research projects, which allows to specify sets of input and output parameters, constraints, regulated and underexploited factors in interaction processes and becomes the framework for formal and casual interaction management. I. Lebid *et al.* (2020) performed modelling of interaction management in academic

projects using the diagnosis of stakeholders involved in innovation. Stakeholder diagnostics was conducted using a matrix, which allowed the grouping of stakeholders in academic projects and the identification of barriers to effective interaction and the implementation of ethical and educational standards.

Most studies focus on the impact of education on entrepreneurial activity, limiting the scientific component which has a significant influence on innovation development. Legislative regulation is regarded as a separate element of interaction, rather than a prerequisite for the development of current prospects. When analysing stakeholder interaction, the authors focus on the unilateral influence of one stakeholder on another, rather than on the effects and results of their interaction. An integrated approach to analytical support for identifying the interaction of education, science and business stakeholders in order to identify problems and further prospects requires attention. Therefore, the purpose of the study was to construct a structural and logical framework of analytical support for identifying trends and problems in the development of interaction between stakeholders of education, science and business.

■ MATERIALS AND METHODS

Methods of analysis and synthesis as well as logical, system-structural analysis were used, which allowed to analyse the budget financing of priority areas of innovation activity, to determine the directions and principles of regulation of Ukrainian legislation on support of educational, innovative and scientific and technical activities, to highlight the forms and characteristics of partnership for the development of education, science and innovation in Ukraine with world organisations and foreign governments and to identify the trends and problems of interaction between stakeholders of education, science and innovation in Ukraine.

The main research methods used in writing the article were: a comparative analysis of scientific publications and studies on stakeholder engagement, generalisation and visualisation of monitoring the use of funds received as a result of technology transfer created at the expense of the state budget, analysis of the integration aspects of the research and innovation system into the European Research Area and support from international scientific organisations and foreign governments. The trends in the activities of businesses, universities or research institutions in the field of technology transfer and academic entrepreneurship in terms of budget allocations were analysed using the decomposition method and comparative analysis. SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis matrices were used to determine the experience of business cooperation with educational and research institutions. The methodology of sustainable development concepts and stakeholder approach was applied to formalise areas for strengthening the interaction of education, science and business stakeholders. The theory of complex systems is applied to understand, model and analyse the mechanisms, characteristics and complexity of a system as well as the emergence and consequences of problems. System analysis is used to

extract, categorise, classify and forecast various aspects and levels of interaction between education, science and business stakeholders.

Literary sources related to the research topic and official reports of ministries and agencies were analysed. In the framework of the analysis, various data sources were reviewed and classified. Classical analytics provided opportunities for data analysis as well as for creating and optimising models, recognising trends and anomalies in economic systems. Information on funding for innovation activities in 2021 in the priority areas of the sectoral level was provided by the three main spending units: MES (The Ministry of Education and Science), NAS (National Academy of Sciences), and NAAS (National Academy of Agrarian Sciences). Since 2022, there has been no statistical data available, due to the difficulty of collecting information on some regions of Ukraine which are under occupation.

■ RESULTS AND DISCUSSION

An important task of science and technology policy is to overcome the disintegration of science and real production. The state policy should be aimed at creating reproductive mechanisms of scientific research based on specific requests of practice. Innovative structures (innovative companies, business incubators, innovation clusters, etc.) that can connect research organizations (or their subdivisions) and specific structures of the production sector are recognized as effective tools for transforming scientific results into real products. As a result, the manufacturing sector gets access to modern knowledge, and educational and research institutions get access to material resources and expanded research programs. Conditions are being created for mutually beneficial investment relations between business structures and educational and research institutions, which is showed in Table 1.

Table 1. Implementation of innovative products (services).
Creation, using and transfer of new technologies by budget funds managers

Period			2014	2015	2016	2017	2018	2019	2020	2021
The number of enterprises that implemented innovative products (services), units	NAS	-	-	146	34	-	10	2	4	
	MES	-	-	185	314	-	83	112	201	
	NAAS	-	-	91	111	-	219	219	219	
including small enterprises	MES	-	-	7	2	-	0	2	0	
	NAS	-	-	16	151	-	15	33	45	
The volume of sales of innovative products (services) sold by the priority direction, thousand UAH	NAS	-	-	96410	13149	-	12445	2742	14259	
	MES	-	-	26686	29681	-	15597	26445	72625	
	NAAS	-	-	94328	119023	-	152963	170100	188036	
Number of new technologies	created	NAS	77	0	82	48	0	78	4	8
		MES	169	118	94	103	77	48	82	106
		NAAS	0	74	0	714	613	532	576	294
		NAMS	45	47	22	2	2	7	3	7
	used	NAS	27	0	22	3	0	11	0	3
		MES	91	48	51	36	8	1	47	41
		NAMS	45	0	16	2	0	0	3	4
	transferred	NAS	23	0	31	26	0	35	3	4
		MES	80	50	26	73	36	39	71	64
		NAAS	537	957	815	714	613	532	576	294
	Revenues from the transfer of new technologies, thousand UAH	NAS	4175	0	7546	6595	0	8834	0	4859
		MES	11102	9224	3029	5940	2903	4289	6609	8135
NAAS		18758	27962	29884	119023	147263	152963	170100	188036	

Note: “–” no data available; NAMS – National Academy of Medical Sciences

Source: generalized by the authors on the basis of Information and analytical note on the impact of technology transfer activities on the financial condition of enterprises, institutions and organisations in 2021 (2022)

According to Table 1, the transfer of technologies and other intellectual property rights was carried out by universities, institutions, enterprises and organizations subordinated to NAS, NAAS, MES and others, reported on the transfer of technologies performed for budgetary funds. Since 2020, amendments have been made to the Resolution of the Cabinet of Ministers of Ukraine No. 300 “Procedure and Directions for the Use of Funds Received as a Result of Technology Transfer, Created at the Expense of the State Budget” (2013), to monitor the amount of funds used to pay persons transferring technologies and/or their components in order to ensure effective monitoring of the payment of remuneration by enterprises, institutions, organizations to the authors of technologies and/or their components and

persons transferring them; updating the directions of use of funds received as a result of technology transfer.

During 2014-2019, the dynamics of increasing the amount of funds used to pay technology authors was observed, but the spread of COVID-19 in Ukraine and the world obviously had a significant impact on this component of the use of funds received under technology transfer agreements (Information and analytical note..., 2022). During the period of quarantine restrictions (2020 and 2021), scientific institutions and universities mainly sold not finished technologies, but the results of research and development, which have a smaller share of funds intended for remuneration to the authors of technologies and/or their components in their cost (Fig. 1).

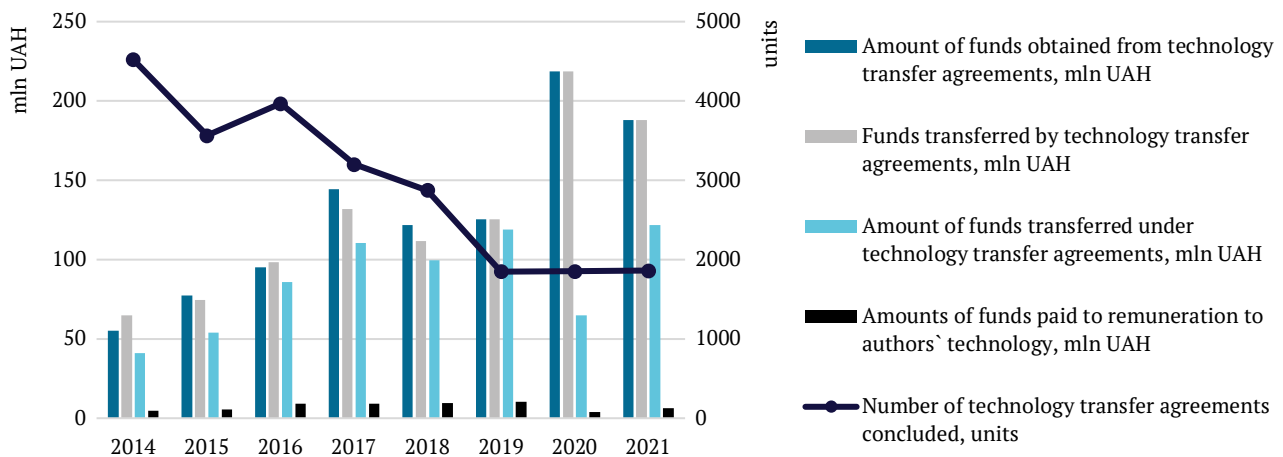


Figure 1. Using the funds obtained as a result of technology transfer at the expense of the state budget

Source: developed by the authors based on Information and analytical note on the impact of technology transfer activities on the financial condition of enterprises, institutions and organisations in 2021 (2022)

The government has approved a priority action plan for 2021, according to which the tasks in the field of interaction between science and innovation are to enable Ukrainian scientists and innovators to participate in the competitions of the European Union's Horizon Europe research and innovation framework program; creation of effective research infrastructures to ensure access of scientists to modern equipment; improving mechanisms and tools for realizing the right of participants in the educational process and researchers to academic mobility; development of a new system of priority areas for the development of science and innovation activities focused on achieving sustainable development goals; development of digital services for scientific, technical and innovative activities (Order of the Cabinet of Ministers..., 2021). Support for educational, innovative, scientific and technical activities involves two areas of their interaction "Science and innovation" and "Education and science", which are based on Key achievements in science and innovation 2020-2022 (2022).

In the direction of "Science and Innovation", measures were taken to create conditions for scientific and scientific and technical activities. The legislative regulation of the development of scientific and innovative infrastructure provided for the revitalization of activities and the development of scientific parks, targeted programs for the development of research infrastructure in Ukraine until 2026 and the stimulation of innovative activities of budget institutions (Order of the Cabinet of Ministers..., 2021). Support for young scientists and financing of scientific projects have also been implemented, namely, the creation of conditions for the employment and career growth of scientists. Integration into the European research space is planned, which involves the restoration and modernization of the destroyed scientific infrastructure, the development of a network of innovative infrastructure, and the approval of the State target program for the development of scientific infrastructure in Ukraine for the period until 2026 (Order of the Cabinet of Ministers..., 2021).

In the "Education and Science" direction, measures for developing accessible education and creating conditions for open science were taken, the Roadmap for the integration of the research and innovation system into the

European Research Area was approved, a number of technical and official negotiations were held, regarding Ukraine's participation in the EU Framework Program with research and innovation in Horizon Europe and the Euroatom complementary program for research and training (Horizon 2020..., n.d.). Further development involves the harmonization of educational and scientific legislation and state policy of Ukraine with the EU, in particular, the analysis of the implementation of the Roadmap for the integration of the scientific and innovative system into the European research space and the creation of infrastructure support for the participation of Ukrainian organizations in the Horizon Europe program. The National Open Science Plan for 2025 provides for the implementation of measures and projects submitted for competitive selection of scientific, scientific and technical works and projects financed by the EU external aid instrument (Decree of the Cabinet..., 2022).

The Order of the Cabinet of Ministers of Ukraine No. 286-p "On Approval of the Strategy for the Development of Higher Education in Ukraine for 2022-2032" (2022) outlines the major goals of the education system nowadays, including the main aspects of the national economy and community, and the basic parameters to be developed by 2032. Taking into account the situation in 2022-2023, the tasks and implementation measures need to be adjusted, but the strategic goals and key objectives remain unchanged. The strategic goals of the strategy relate to improving the quality and internationalization of higher education, the attractiveness of universities for study and academic career, as well as increasing the trust of citizens, the state and business in the educational, scientific and innovative activities of universities. The Law of Ukraine No. 2299-IX "On Termination of the Agreement between the Government of Ukraine and the Government of the Russian Federation on Scientific and Technical Cooperation" (2022) provides for the complete termination of cooperation between ministries of education, research institutions, scientific organizations and societies, universities and enterprises, etc. The draft of Recovery plan: Education and science (2022) was prepared, which contains seven main goals and a number of tasks and measures to achieve them. The plan correlates with the higher education development strategy for

2022-2032 (Order of the Cabinet of Ministers..., 2022). The Ministry of Education and Science developed the Education 4.0: Ukrainian Sunrise (2022) program, which is grounded on the basic concepts of the renewal agenda and focuses on developing an education system envisaging adaptation of Ukrainian and European educational systems and corresponding to the challenges of human resources in Industry 4.0 (Gorodnichenko *et al.*, 2022).

In the field of professional higher education and science, the program provides for several goals of their implementation, such as focusing on post-war reconstruction, increasing trust in the teaching, academic and experiential activities of universities and developing a comprehensive network and innovative university infrastructure, which involves raising funds through public-private partnerships, private capital and business, as well as international assistance; sufficient funding of the higher education and science system for its effective functioning and increasing the amount of funds for research and creation of innova-

tion parks through co-financing from various sources, including business. In the direction of integration into the European educational and scientific space, harmonization of educational and scientific legislation and state policy of Ukraine with the EU is envisaged as further bringing internal systems of quality assurance in higher education in line with Environmental, Social, and Governance requirements, establishing a domestic platform for global research and technology partnerships and an overseas network of infrastructure and R&D (Research & Development) facilities.

The challenges encountered by Ukraine make it possible to build a new system of relations between science and society, to increase its relevance in scientific and technological progress, innovation, and strengthening the country's defence capabilities. A special communication platform Science2Business (n.d.) became an innovative tool for finding partners, executing and implementing scientific, research and innovation projects, and sharing the existing research and innovation infrastructure (Table 2).

Table 2. International projects and resources for cooperation between education, science and business stakeholders

Resource	Science2Business	National portal of international scientific and technical cooperation	Technology and innovation support centre (TISC)
Essence	According to the order of the Federal Ministry for Economic Cooperation and Development (BMZ), the platform "Advisory Fund for Support of the EU-Ukraine Association" was created within the project in cooperation with the federal company Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	A resource for interaction among the potential network of National Contact Points, the Horizon Europe Office in Ukraine, participants and advisors from Ukraine in the relevant agencies engaged in the implementation of Horizon Europe and European Atomic Energy Community (Euratom) programs	The World Intellectual Property Organization (WIPO) Global Program has been ongoing in Ukraine since 2018 pursuant to the Memorandum of Understanding (MoU) with the Ministry of Economic Development and Trade (MEDT) of Ukraine for the establishment of Technology and Innovation Support Centres (TISC) in Ukraine
Structure	Almost 100 current scientific developments and about 30 proposals for cooperation in various fields are registered on the platform	Horizon Europe; Euratom; The LIFE (L'Instrument Financier pour l'Environnement) programme; COST (European Cooperation in Science and Technology)	The Central TISC operates on the basis of the State Enterprise "Ukrainian Institute of Intellectual Property" which coordinates the activities of the network of regional centres throughout Ukraine. 15 regional centres have been opened in Ukraine
Purpose	The development of the innovative economy in Ukraine and the creation of an attractive, competitive and high-quality business environment for investors, focused on the practical use of scientific research and development by scientists	Facilitating the upscaling of the implementation of Ukrainian programs and their participants in international cooperation programs by implementing options for communicating information with Ukrainian researchers, innovators and businesses about the European Union's Framework Program for Research and Innovation "Horizon Europe", and Euratom's Education and Research Activity, within other programs of international scientific and innovative cooperation	Providing applicants with convenient and comprehensive advice and ongoing support regarding national and overseas intellectual property rights, while promoting intellectual property (IP) enforcement among SMEs, start-ups, inventors and developers. The range of competencies of the TIC includes all aspects of the purchase, management and enforcing of intellectual property, related problems encountered by applicants. The Intellectual Property Centre's training activities are focused on increasing knowledge of intellectual property protection, promoting a public understanding of the IP rights, and deepening interaction with stakeholders in Ukraine's innovation and talent generation

Table 2. Continued

Resource	Science2Business	National portal of international scientific and technical cooperation	Technology and innovation support centre (TISC)
Activities	The presentation took place on October 30, 2021, during the two-day Science2Business StartupBootcamp event for scientists, start-ups and early-stage entrepreneurs in the field of knowledge-intensive innovations and technologies	Portal events; National Contact Points (NCPs) events; Events of representatives and experts	The roundtable is an event of the project “Strengthening public participation in the creation and implementation of Ukraine’s digital agenda and harmonization of digital markets with the EU and EaP (Eastern Partnership) countries”, implemented by the NGO (non-governmental organization) “Centre for Innovation Development”, funded by the European Union and the International Renaissance Foundation within the framework of the Civic Synergy Project under the auspices of the Ukrainian side of the EU-Ukraine Civil Society Platform and the Ukrainian National Platform of the Eastern Partnership Civil Society Forum

Source: compiled by the authors based on Technology and innovation support center (n.d.), National portal of international scientific and technical cooperation (n.d.), Science2Business (n.d.)

Starting from February 24, 2022, Ukraine has been receiving support for education, science and innovation from international organizations, governments and the EU. The government of Ukraine has prepared letters to international partners calling for the termination of cooperation with the Russian federation and Belarus, the deprivation of Russian and Belarusian institutions of access to electronic databases of scientific information and the exclusion of Russian and Belarusian institutions from international university rankings (Support for education and

science..., 2023). Communication was conducted with representatives of large publishers of scientific literature (Elsevier, John Wiley & Sons, Taylor & Francis, Emerald, Sage Publications, Oxford University Press, Cambridge University Press) to provide Ukrainian scientists with access to electronic resources of scientific information (journals, books, databases, etc.). From the very beginning of the full-scale war, Ukrainian science began to receive tangible moral and financial support from many national scientific communities and international scientific organizations (Table 3).

Table 3. Partners in the development of education and science in Ukraine and areas of their support

Organization	Directions of support
Clarivate	Free webinars for scientists in Ukrainian on scientometrics and bibliometrics, which addressed the peculiarities of publishing the results of scientific activities of scientists in publications indexed by the Web of Science database, the possibility of using Web of Science and platform tools
Zoom	Providing free licenses to educational institutions and the Ministry of Education and Science. Three free licenses for up to 1000 participants were obtained for use by the Ministry of Education and Science. A preliminary agreement was reached on the free provision of about 1,500 licenses for vocational (vocational and technical), professional pre-university, and universities to ensure the continuity of the educational process, as well as 20 licenses for general secondary education institutions that provide training for a large number of students under martial law
Microsoft Google	Providing infrastructure support for Ukrainian educational institutions, as well as integrating the All-Ukrainian Online School with Google Workspace for Education
International Bank for Reconstruction and Development	Support for the modernization of the electronic examination system and support for the introduction of distance learning for universities
OECD (Organisation for Economic Co-operation and Development)	Support for education as the development of the All-Ukrainian School Online
Ministry of Education of Slovakia	Communication and popularization of the All-Ukrainian School Online and other educational opportunities for Ukrainian children abroad
UNICEF (United Nations Children’s Fund)	Cooperation to support evacuated students and teachers. Ukraine took part in and presented its position at the British Educational Training and Technology Show 2022, a global educational event in the field of educational technology; Current projects and areas for further cooperation were developed, including unlocking the multiplier mechanism of the Global Partnership for Education; Support for the continued implementation of the project of the Unified

Table 3. Continued

Organization	Directions of support
Estonian Academy of E-Governance	Interagency Information System for the recruitment of foreign students to universities and readiness to support the project on e-documents on education and e-exams. The technical details of cooperation with the EU4Digital project team are being worked out
UNESCO (United Nations Educational, Scientific and Cultural Organization)	Support for a number of educational needs in wartime, including providing evacuated students with computer equipment, creating e-content and prototype of an electronic system for the National Multidisciplinary Test
British higher education consulting company Cormack Consultancy Group with the support of Universities UK	In order to provide support to professional universities, restore them and overcome the consequences of the armed aggression of the Russian Federation against Ukraine, an online meeting "How to become part of the Twinning Initiative?" was held on April 15, 2022. This initiative was created to establish partnerships between universities in Ukraine, the UK, the US, and the EU, to find optimal ways to support Ukrainian universities and to create long-term strategic alliances of universities
EU	Cancelled the fees for Ukraine's participation in the Horizon Europe program to the amount of about €20 million; Launched separate competitions to support Ukrainian scientists and innovators within the Horizon Europe program, created support portals ERA4Ukraine and Horizon4Ukraine
Research4Life, Clarivate, Elsevier	Provided Ukrainian institutions with free access to scientific databases
Amazon Web Services	Provided \$10,000 in loans to all 7 teams participating in the Science & Business Start-up Hackathon
Cormack Consultancy Group	Conducted a course on writing and implementing grants for Ukrainian universities as part of the Initiative of Unity project

Source: compiled by the authors based on International support for education and science in Ukraine under martial law (2022)

A specific step in the structural and logical framework of analytical support for identification trends and problems in the development of interaction between stakeholders of education, science and business is the need to determine the readiness of the real sector of the economy to implement technologies developed by Ukrainian universities and research institutions and the necessary measures to intensify technology transfer activities, including possible changes in the allocation of funds to finance relevant areas of research, taking into account the challenges associated with the military aggression of the Russian Federation in Ukraine.

According to the letter of the Ministry of Education and Science to ensure participation in the survey "Activities of higher education institutions and research institutions on technology transfer and academic entrepreneurship" (General analysis of the survey..., 2022), information

was received from the following key budget spending units: NAS, NAAS, NAMS, the Ministry of Health, the Ministry of Agrarian Policy, the Ministry of Regional Development, the Ministry of Defence, the Ministry of Justice, the Ministry of Internal Affairs, the State Emergency Service (Fig. 2).

Regarding the experience of cooperation with Ukrainian research institutions, business noted cooperation with more than 37 research institutions of the National Academy of Sciences of Ukraine, research institutions of the National Agrarian and Medical Academies of Sciences of Ukraine, the Ukrainian Technological Academy, the State Research and Testing Centre of the Armed Forces of Ukraine, as well as a number of joint-stock companies engaged in research activities. Based on the Survey of business representatives on innovative activities and current R&D issues (2020), SWOT-analysis of the interaction between stakeholders of education, science and business was formed (Table 4).

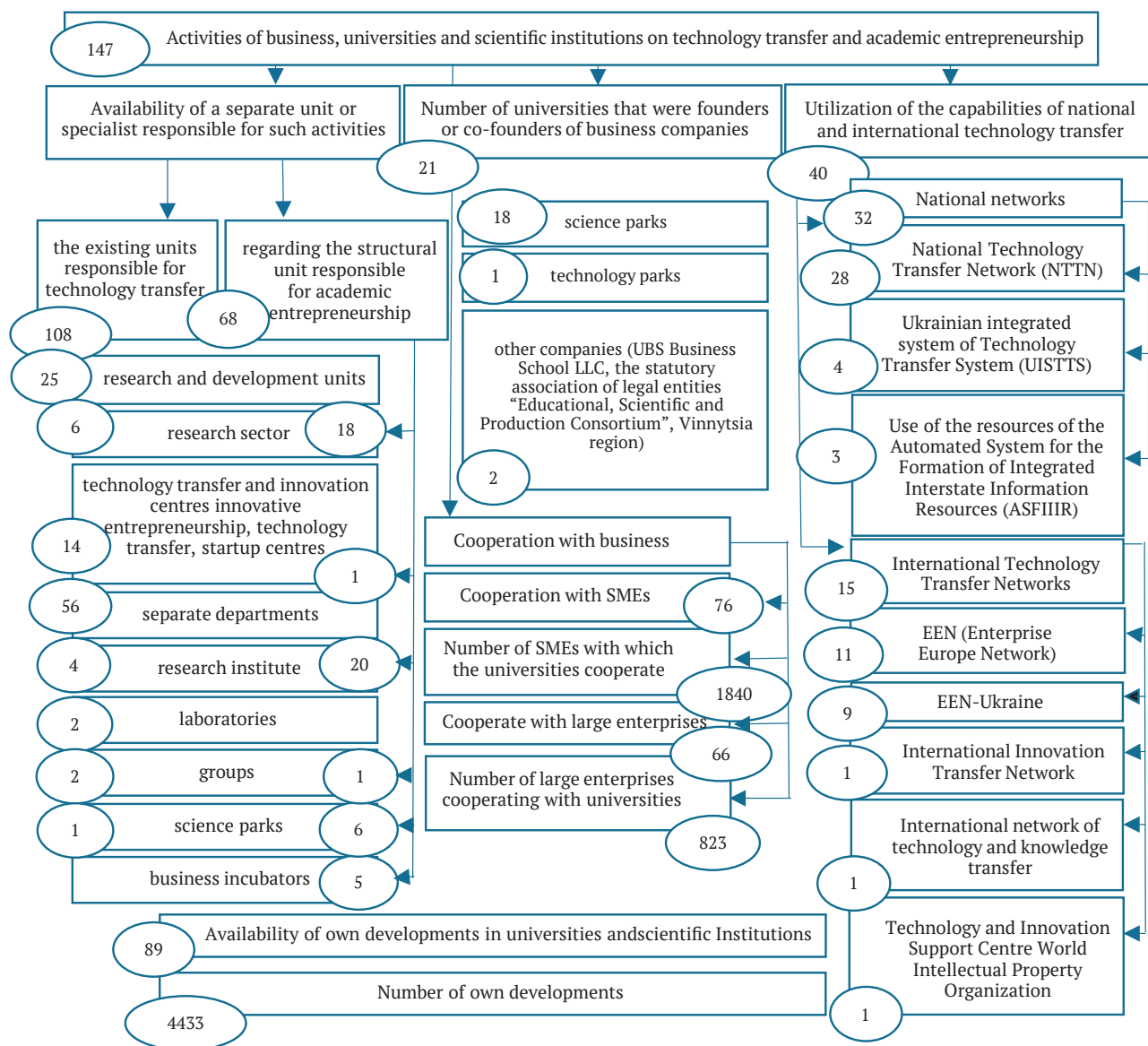


Figure 2. Activities of business, universities or scientific institutions on technology transfer and academic entrepreneurship

Source: developed by the authors based on General analysis of the survey "Activities of higher education institutions and research institutions on technology transfer and academic entrepreneurship" (2022)

Table 4. SWOT-analysis of the interaction between stakeholders of education, science and business

STRENGTHS	WEAKNESSES
<p>Strong knowledge of scientists in the basic and associated sectors; The possibility to engage outstanding specialists to work at the enterprise; Readiness to engage with scientists; High level of professionalism of representatives of the university; Academic capacity; Top-notch smart and innovative solutions; Professional development; The ability to obtain specialist and technological support; Strong cost-effectiveness of the suggested decisions; Stable demand for the proposed solutions; Motivation and efficiency of the research staff; The ability to introduce the latest technologies gradually; Dynamic testing of technologies in practice; Creative thinking of some students; Increasing the innovative component of developments; New forms of work; Territorial and mental affinity; Combining technological processes into one innovative technology; Joint analytical and marketing research; Availability of a single information space; Joint research and development; The ability to create developments on global level</p>	<p>Bureaucratized management system; Lack of modern materials and technical base for the implementation of developments; Disconnection of science from practice and market needs conservatism, for example, paperwork; Lack of co-financing from higher education institutions and/or research institutions; Organization of the cooperation process; Scientists are poorly focused on the final practical result; Scientists have too theoretical approach; Lack of state financial support for such cooperation; Lack of understanding of the structure of venture capital financing; Passivity of young people; Not all universities have a systematic implementation technology; Unwillingness to work in rural areas; Universities sometimes formally introduce the latest technologies; Insufficient research in narrow and rare areas; Low ethics of some employees; Inexperience; Lack of highly qualified personnel; Formal approach to cooperation; Inconvenient geographical location; High cost; Inability of universities to cooperate “to order”</p>
OPPORTUNITIES	THREATS
<p>There was no need; Low level of qualification of scientific staff; Lack of communication from universities and/or scientific institutions; Lack of information from universities and/or scientific institutions about their developments; Bureaucratization of the cooperation process and staff bias; Universities and/or scientific institutions do not create the required product; Lack of transparency regarding cooperation; Lack of a separate department at universities that provides information and defines the terms of cooperation; Difficulty in establishing the cooperation process; Non-competitive price of development; Stereotypes related to the quality of education in Ukraine; Long duration of the process; Lack of a unified sectoral approach to working with innovations</p>	<p>Difficulties in obtaining state financial support for innovation activities; Lack of information about state institutions that provide support for innovation activities; Lack of information on the types of state support for innovation activities; Lack/insufficient level of training of personnel in the required specialty; Tax burden; Obtaining permits and licenses; Administrative restrictions; Environmental restrictions; Difficulties arising during the company registration procedure, in particular, communication with registrars; Insufficient level of innovation culture of the public in general; Insufficient level of development of companies in Ukraine; Financial constraints; Lack of incentives at the state level for innovative activities; The need to increase information, moral and financial support for innovative business in Ukraine</p>

Source: developed by the authors based on Survey of business representatives on innovative activities and current R&D issues (2020)

The directions of integration of scientific, educational and business activities are defined in accordance with the stages of their interaction, as involvement, financing and implementation are formed in accordance with the needs of business representatives (Fig. 3).

International growth is expanding the value of education and science and enhancing the standards for R&D services and knowledge transfer. The Ukrainian society's European and global integration has encouraged deep

structural changes in the educational and research sector, which has contributed to a reduction in public funding and a shift to private financial support.

According to Figure 4, the development of relations with stakeholders involves the formation of a system of strategic partnership between the university and academic science, industry and business, involves the involvement of universities and scientific organizations in solving the problems of innovative development of

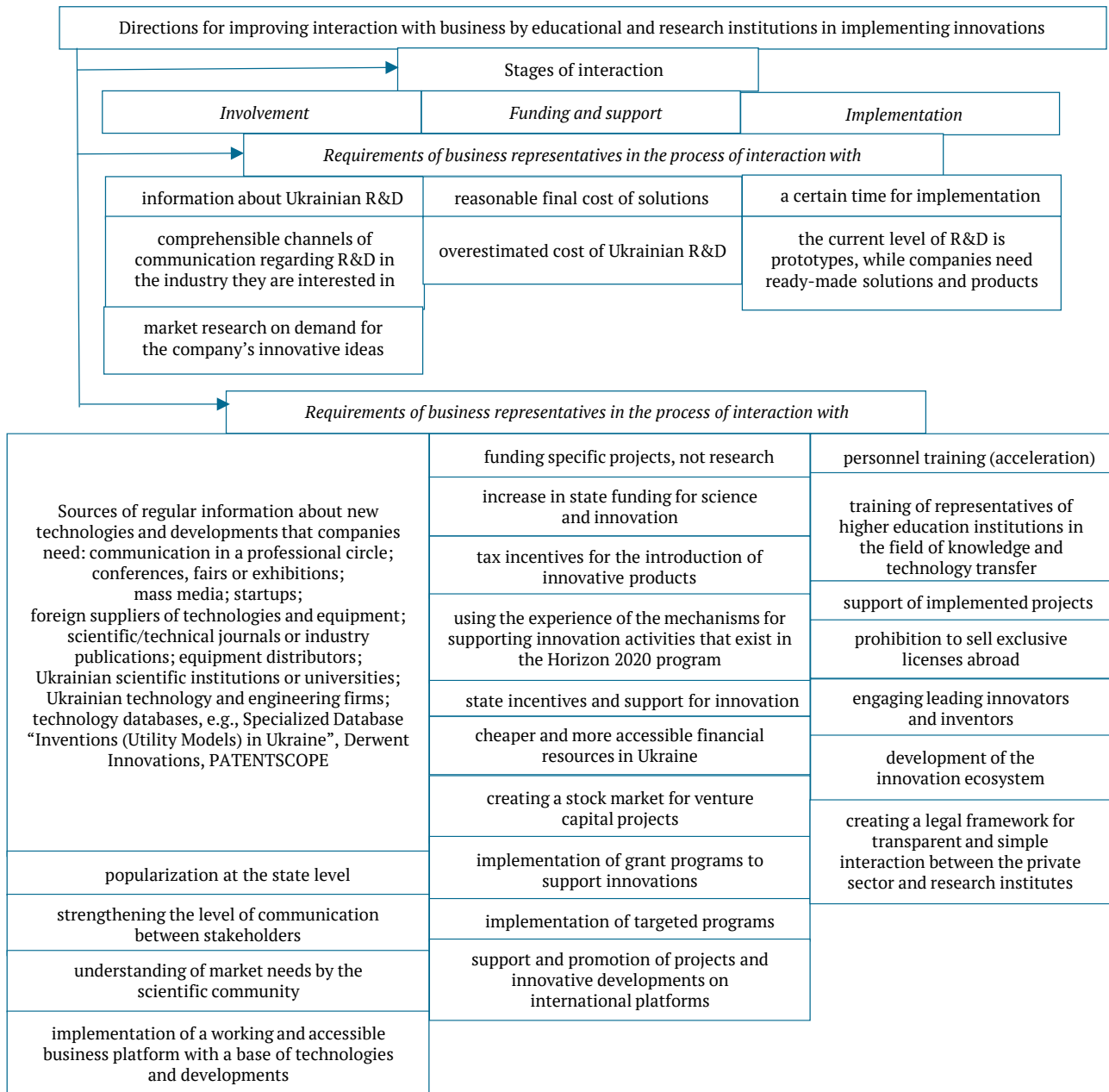


Figure 3. Directions of improvement of interaction with business by educational and research institutions in the process of innovation implementation

Source: made by the authors

the region and the country. Also, the development of the infrastructure of interaction with the external environment, the monitoring of the external environment and the marketing of specialized markets, the expansion of cooperation and the creation of joint structures are an important direction, involvement of existing small innovative enterprises in the implementation of innovative developments of the university; cooperation with foreign and Ukrainian universities and scientific organizations. One of the important signs of a strong country and economy

is a competitive and developed education, science and innovation sectors. Ukraine is undergoing significant changes in 2022-2023, which necessitates a review of the state and trends of interaction between education, science and business stakeholders in problematic areas and which also will help determine the country's future development prospects. The main trends that significantly slow down business growth due to insufficient use of the effect of integration into science and education are presented in Figure 4.



Figure 4. Structural and logical framework of analytical support for identification trends and problems in the development of interaction between stakeholders of education, science and business
Source: developed by the authors

Stakeholder theory is a well-known approach to governance that has been adopted mainly in the last few years. A significant number of studies, such as L. Fobbe & P. Hilletoft (2021) and O. Sena *et al.* (2023) aimed to provide a systematic review of the stakeholder management process. L.M. Ferri & M. Pedrini (2018) conduct a systematic literature review to consider the preconditions that may affect the role of stakeholder interaction in sustainable business models (SBMs). It also highlights research gaps and managerial implications of the role of

stakeholder engagement in SBMs. However, the literature reviews presented are theoretical in nature and do not address current contemporary aspects of the topic in contrast to this article.

T. Yamane & S. Kaneko (2022) not only reviewed the literature, but also analysed the results of a survey of stakeholders involved in standardisation, who ranked the relevance of the SDGs (Sustainable Development Goals) and assessed how different types of standards contribute to the achievement of these goals. The study by K. Blind &

P. Heß (2023) examines the business benefits of contributing to the SDGs and the impact of raising awareness of the integral nature of the SDGs on stakeholder preferences.

Researchers T. Kytsak & Yu. Marshavin (2020), O. Koldiziev *et al.* (2023) analysed stakeholder engagement for Ukrainian companies in accordance with the main trends, including digitalisation, openness, networking and globalisation of processes. The impact of stakeholder engagement on the socio-economic development of business in the new economy is determined and the list of potential opportunities and development prospects for business in the direction of improving business processes is supplemented. Unlike existing studies, the authors of this article analysed not only internal business stakeholders, but also development opportunities beyond corporate governance.

V.O. Shcherbachenko *et al.* (2022), presented the results of a study of the role of stakeholders in the process of commercialisation of innovations in the international business environment, for which they identified the stages of analysis of stakeholders in the commercialisation of innovations, analysed the degree of their importance and interest and identified methods of stakeholder interaction in the international business environment. A separate aspect of the interaction of education, science and business stakeholders is the analysis of existing regional development strategies and programmes which confirms the active interaction of the region with numerous organisations, groups and individuals, as presented in V. Smalysky *et al.* (2020). The peculiarity of the proposed measure is that the stakeholder engagement effectiveness scheme is a synthesis of quantitative and qualitative assessment of stakeholder engagement effectiveness. However, a very important aspect is to identify trends and priorities for budget financing of innovation activities. There is no clear trend in the development of technology transfer and other intellectual property rights carried out by universities, research institutions, enterprises and organisations. To do so, it is necessary to identify the reasons and directions for remedying the current situation.

In the context of a full-scale war, integration into the European educational and scientific space is extremely important and the tangible moral and financial support received from many national scientific communities and international scientific organizations has contributed to the establishment of a national portal for global R&D integration and an international network for infrastructure and research. Z. Van Veldhoven & J. Vanthienen (2022) proposed a new framework by consolidating different concepts, taking into account the role of society, emphasising the driving forces of digital transformation as a perspective of interaction between business, society and science. In contrast to the presented study, the authors consider the formation of a modern network and state-of-the-art infrastructure in the form of special communication platforms that will become an innovative tool for finding partners, performing and implementing scientific, research and innovation works and projects and sharing the existing research and innovation infrastructure.

S. Kryshtanovych (2023) identified the direct and indirect influence of stakeholders on the quality of the educational process and the formation of an educational product and identified weaknesses in the educational process

that require innovative approaches in the organisation, focusing on changes in society. The results by I. Nechitailo *et al.* (2022) revealed the trends in the university social partnership development: changing significantly and similar purposes between representatives of the university society and business on the concept of social partnership in higher education (in 2011) and adopting some management solutions regarding interaction with stakeholders and implementation of principles and objectives by stakeholders (in 2022). However, these authors focused only on the educational component, without taking into account the scientific component which was considered in this article and which is the basis of innovative business development.

Many studies identify specific aspects of stakeholder activities without taking into account the current state, trends and prospects of their interaction. The presented consolidation allowed to outline the key steps of structural and logical framework of analytical support for identification trends and problems in the development of interaction between stakeholders, which will accordingly contribute to the formation of directions for improving interaction with business by educational and scientific institutions in the process of implementing innovations.

■ CONCLUSIONS

This study examined the range of problems and challenges faced by stakeholders in Ukrainian education, science and innovation due to the consequences of the pandemic and a full-scale war. The authors aimed to evaluate the experience and solutions of authorities, educational, scientific and business organizations in responding to these challenges. The participation of European and international partners was also taken into account, in accordance with priority and long-term needs that require the assistance of partners and the expansion of cooperation between Ukrainian and foreign stakeholders for an effective response.

A structural and logical framework of analytical support for identification trends and problems in the development of interaction between stakeholders of education, science and business is proposed, which includes 4 steps and considers stakeholder interaction at different levels, such as micro-level (at the enterprise level), state level (regional aspects and state regulation), international level (interaction with international organisations and foreign governments). The analysis was carried out in accordance with qualitative and quantitative indicators, which made it possible to determine both the result of this interaction and current prospects. Each step considers trends that slow down the effect of interaction between education, science and business stakeholders.

In order to assess the experience of cooperation between business entities and research institutions of various ministries and departments, as well as a number of joint-stock companies engaged in research activities, a SWOT analysis was conducted and stakeholders' interaction in the fields of education, science and business was formed. As a result, the directions for the integration of scientific, educational and entrepreneurial activities according to the stages of their interaction are proposed, since attraction, financing and support and implementation are formed in accordance with the needs of business representatives.

The direction of further research is the construction of a model using two types of qualitative analysis and the tool of quantitative network analysis, which will make it possible to identify the potential, trajectory and directions of interaction of stakeholders of education, science and business.

■ ACKNOWLEDGEMENTS

None.

■ CONFLICT OF INTEREST

None.

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Аналітична підтримка виявлення тенденцій та проблем розвитку взаємодії стейкхолдерів освіти, науки та бізнесу

■ **Анотація.** Вступ України на шлях інноваційного розвитку економіки потребує модернізації взаємодії стейкхолдерів освіти, науки та бізнесу для створення мережі співпраці з урахуванням запитів стейкхолдерів, зумовлених непростою на 2023 рік ситуацією в Україні, орієнтуючись на зміни в світовому господарстві. Метою статті була побудова структурно-логічної схеми аналітичного забезпечення виявлення тенденцій та проблем розвитку взаємодії стейкхолдерів освіти, науки та бізнесу. Методологія базувалася на застосуванні логічного, системно-структурного та компаративного аналізу. Аналіз бюджетного фінансування пріоритетних напрямів інноваційної діяльності, реалізації інноваційної продукції (послуг) і нових технологій за розпорядниками бюджетних коштів показав відсутність тенденцій та пріоритетів щодо розвитку трансферу технологій та інших об'єктів права інтелектуальної власності, що здійснюються університетами, науково-дослідними установами, підприємствами та організаціями. Узагальнення змін та перспектив законодавчого регулювання підтримки освітньої, інноваційної, наукової та науково-технічної діяльності бізнесу в умовах їх взаємодії передбачає підвищення довіри до освітньої, наукової та експертної діяльності закладів задля їх ефективного функціонування та збільшення обсягів фінансування наукових досліджень. Аналіз інтеграційних аспектів науково-інноваційної системи до Європейського дослідницького простору та підтримка від міжнародних наукових організацій й урядів іноземних країн довели отриману від багатьох національних наукових спільнот та міжнародних наукових організацій підтримку в створенні порталу міжнародного науково-технічного співробітництва, та міжнародного консорціуму з інфраструктури та досліджень. Практичне значення дослідження полягає в запропонованих окремо за стадіями взаємодії зі стейкхолдерами (залучення, фінансування та реалізація) напрямках покращення взаємодії з бізнесом освітніх та наукових установ у процесі реалізації інновацій

■ **Ключові слова:** інноваційна діяльність; трансфер технологій; міжнародна підтримка; законодавче регулювання; університет; підприємство