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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

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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	

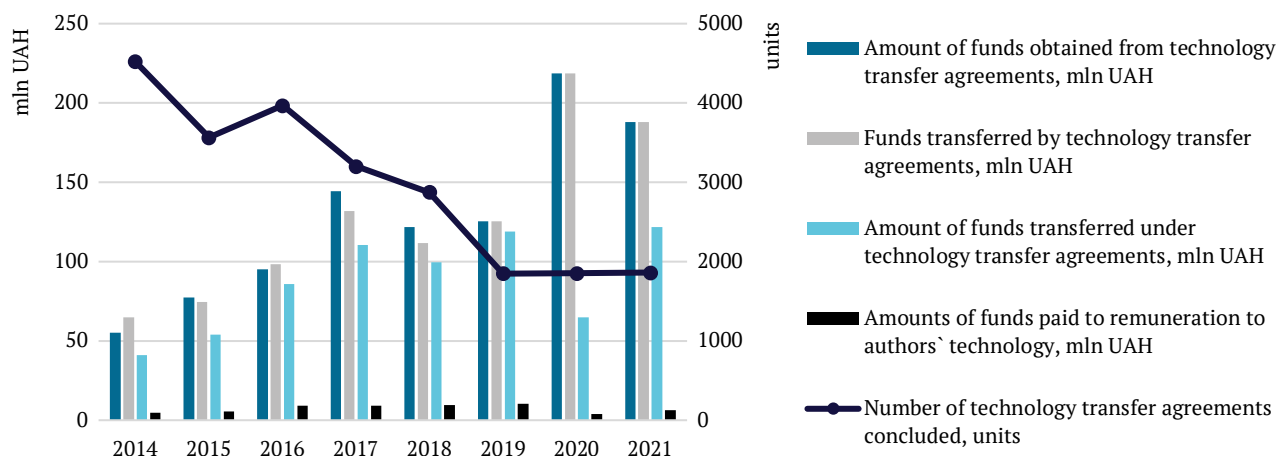
**Note:** “-” no data available; NAMS – National Academy of Medical Sciences

**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

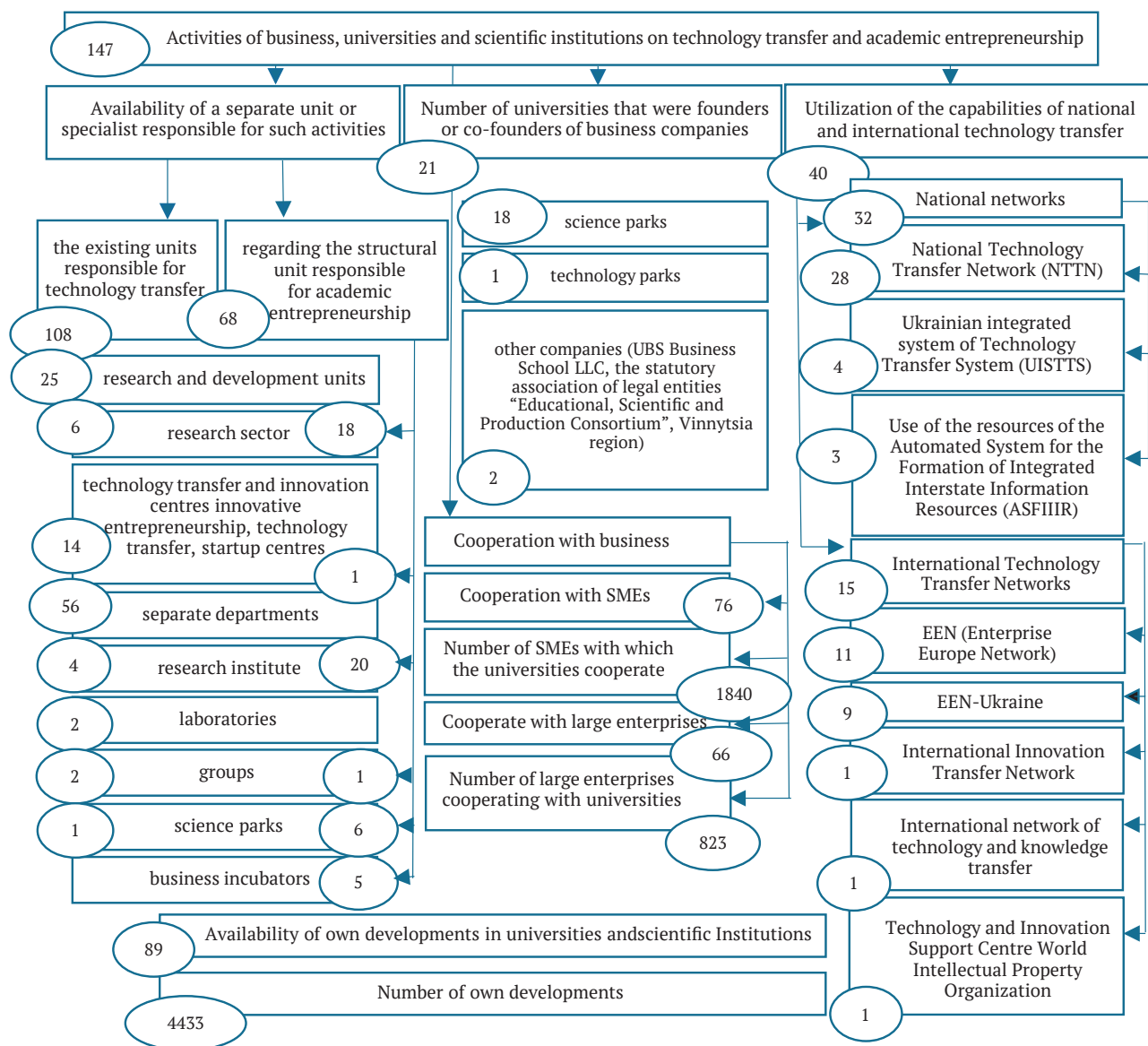
**Source:** compiled by the authors based on International support for education and science in Ukraine under martial law (2022)

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 (Neboha, 2022).

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>

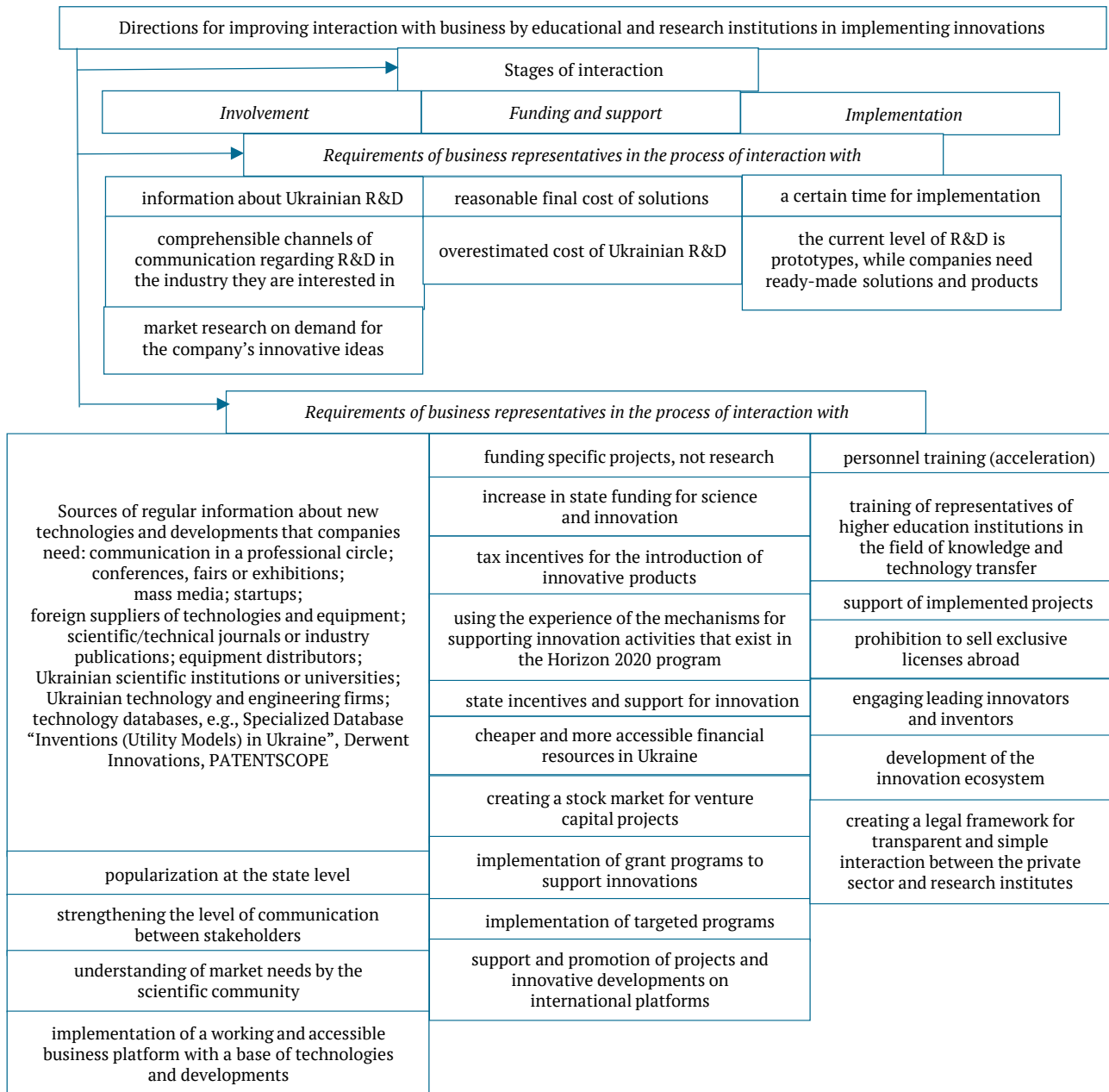
**Source:** developed by the authors based on Survey of business representatives on innovative activities and current R&D issues (2020)

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), L. Ligonenko *et al.* (2022) and O. Kolodiziev *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. Kukharyk & T. Nübling (2021) and 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. Smalskys *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 O. Vilenchuk (2019) and 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.

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#### ■ 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

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## Determinants of sustainable development in the post-war recovery of Ukraine

■ **Abstract.** Ukraine's course towards sustainable development requires the implementation of modern practices of interaction in the triangle of the state, business and society. There is a need to develop institutional mechanisms for harmonization and strengthening comparability of corporate reporting at the international level in the context of the sustainable development goals. The purpose of the article was to develop organizational and methodological issues of monitoring the corporate sector's contribution to achieving the sustainable development goals at the stage of Ukraine's post-war recovery. Methods of analysis and synthesis (to study the consequences of Russia's military aggression), comparison (when analysing the requirements of international normative acts for the structure, stages of formation and a set of reporting indicators), a process approach (for the development of recommendations for a database creation) have been applied in the research. The consequences of Russia's military aggression for the economic development of Ukraine and the achievement of sustainable development goals have been analysed. The institutional mechanisms of strengthening harmonization and comparability of reporting on sustainable development at the international level in the context of the sustainable development goals achievement have been substantiated. Recommendations for the creation of the "State Repository of Reports on Sustainable Development of Enterprises and Organizations of Ukraine" have been developed. A national institutional model for the calculation of indicator 12.6.1 "The number of enterprises publishing reports on sustainable development" has been constructed. It is proposed to expand the set of indicators for releasing information on anti-corruption practices by disclosing indicator D.2.3 "Amount of funds (in US dollars) directed to anti-corruption measures, including the training of one employee on anti-corruption issues, per year". The obtained results can be used for the development of institutional mechanisms for the coordination of global and strategic documents at the global and national levels in order to create a unified vision of the countries' contribution to the achievement of sustainable development goals

■ **Keywords:** corporate governance; non-financial reporting; military aggression; institutional mechanisms; state repository; corruption

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## ■ INTRODUCTION

Since Ukraine has embarked on the path of the United Nations (UNs) sustainable development initiatives, adaptation of the national legislation in the field of corporate reporting to the requirements of the European Union became an important step towards development of a state system for monitoring the achievement of the Sustainable Development Goals (SDGs). In order to improve the monitoring and reporting system for assessing the contribution of the corporate sector of Ukrainian economy to achieving the SDGs at the stage of post-war recovery, it is advisable to start discussing the organizational aspects of strengthening the harmonization and comparability of reports on sustainable development at the global level. In 2023 European Commission should approve new EU Sustainability Reporting Standards (EUSRS) (The EU is strengthening control..., 2022). It is declared that new standards along with other used approaches (GRI – Guidelines of the Global Reporting Initiative, ISSB – International Sustainability Standards Board, IFRS – International Financial Reporting Standards etc.) will be designed more specifically for different industries and revised every 3 years. Yu. Serpeninova *et al.* (2022) noted that these new rules will provide investors and other interested parties with access to the information needed to assess investment risks related to climate change and other sustainable development matters. They will also create a culture of transparency regarding the impact of companies on society and environment. Environmental matters have become especially relevant as a result of a large-scale environmental tragedy associated with the destruction of the Kakhovka Dam caused by Russian occupation forces.

I. Horbachova (2022) noted that in the field of sustainable development it is extremely important to activate participation of the global community. This is especially relevant during the post-war recovery of Ukraine. In case western partners increase their official assistance for the SDG's implementation, Ukraine most likely will be able to achieve its purpose in the field of sustainable development by the year 2030. However, when it comes to providing financial aid for the sustainable development strategy implementation, ensuring investors' confidence that the government, business and the whole society are doing their best to achieve the best sustainable development indicators becomes the most important issue. For this purpose, information, which can be obtained by analysing non-financial reporting on sustainable development, is needed. According to O. Baskov (2022), the key issue for the world community now is credibility confirmation and comparability assessment of the sustainable development reporting indicators. A. Ozeran & R. Korshikova (2019) in this regard point out that for Ukraine one of the possible obstacles in the sustainable development reporting process is that format and regulation of the reports are not clearly defined in this country.

The 2030 Agenda stated that this generation could be the first to succeed in ending poverty and the last to have a chance of saving the planet and Ukraine must be ready to contribute to the global progress (Transforming our world..., n.d.). Having analysed the contribution of official bodies, researchers and practice of the socially responsible enterprises in achieving the SDG's, it can be resumed that

there is a need to increase and improve both the quantity and the quality of non-financial information disclosure in the Ukrainian business' reports, which requires the development of organizational and methodological issues of monitoring the corporate sector contribution to achieving the SDGs at the stage of post-war recovery of Ukraine and it has become the purpose of this research. According to the set goal, the main tasks of the study were to: show the consequences of Russia's military aggression for the economic development of Ukraine and achieving the SDG's; work out recommendation on implementing United Nations Conference on Trade and Development (UNCTAD) Good Practices in Corporate Governance Disclosure in reporting practice of the Ukrainian business entities; improve the system of disclosing information on anti-corruption practice in non-financial reporting.

## ■ MATERIALS AND METHODS

The article used general scientific and special methods, such as: literature review, analysis and synthesis, system analysis and modelling, comparison, process approach, induction and deduction, theoretical analysis, bibliometrics, statistical and content analysis. With the help of literature review the analysis of scientific sources, such as articles, books, and reports related to sustainable development and post-war recovery of Ukraine, was carried out. This made it possible to review previous research, identify sustainable development determinants and gaps that require further study. Analysis and synthesis were used for studying consequences of Russia's military aggression for economic development of Ukraine and achievement of the SDGs. This made it possible to identify and systematize the main problems that Ukraine will face during the preparation of a voluntary national review (VNR). Content analysis was used for the study of institutional mechanisms for strengthening the harmonization and comparability of reporting on sustainable development at the international level in the context of achieving the SDGs. Identifying the interconnection between three key components of sustainability that describe the relationships between the environmental, economic, and social aspects and determining the impact of various systemic changes on sustainable development were conducted using system analysis and modelling. With the help of the comparison method, a comparison of the requirements of international normative acts of different levels to the structure, stages of formation and a set of sustainable development reporting indicators was carried out. A process approach allowed developing recommendations for designing the "State Repository of Reports on Sustainable Development of Enterprises and Organizations of Ukraine", where business units will be able to post reports on sustainable development in the form of open data. Using a case study method allowed carrying out a detailed study of the Ukraine's Recovery Plan and determine the main tasks for achieving the SDGs at the post-war recovery stage. Neo-institutional theory approaches were used to develop recommendations for the disclosure of indicator D.2.3 "Amount of funds (in US dollars) directed to anti-corruption measures, including training of one employee on anti-corruption issues, per year" in the reporting

on sustainable development. This will make it possible to consider corruption as a consequence of the imperfection of institutional conditions rather than individual actions. Research uses statistical measurement tools and data provided by international organizations such as the United Nation, Transparency International, World Bank, Institute for Economics & Peace etc. With the aim of seeing whether there is a link between Corruption perception index and the SDG Index the authors focused on synthesis of quantitative indicators that make it possible to draw a conclusion about the position of Ukraine. Graphical and tabular representation were used to visualize the research results.

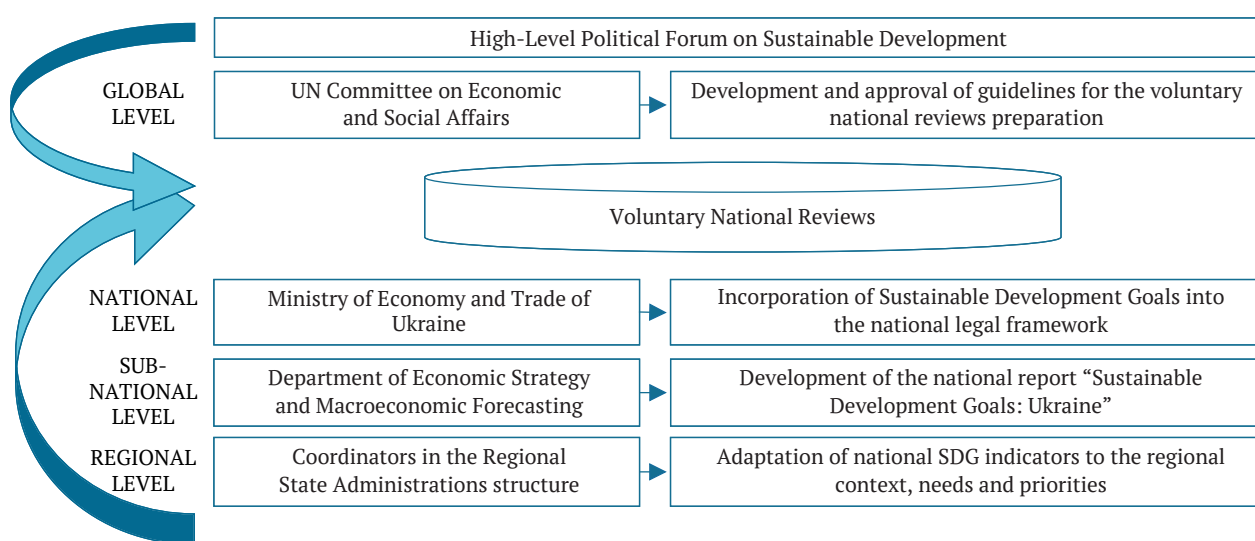
## ■ RESULTS AND DISCUSSION

After a year of war documented direct losses of housing, real estate and other infrastructure of Ukraine are estimated at more than \$95.5 billion, general indirect losses of Ukraine economy are evaluated at \$126.8 billion and Ukraine's need for restoration is estimated approximately \$165.1 billion (Ukraine recovery plan, n.d.). According to the United Nations development program (The development impact..., 2022), the war has caused 50% of Ukrainian businesses to shut down completely, while the other half is forced to operate well below its capacity. If the war deepens and protracts further, up to 90% of the population of Ukraine could be facing poverty and vulnerability to poverty (The development impact..., 2022).

Dynamics of the institutional environment of countries with emerging markets in the last two decades has been the subject of a great deal of research. Given that traditional approaches have not proven to be effective enough for studying transitional economic systems, it is necessary to emphasize the importance of international experience exchange and bring together researchers for collaborative scientific studies within the Accounting Research Network (ARN) to deepen institutional change through the quantitative and qualitative improvement of various social institutions for integrating the SDGs into the national regulations.

After a meeting with state institutions and development partners regarding the SDGs progress, the Secretariat of the Cabinet of Ministers of Ukraine announced the intention to submit a VNR in 2023 (Despite the ongoing war..., 2022). At the same time, as a result of Russian aggression, a significant number of businesses in Ukraine ceased to exist due to the loss of both material and human resources. The unemployment also increased. It is estimated that almost five million people lost their jobs, rising to seven million if the hostilities continue (Dzombak, 2022; Skydan et al., 2023). Besides, while the ongoing Russia-Ukraine war threatens global nutrition security, the magnitude and extent of its impact remain under-examined (Deng et al., 2022). It can increase prices in future, putting even more businesses at risk leading to paralyzed supply chains (Rice et al., 2022). Non-financial information is essential for building trust in society by responding to the expectations and needs of society and for communicating with external stakeholders, including investors, regarding medium- and long-term value creation (Management of non-financial..., 2021).

Before the full-scale invasion of Russia, Ukraine has already made significant efforts in the process of forming a national institutional model for ensuring achievement of the SDGs. A High-level group, connecting 17 working sub-groups corresponding to each goal, was created in Ukraine as a part of the sustainable development tasks contextualization. More than 800 specialists in all regions of Ukraine participated in the process of defining the national sustainable development goals in institutional, economic, ecological and social areas (Sustainable development..., 2017; Iefymenko, 2019). Established institutions ensure laws and strategies development as well as data collection for assessing the indicators of the SDGs achievement. The national policy of Ukraine, developed by the Ministry of Economy and Trade of Ukraine, incorporating the goals of sustainable development into the national legal framework, was coordinated with the Central Development Strategy (Fig. 1).



**Figure 1.** Institutional mechanisms for strengthening the harmonization and comparability of reporting on sustainable development at the international level in the context of achieving the SDGs

Source: made by the authors

At the sub-national level, the Department of Economic Strategy and Macroeconomic Forecasting developed a draft of the national report “Sustainable Development Goals: Ukraine” and a draft of the Procedure for Coordination of Data Collection for Monitoring the Sustainable Development Goals with a list of those responsible for submitting data in terms of SDGs indicators (Sustainable development..., 2017). At the regional level, the adaptation of national indicators of the SDG to the regional context, needs and priorities is carried out by coordinators from the SDGs in the structure of regional state administrations, which coordinate the collection of information for the presentation of voluntary national reviews at the High-Level Political Forum on sustainable development.

As it was highlighted at the first workshop for the voluntary national reviews, presented at the 2023 United Nations High-level Political Forum for sustainable development, an indispensable tool for deepening commitment to the 2030 Agenda at the global and local level is to provide voluntary national reviews (First workshop for..., 2022). In 2020 Ukraine prepared its first VNR (Voluntary national review..., 2020). Despite the significant achievements of Ukraine in adaptation of the SDGs, even before the war there was a need for further studies of comparability indicators of the progress towards achieving all 17 SDGs at the mega-, macro-, meso- and micro-levels and assessing the individual indicators contained in the reporting on sustainability, which arises from differences in the methodology for their calculation, both national and international (for example, the calculation of value added, net value added, the amount of green investments, as well as social ones, etc.) (Fedorenko, 2023; Khodakivska *et al.*, 2023). In addition, the situation worsened dramatically as a result of Russian aggression.

Assessment and presentation of national progress in achieving the SDGs is complicated for Ukraine by the impossibility of determining the number of enterprises that will be able to generate non-financial reports, which gives the possibility to assess and report on national progress towards implementation of the 2030 Agenda for sustainable development and its 17 SDGs and 169 indicators. In addition, the UNCTAD (2019) in 2021 has updated as provided by the “Guidance on core indicators for entity reporting on contribution towards implementation of the sustainable development goals” recommendations on disclosure of core indicators for sustainability reporting, which intends to assist entities to provide baseline data on sustainability issues in a consistent and comparable manner that would meet common needs of many different stakeholders of the SDG agenda and give an opportunity to assess the private sector contribution to the SDG implementation and enable them to report on SDG indicator 12.6.1. This actualizes the development of new approaches to improving the information provision for determining the indicator 12.6.1 “Number of companies publishing sustainability reports” by Ukrainian business entities.

A significant step towards improving the information provision for determining the indicator 12.6.1 “Number of companies publishing sustainability reports” by Ukrainian business entities was the introduction of a new form of reporting for more than 15 thousand medium and large companies in 2018 – Management Report, which contains both financial and non-financial information describing the

state of the company and revealing the risks to its activities in the economic, environmental and social areas (Order of Ministry of Finance..., 2018). Individual non-financial indicators are also presented in the Reports on payments to the state. As the analysis shows, Management Report contains the largest number of indicators from the minimum format of indicator disclosure according to the Draft Guideline on Indicator Disclosure Methodology 12.6.1. However, as practice shows, Ukrainian business entities that prepare sustainability reports usually post them on their own website or generally issue sustainability reports only in paper form, which complicates or even makes it impossible to obtain information for calculating the indicator 12.6.1 “Number of companies publishing sustainability reports”. Moreover, in the national program “Sustainable Development Goals: Ukraine”, the indicator 12.6.1 is not taken into account at all (Our work on the..., n.d.). Therefore, national institutional model of calculation of the 12.6.1 indicator was constructed (Fig. 2).

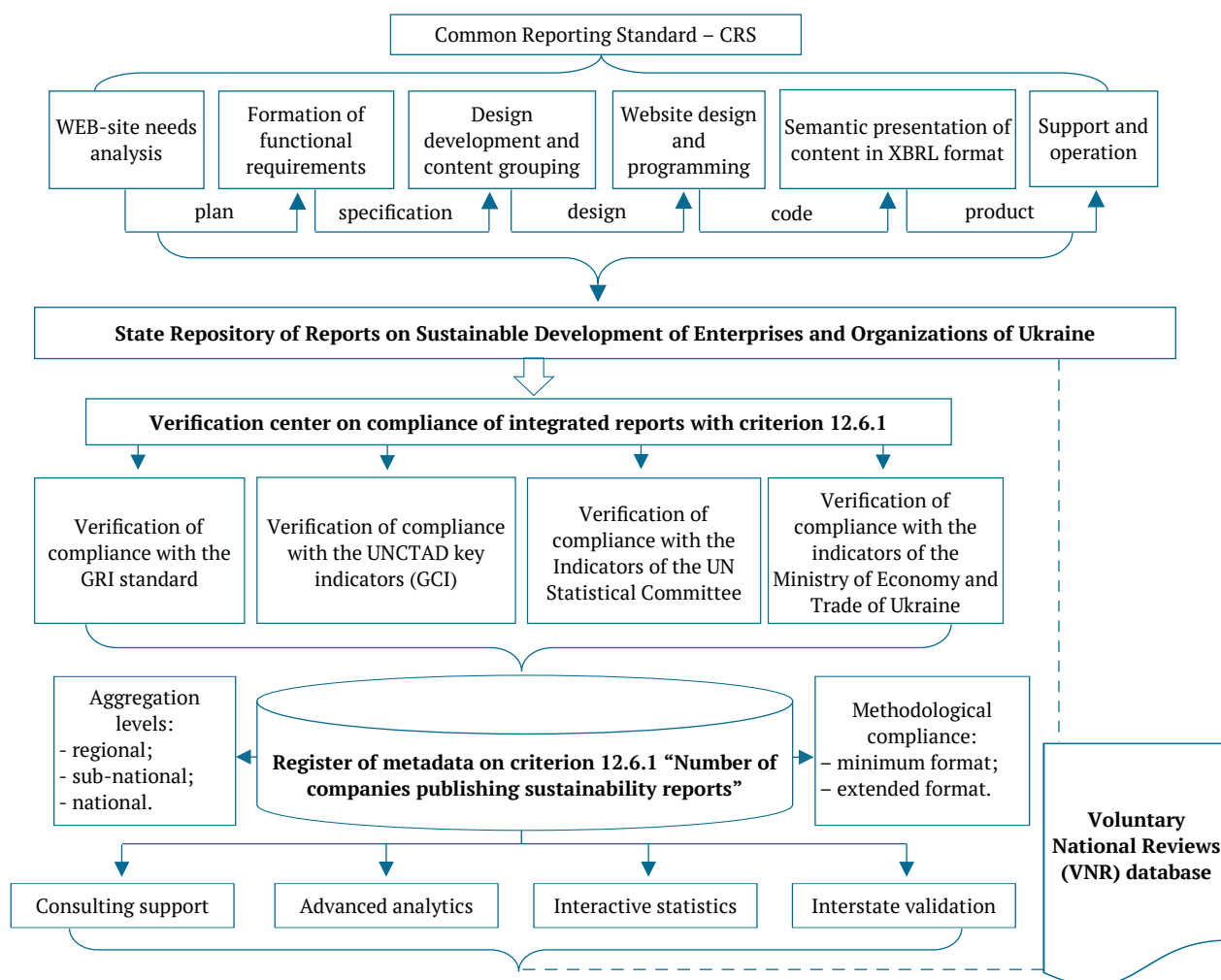
Within the framework of the presented model, in order to strengthen the corporate position regarding the sustainable development and satisfy the growing demand on information on the Ukrainian business entities progress towards achieving the SDGs, the authors of the article recommended creating a “State Repository of Reports on Sustainable Development of Enterprises and Organizations of Ukraine”, where entities will be able to post sustainability reports in the form of open data. It is proposed to fill in this repository on a voluntary basis according to the algorithm, which regulates the systematization and storage of information in accordance with the criteria of the minimum or extended regulation of disclosure by companies of this indicator according to the Draft Guidelines on the methodology of the disclosure of the indicator 12.6.1. In accordance with the requirements of the Common Reporting Standard (CRS) semantic presentation of the content of the State Repository must be done in XBRL (eXtensible Business Reporting Language) format. This will ensure the information exchange of the State Repository with the financial and tax reporting portals existing in Ukraine and the mechanism for transferring reporting data of Ukrainian companies to the Database of Voluntary National Reviews, joined by Ukraine in 2020.

Russian aggression affected achievement of all 17 SDGs. However, unlike the SDGs in economic and environmental areas, achievement of which require peace and significant financial resources, goals in social area are important to be achieved now. While Ukraine shows great progress in most goals of social area such as human rights, democracy or management board diversity, corruption remains the most vulnerable area for Ukraine and overcoming it will affect outcomes in all others. Effects of corruption can be extremely dangerous if not fatal for Ukrainian economy in the post-war period. Therefore, the second stage of the post-war recovery plan of Ukraine “Structural modernization and full integration to EU” (Ukraine recovery plan, n.d.) requires the development of indicators for overcoming corruption in Ukrainian society.

There is a long way to go before national processes of review and follow up are “open, inclusive, participatory and transparent for all people” (Transforming our world ..., n.d.). Corruption troubles Ukraine’s society and polit-

ical landscape. According to Transparency International's 2022 Corruption perceptions index, Ukraine ranked 122<sup>nd</sup> out of 180 countries, among such countries as Eswatini, Gabon and Mexico (Corruption perceptions index, 2021). The urgency of deepening integrity and intolerance to corruption becomes even more important for the Armed Forces of Ukraine given lately manifested cases of obtaining illegal benefits by officials in the main paramilitary structures of Ukraine (Shopina *et al.*, 2022). However, according to the Millennium Challenge Corporation public opinion survey

of anti-corruption efforts in Ukraine, 52% of Ukrainians believe that corruption is justified in most situations to get things done; and 77% of the population believe that corruption levels have remained the same or have increased since 2004 (Neutze & Karatnycky, 2007). Based on European Court of Auditors research from 2016 to 2021, the three major obstacles to foreign investment in Ukraine remained the same: widespread corruption, a lack of trust in the judiciary, market monopolization and state capture by oligarchs (Reducing grand corruption..., 2021).



**Figure 2.** Institutional model of the indicator 12.6.1 calculation and VNR preparation

**Source:** made by the authors

Interstate investments in the process of achieving the SDGs strengthen the key indicators of business success of individual countries, which includes legal markets development, transparent financial systems establishment and corruption-free institutions with high quality management. At the same time, various studies have shown a correlation between a reduction in corruption and economic growth, while most stakeholders note that real change in Ukraine cannot take place without overcoming corrupt schemes and influence of corrupted institutions. The war has made the problem even more acute and American and European communities strongly urge Ukraine to do more to act on corruption starting from the early days of independence.

This leads to the need of improving institutional mechanisms for strengthening the harmonization and comparability of non-financial reporting at international level in the context of the SDGs achievement.

According to the defined sustainable development policies the agendas for every country must be developed in accordance with international legislation. Monitoring achievement of the SDGs in Ukraine, as well as other countries, requires significant financial resources and interaction between stakeholders at different state levels: national, sub-national and regional. For this purpose, the program for the promotion of strategic planning and financing of sustainable development in Ukraine was adopted in 2021.

Because of the war Ukraine faced new challenges related to implementation of the Sustainable Development Goals. To overcome them the Draft Ukraine's Recovery Plan 2022 was created as a main task for Ukraine to become an international leader in sphere of overcoming corruption, civil society institutions development and openness of public information, which are essential and inseparable parts of democracy (Ukraine recovery plan, n.d.). The main strategic task for the period 2026-2032 is the implementation of European legislation on free movement of impersonal data, accelerating data transparency and openness principles.

The purpose of the SDG 16 "Peace, justice and strong institutions" is to "promote peaceful and inclusive societies to achieve sustainable development, provide access to justice for all people and develop effective, accountable and inclusive institutions at all levels" (Take action..., n.d.). From the neo-institutional theory standpoint corruption should be considered as an informal institution characterized by a stable type of opportunistic behaviour and a set of expressed in formal institutions informal norms that run counter to the collective ideals and goals. In this context, the level and forms of corruption should be defined as negative effect of informal institutionalization in the issue of violation of the formal and informal rules balance. Neo-institutionalism is adaptive to contemporary analysis of corruption practices and is the only optimal methodology for corruption study, since: 1) the conceptual basis of neo-institutional theory is relevant to contemporary ecologo-socio-economic processes; 2) neo-institutionalism is flexible and capable for the dynamic and changing processes analysis; 3) the functional apparatus of neo-institutionalist methodology helps to study formal and informal rules in order to prevent institutional conflicts.

So far, as increasing corruption level and inadequate rule of law, as major obstacles of sustainable development,

require designing of the effective institutional mechanisms for prevention of corruption at all levels of government and creation of the transparent national model of the SDGs monitoring. In post-Soviet states such as Ukraine corruption is a transitional phenomenon responding to the absence of legal norms in a period of profound property redistribution (Neutze & Karatnycky, 2007). In addition, the war generated new opportunities for corruption. It can cause a great risk for the post-war recovery of Ukraine and its further development in the direction of European integration and implementation of international practices and standards. Having analysed the main recommendations and the best practices of the Guidance on core indicators for entity reporting on contribution towards implementation of the sustainable development goals prepared by the UNCTAD (2019) in the framework of implementation of the Goal 16 of sustainable development strategy "Contribute to the construction of a peaceful and open society in the interests of sustainable development, ensure access to justice for all and create effective, accountable and based on broad participation of institutions at all levels", authors propose to introduce indicator D.2.3 "Amount of funds (in US dollars) allocated for anti-corruption measures, including the training of one employee on anti-corruption issues, per year" in group D.2 "Anti-corruption practice". Information for its monitoring is generated in the accounting system. Suggested indicators presented in the Table 1 reflect global best practices for sustainability reporting helping organizations with responding to emerging information demands from stakeholders and regulators and comply with the national legislation as well as recommendations of GRI 205, which is devoted to the anti-corruption topics as a part of Global Reporting Initiative (GRI) Standards (The global standards..., n.d.).

**Table 1.** Composition of the UNCTAD guidelines key indicators on corruption level in Ukraine

Disclosure elements for the Minimum Requirement Methodology for SDG indicator 12.6.1	Governance structure, including economic, environmental and social issues					Anti-fraud, anti-corruption and anti-competitive behaviour practices	
	1	2	3	4	5	6	7
UNCTAD ISAR (International Standards of Accounting and Reporting) Indicator	D.1.1. Number of Board meetings and attendance rate	D.1.2. Number and percentage of female board members	D.1.3. Board members by age range	D.1.4. Number of meetings of audit committee and attendance rate	D.1.5. Compensation: total compensation per board member	D 2.1. Amount of fines paid or payable due to settlements	D 2.2. Average hours of training on anti-corruption issues per year per employee
Relevant SDG Indicator	16.6 "Develop effective, accountable and transparent institutions at all levels"	5.5.2 "Proportion of women in managerial positions"	16.7.1 "Proportions of positions in national and local institutions, including (a) the legislatures; (b) the public service; and (c) the judiciary, compared to national distributions, by sex, age, persons with disabilities and population groups"	16.6 "Develop effective, accountable and transparent institutions at all levels"	16.5.2 "Proportion of businesses that had at least one contact with a public official and that paid a bribe to a public official, or were asked for a bribe by those public officials during the previous 12 months"		

Table 1. Continued

1	2	3	4	5	6	7	8
Adapted in Ukraine SDG Indicator	Non-adapted	5.4 “To ensure equal opportunities for representation at the highest levels of decision-making in political and social life”	16.7. “To increase the efficiency of the activities of state authorities and local self-government”	Non-adapted		16.6.1 “Indicator of perception of corruption in the public sector by business circles and experts”	
Available Sources of Information	Company data	State statistical observation	Company data			Administrative data of Prosecutor General’s office of Ukraine	
VNR data gathering	Requires methodology adaptation for implementation	Adopted, implemented	Requires methodology adaptation for implementation			Has adapted methodology, can be implemented	Adopted, implemented

**Source:** authors’ suggestions based on Methodology for SDG indicator 12.6.1 proposal from the custodian agencies (2019)

An important condition for the SDGs achievement according to Faculty of Education University of Barcelona researchers is implementation of effective social institutions. They insist on the relevance for the post-war economy for SDG 16 achievement of three learning objectives: cognitive, socio-emotional and behavioural (Gonzalez-Vazquez *et al.*, 2021).

The means of SDG implementation in the private sector must be upgraded significantly and shared around the globe for businesses to use. Strategies to better implement the SDGs in the private sector seem to be missing in most research (Palau-Pinyana *et al.*, 2023). The Russian-Ukrainian war influences significantly energy prices, which leads to an increase in the number of people lacking access to electricity up to 600 million and about 2 billion most likely will use mainly polluting fuels and technologies in the households. Given current situation, to ensure the achievement of all SDG related to energy access by the year 2030, it is necessary to increase investments in renewable energy sources and improve electricity grids (Progress towards..., 2023). The breach in the dam at the Kakhovka hydroelectric power station only worsened the situation. Therefore, further research on the SDG’s implementation at corporate level should be carried out, emphasizing the strategies of SDG 7 and SDG 4 implementation, which can be a great deal of contribution to the progress in all SDG’s. Besides, there is a certain category of SDG’s global indicators, information on which is available in Ukraine but it does not fully comply with the name of proposed indicator. It should be noted that some global indicators can be calculated by international organizations, which requires the development of further methodological explanations.

Much attention was paid to the issue of sustainable development assessing and monitoring by both Ukrainian and foreign researchers. Theoretical background was studied as early as the Club of Rome foundation in the last century (Randers *et al.*, 2018). The importance of the sustainable development concept, non-financial information disclosure and monitoring of the SDG’s was highlighted by L. Zaitseva (2019), I. Zhuk (2021), L. Lipych *et al.* (2023). Highly appreciating the achievements of scientists, it should be noted that they mostly relate to the impact of crisis phenomena on the achievement of the SDGs in the global scale, missing the issues of the SDG’s assessment and monitoring in Ukraine during the war and post-war recovery.

Summarizing different positions, it can be admitted that like E. Escrig-Olmedo *et al.* (2019) most researchers suggest using the existing frameworks and tools of preparing non-financial statements, which prove to be sufficient to measure corporate sustainability, for instance – Guidelines of the Global Reporting Initiative (GRI Standards, 2022), UN Global Compact (The Ten Principles..., n.d.), OECD (2023) principles for multinational companies or ISO 26000:2021 (2021) (ISO – International Organization for Standardization). M.-T. Sorrosal-Foradellas *et al.* (2023) hold similar views admitting correlation between corporations and a lack of transparency and provide sustainability ratings at the company level and at the level of financial investments based on the Morningstar Sustainability Rating, which could be useful for Ukraine due to sufficiency to contribute positively to the economic, environment or social causes. At the same time, direct transfer of those tools and indicators to the legal field of Ukraine is not possible due to the peculiarities, arising from differences in the methodology for their calculation. Institutional mechanisms for strengthening the harmonization and comparability of reporting on sustainable development have to be improved.

M. Chopra *et al.* (2022) describing the effect of natural disasters on the SDGs admit that decline in the 2030 Agenda reaching was underestimated, which demands new steps towards sustainable development goals achievement worldwide and requires the creation of an institutional mechanism for the SDGs monitoring and VNR preparation to support countries in strategizing for implementing the SDGs and in mobilizing donors in the case of developing countries. T. Iefymenko *et al.* (2021) came closest to solving this task considering in detail the information asymmetry of reporting by Ukrainian companies on the contribution to implementation of the sustainable development goals and formulated methodological principles of its avoiding during the period of crisis phenomena such as COVID-19. Scientists systematized information sources for the recommended indicators in economic, social and environmental spheres of sustainable development disclosure. Besides, they agree with the urgent need in a non-financial reports repository for Ukraine but fail to provide recommendations regarding its content, structure, collaboration among data creators and users and interaction with other reporting databases.

Systematic literature review and bibliometric analysis prove high intensity of research under corruption concerning sustainable development but a clear set of disclosure of anti-corruption practices has not been developed yet. As A. Skoczylas-Tworek (2020) discovered, not more than 70% of the surveyed market players record the presence of anti-fraud and abuse policies and only 15% of them disclose anti-corruption indicators in the non-financial reports. Research of non-financial reports showed that even less companies disclose anti-corruption practices in their non-financial reports. Supporting an ongoing debate concentrated on extending focus to a such frequent abusive phenomenon as corruption, affecting all components of SDGs, B. Lucey *et al.* (2023) propose mechanisms for understanding the key drivers for individuals taking up activities of corruption like age, gender, education, political background, religion, peer group, geographical orientation, cultural factors, personality and psychological factors. They contribute in combating corruption in finance by exploring a wide area of disruptive technologies and applications like artificial intelligence, cloud technology, distributed ledger technologies, and IoT (Internet of Things) in business ecosystems and could assist the finance forensics in fraud investigation and auditability. It would be contributing to use them in Ukraine but it requires the introduction of new indicators for disclosure of anti-corruption practice by Ukrainian companies.

Within the framework of the 74<sup>th</sup> session of UN General Assemblies in New York (USA) during UN Summit in September 2019 Volodymyr Zelensky emphasized that: "No state will reach sustainable development without peace and security. Sustainable development is impossible to the sounds of shelling and explosions, it is impossible at the place where aggressive geopolitical strategy dominates, which applauds to invasion to other states and violation of human rights and freedom" (Kolishevskyi, 2020). When the hostilities between Ukraine and Russia cease is unclear but it is obvious that the conflict has had adverse effects on the SDGs (Pereira *et al.*, 2022). Bill Gates noted that due to the war in Ukraine, the world is unlikely to be able to achieve at least one of the UN's sustainable development goals, which were to be achieved by the year 2030 (Bill Gates said..., 2022).

The first stage of SDG's implementation process began in Ukraine in 2015 and covered the adaptation of the SDGs, monitoring of the SDGs and key trends analysis, assessment of the degree of the SDGs incorporation into the strategic and program legislative acts of Ukraine (Sustainable development goals..., 2017). Thenceforth Ukraine began for VNR. However, during the war and the post-war recovery Ukraine faces difficulties caused by the impossibility of determining the number of enterprises that will be able to generate non-financial reports (Roshylo, 2023). Therefore, further research is needed to develop new

principles and approaches to improving the information provision for determining the sustainable development indicators and creating a single online platform, where local enterprises and organizations can post their reports on achieving the SDGs. Such steps can also support Ukraine in strategizing for implementing the SDGs and mobilizing donors during the post-war recovery.

## ■ CONCLUSIONS

This paper describes institutional mechanisms for strengthening the harmonization and comparability of reporting on sustainable development during the war and the post-war recovery of Ukraine. The proposed structure provides strong hierarchy of regulators at national, sub-national and regional levels, which will allow collecting sufficient data for a voluntary national review.

The study has shown that Russian-Ukrainian war affected SDGs in Ukraine and it proves that assessment and presentation of national progress in achieving the SDGs is complicated for Ukraine by the impossibility of determining the number of enterprises that will be able to generate non-financial reports, which gives the possibility to assess and report on national progress towards implementation of the 2030 Agenda. Recommendations on approaches to improving the information provision for determining the indicator 12.6.1 "Number of companies publishing sustainability reports" have been made. In order to strengthen the corporate position regarding the sustainable development and satisfy the growing demand on information on the Ukrainian business entities progress towards achieving the SDGs, a methodological approach of creating a "State Repository of Reports on Sustainable Development of Enterprises and Organizations of Ukraine", where entities will be able to post sustainability reports in the form of open data, has been proposed.

In the framework of implementing the Goal 16 of sustainable development strategy a number of indicators for anti-corruption actions have been formulated. Suggested indicators reflect the world's best practices for sustainability reporting helping organizations to take into account the Global Reporting Initiative Standard 205 recommendations on anti-corruption practises and related topics. Future studies could be linked to the certification standards of state anti-corruption policy to ensure its efficiency and effectiveness. For further progress it is necessary to develop institutional mechanisms for the coordination of strategic documents at the global and national levels in order to create a unified vision of the contribution of countries to achieving the SDGs.

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## ■ CONFLICT OF INTEREST

None.

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## **Детермінанти сталого розвитку в умовах післявоєнного відновлення України**

■ **Анотація.** Перехід України до сталого розвитку потребує впровадження сучасних практик взаємодії в трикутнику держава, бізнес та суспільство. Існує потреба в розробці інституційних механізмів для гармонізації та посилення порівнянності корпоративної звітності на міжнародному рівні в контексті цілей сталого розвитку. Метою статті була розробка організаційно-методичних питань моніторингу внеску корпоративного сектору в досягнення цілей сталого розвитку на етапі повоєнного відновлення України. В дослідженні використовуються методи аналізу і синтезу (для дослідження наслідків військової агресії Росії для економічного розвитку України та досягнення цілей сталого розвитку), порівняння (при аналізі вимог міжнародних нормативних актів до структури, етапів формування, набору показників звітності), процесний підхід (для розробки рекомендацій щодо створення репозитарію). Проаналізовано наслідки військової агресії Росії для економічного розвитку України та досягнення цілей сталого розвитку. Обґрунтовано інституційні механізми посилення гармонізації та порівнянності звітності про сталий розвиток на міжнародному рівні в контексті досягнення цілей сталого розвитку. Розроблено рекомендації щодо створення «Державного репозитарію звітів про сталий розвиток підприємств та організацій України». Побудовано національну інституційну модель розрахунку індикатора 12.6.1 «Кількість підприємств, які публікують звіти про сталий розвиток». Запропоновано розширити склад індикаторів для оприлюднення інформації про антикорупційні практики шляхом розкриття показника D.2.3 «Сума коштів (у доларах США), спрямованих на антикорупційні заходи, в тому числі на навчання одного працівника з питань протидії корупції, на рік». Отримані результати можуть бути використані при розробці інституційних механізмів координації глобальних і стратегічних документів на глобальному та національному рівнях з метою формування єдиного бачення внеску країн у досягнення цілей сталого розвитку

■ **Ключові слова:** корпоративне управління; нефінансова звітність; військова агресія; інституційні механізми; державний репозитарій; корупція

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## The role of state finance audit in the system of accounting and analytical support of the state funds management system

■ **Abstract.** During the period of martial law, the problem of the need for constant control over state finances in connection with their limitations and the importance of effective use became important. The issues of the activities of audit firms and the effective organization of audits are constantly in the focus of attention of scholars. The purpose of the article was to substantiate the theoretical aspects and provide scientific and practical recommendations aimed at improving the audit of state finances. The method of induction was used at the stage of collecting, systematizing and processing information for conducting research, deduction – in the process of theoretical understanding of the main questions and problems of the audit of state finances and the search for the root causes of their occurrence, generalization – during the identification of the main features and properties of the system of accounting and analytical support of the audit of state finances, methods of comparison, analysis, synthesis, abstract-logical method. Scientific works were summarized and analysed in order to determine the essence of important components of scientific research, in particular: audit of state finances, state financial audit, accounting and analytical information, accounting and analytical support and the main components of an effective system of management and control over state finances were determined. The main components of financial control in the public sector of Ukraine are schematically presented, and the place of public finance audit as a component of state financial control is determined. The need to distinguish the concepts of “audit of state finances” and “state financial audit” was discussed. The main conditions that contribute to the creation of an effective system of management and control over state funds are highlighted. Common and distinctive features of control over state funds in Ukraine and foreign countries are identified. The main problems and shortcomings of the system of management of state funds are identified and recommendations for their solution are provided. The results of the study can be used by all state enterprises that are looking for new approaches in management and strive for the effective distribution of state funds in the conditions of martial law

■ **Keywords:** standards; reliable information; effective control; auditing activity; blockchain technologies

### ■ INTRODUCTION

Since 2022, Ukraine's economy has been suffering from a full-scale military invasion by the Russian Federation, which is causing significant losses every day. A business that is unable to resume operations in part or in full tries to reduce losses by using the instrument of avoiding liability for non-performance or late performance of an obligation, using both virtuous and dishonest methods. An urgent issue for users of any financial information is confidence in

its reliability. Officials and employees of government institutions are responsible for fair use of state funds. The audit of public finances contributes to increasing this responsibility at all levels. It requires a significant increase in interest in the process of creating accounting and analytical support, its rethinking, improvement, development of new, more informative and effective instruments related to the preparation and presentation of accounting and

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economic information on the availability and movement of state finances, which would fully correspond to the system of management.

In Europe, the evolution of the origin of state finance and the standards that are associated with this process has a long history. One can agree with the opinion of O. Shevchuk & A. Kovalskiy (2019), who believe that during a rather long period of the origin of the existing Western society, new methods, institutions and instruments of state finance control were developed, which reached the level of national scale, first off all in the countries of Western Europe and the USA. L. Borysenko (2020a; 2020b) places an emphasis on the fact that in developed countries state audit is consistent with the principles of the Lima Declaration, which is called the International Organization of Supreme Audit Institutions (INTOSAI), as well as its structural part – the European Organization of Supreme Audit Institutions (EUROSAI), of which Ukraine is also a member. These bodies provide methodical and practical recommendations on the effective organization of audit and state financial control. O.M. Pihotska & M.R. Pihotska (2022) believe that the system of control over state finances, which is inherent in a certain state, has its own characteristics, due to historical aspects, and a number of those principles, procedures, methods and stages of auditing used by foreign countries cannot be applied in Ukrainian practice. This is explained by a different level and specificity of regulatory and legal support, as well as national features of social life. However, the experience of other countries in audit of state finances is valuable for Ukraine, as it gives auditors the opportunity to compare different practices of audit procedures and verification methods, analyse their positive and negative sides and introduce into practice methods that will contribute to improving the quality of audit inspections.

Summarizing the foreign experience of the state finance management system, K.P. Melnyk & A.A. Ploskina (2022) concluded that the audit of state finances was developed and established under the influence of various factors, in particular: the need to improve the quality of audits related to state funds; the complexity of the procedure for registration and submission of accounting information; the need to implement a better and faster inspection, which would facilitate prompt and thorough control over the receipt and use of state funds. In addition, in the general system of control over state property, it is advisable to include such inspection bodies as: the supreme body of control over state finances, which is subordinate to the President and higher control bodies and carries out an inspection of the movement of state budget funds; state departments and subdivisions of ministries and agencies that are under the supervision of higher state control bodies and carry out checks on the timeliness of the receipt and distribution of state funds; a tax authority that would control the timeliness of paying taxes and mandatory payments. Most scientists, in particular O. Panchenko & V. Zhdan (2019), consider the development of accounting and analytical support for the state finance management system through the construction of “an integrated system of strategic accounting and strategic analysis”. At the same time, as argued by U. Pelekh (2022), the development of a conceptual model of accounting and analytical support requires organization of theoretical and methodological foundations with the use

of principles and instruments of strategic management in them, in particular instrumental means of strategic analysis for “determining critically important informational data of external and internal environment”.

Verification and control of state finances with the help of an effective state funds management system differs from traditional control in that it carries out a number of measures that ensure the true and rational distribution of state funds and property and makes it possible to increase the level of trust in the quality of audit services. That is why it is necessary to increase interest in this problem. The purpose of this study was to determine theoretical issues related to the organization and methodology of control over state finances, as well as to provide recommendations aimed at improving the system of their audit. To achieve it, the following main tasks were solved: to study the theoretical provisions and peculiarities of the organization of the audit of state finances in Ukraine and in European countries; determine the essence of the accounting and analytical support of the state finance management system and consider the conditions for its creation; distinguish the positive and negative aspects of control over state funds in Ukraine and abroad.

## ■ MATERIALS AND METHODS

In the research process, the decomposition method was used, on the basis of which the system of managing funds belonging to the state was divided into subsystems and the sections, that will deal with it, were selected. In turn, subsystems – into functions, functions – into tasks, tasks – into subtasks, subtasks – into operations. The next method used at the stage of analysis of the management system of Ukraine and other countries is the method of chain substitutions. With the help of this method, the influence of various factors, both external and internal, on the formation of the management system was studied. The comparison method made it possible to compare the current system of state funds management in Ukraine with other systems that exist in European countries. The comparison made it possible to identify the positive and negative aspects of the management system, and the synthesis method allowed to develop proposals for its improvement based on the positive experience of other countries. Using the goal structuring method, the role of the audit of state finances and the compliance of its goals with the goals of the accounting and analytical support system and the state funds management system as a whole were substantiated. An important place in the methodology of this study belongs to the expert-analytical method, which explains the need to involve highly qualified experts – professionals, that is auditors.

The scientific research is based on a systematic approach and generalization of various economic phenomena and processes. The methods of grouping and abstraction, sampling were applied for the schematic presentation and study of the main components of the state finance management system. Using the methods of induction and deduction, the theoretical and methodological provisions of the audit of state finances were considered and the main reasons for their occurrence were identified. The method of generalization made it possible to identify and generalize the general features, as well as the properties of the system of accounting and analytical support for the audit of state finances. The methods of grouping, analysis and

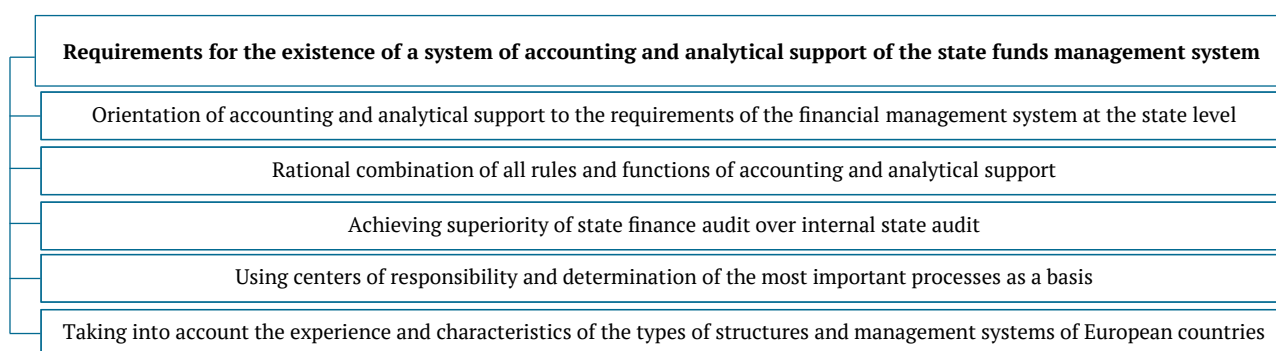
synthesis made it possible to divide the information collected for writing the article into certain parts, group it, combine various elements, as well as aspects of the research subject into a single whole. The abstract-logical method made it possible to determine the main categories, as well as concepts related to the research topic, to formulate conclusions and provide recommendations. Presenting the material in a more convenient form with the help of drawings and diagrams allowed the use of a graphic research method. The main materials used to solve the research tasks were legislative documents, normative legal acts, which relate to the issues of state finance audit. In addition, scientific publications of Ukrainian and other authors on the theory, methodology, methods and organization of financial control, instructional and methodical documents, materials of scientific and practical conferences; reporting, information-analytical and statistical materials of the Accounting Chamber of Ukraine, the Ministry of Finance of Ukraine, central executive authorities were used.

## ■ RESULTS AND DISCUSSION

The audit of state finances is a system of measures related to the optimization of resources that are state ones, as well as reducing the risk of detection of violations and

malicious appropriations in the state sector. It occupies an important place during control over the receipt and expenditure of state resources. Before assessing the state of use of state funds of Ukraine, it is also necessary to provide an assessment of such an important form of control in the general system of accounting and analytical support for the management of state funds.

In the economic literature, accounting and analytical support is defined as a set of ways and methods that make it possible to implement all the functions of financial control. According to T. Kucherenko & N. Anishchenko (2022), it is based on a combination of financial and intra-economic accounting system, the result of the interaction of which is the accounting and reporting information. With this approach, a combination of the main components of this system, their form and content is necessary. This condition can be met by combining accounting and analytical functions, which make it possible to improve the control over the state funds management system. It is important that accounting and analytical support is the main element of the information system for managing state funds. When creating a management system, a number of requirements must be met, the main ones of which are presented in Figure 1.



**Figure 1.** Conditions for creating a system of accounting and analytical support for the state funds management system

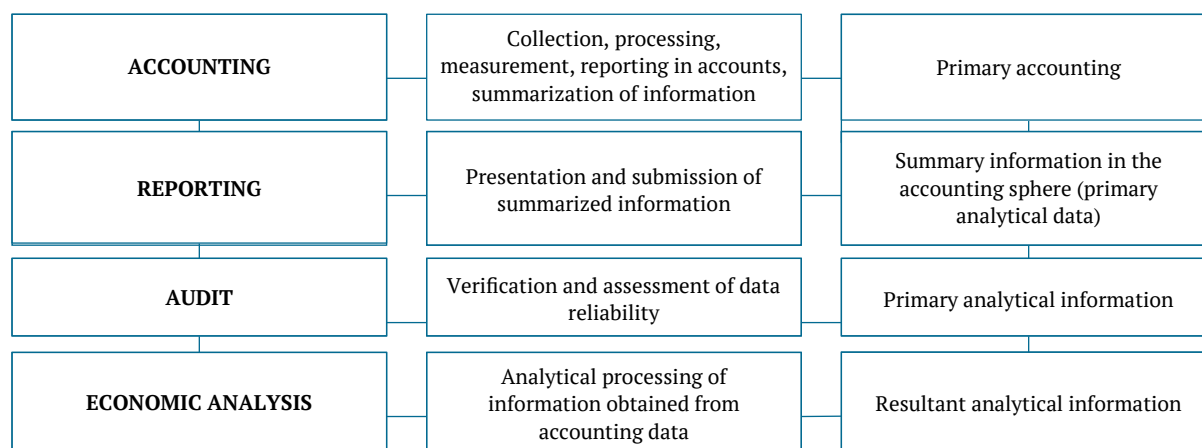
**Source:** developed by the author based on research by L. Borysenko (2020a; 2020b)

The main purpose of the accounting and analytical presentation in the state finance control system is the collection, operational processing and submission of analytical information on operations related to the receipt, expenditure and distribution of state budget funds in the current period and for the future; assessment of the state's level of provision of financial resources, which will make it possible to warn and reduce the level of uncertainty regarding their rational or ineffective distribution. It is expedient to form a single effective accounting and analytical system that would make it possible to combine all the information coming from various branches of management and to ensure control at the level of all financial and non-financial indicators of state finances, as well as to effectively distribute all information flows, connect all the information together, present it in the form of detailed analysis and reporting. A big problem that needs to be solved is the duplication of tasks and functions of various control bodies, which significantly complicates the movement, processing, submission of information, and, most importantly, causes significant difficulties in determining the level of responsibility in case of poor reporting.

An important part of this system is the audit of state finances, which has a managerial orientation, that is, its purpose is to check the legality and rationality of spending funds and property, other assets belonging to the state, the legality of internal control and its necessity, as well as increasing the level of management and control at all stages of the accounting and control process, choosing the best method of control over the management system of processes related to the receipt and distribution of state funds. Permanent control and internal control over the state's financial resources will ensure a reduction in corruption and increase public trust in state authorities. Accounting information is extremely important, as it allows systematization and accumulation of data reported in primary documents, accounting registers, reporting on the company's activities at all stages of the accounting and analytical process. At the same time, all analytical and accounting information is part of the accounting system, on the basis of which the control and analysis of the activities of enterprises is carried out. This means that the "accounting" part contains all important accounting information, both analytical and synthetic. The analytical component

embodies a certain type of information that was obtained from the accounting one, which is connected with the close relationship between these two components. That is why the category “accounting and analytical information” combines data created by operational and financial accounting and information created using methods of economic analysis. The definition of “accounting and analytical support

of the management system” is much broader than the concept of “accounting and analytical information” and combines the processes of supplying real and true information to users of financial statements and management and control bodies. Four stages of the process of preparation of accounting and analytical support can be distinguished: accounting, reporting, audit, analysis (Fig. 2).



**Figure 2.** The process of preparation of accounting and analytical support for the management system

**Source:** developed by the author based on research by O.H. Sokil (2020)

Audit is an important element of ensuring the quality of accounting and analytical information. It makes it possible to significantly reduce risks when making management decisions, which is especially relevant during the period of martial law. Supporting the opinion of A. Savchenko & V. Poliakov (2019), it can be said that in Ukraine in 2023 there is a large number of state enterprises and institutions, however, the vast majority of them work inefficiently or are in the stage of liquidation. All of them require financing from the state budget, but expediency and effectiveness of their use of budget funds require the functioning of a high-quality and modern system of financial control, a component of which is the state financial audit. In the process of preparing accounting and analytical information, an audit can be defined as an operational control that allows you to check the appropriateness and correctness of accounting information (internal state audit) or as a method of checking primary and reporting accounting information. It enables users to be assured of data authenticity, recognition, assessment, reporting, compliance and disclosure in all essential aspects (external audit). This assurance can be achieved through the auditor’s performance of mandatory procedures provided for by International standards on auditing (n.d.), in particular: identification and assessment of the risks of significant distortion of accounting information, assessment of the state of the internal control system of state-owned enterprises; selective verification of information regarding its recognition, submission and compliance.

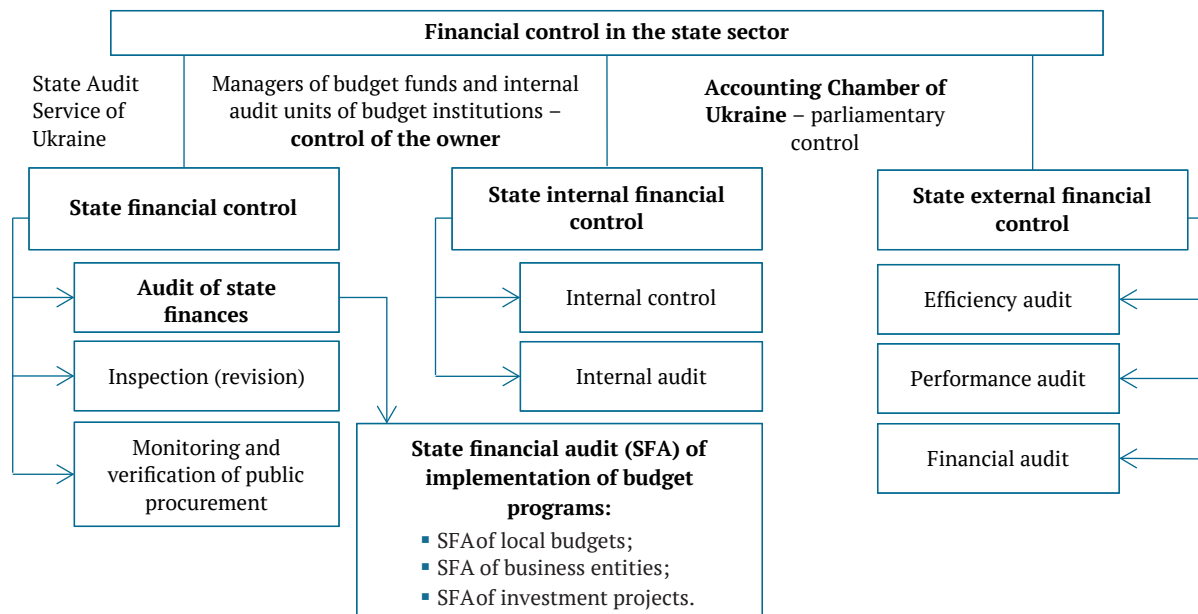
In the process of research, the areas of implementation of accounting and analytical support of the audit of state finances in the system of state funds management were determined. One of the most important is a detailed verification of the financial position of state-owned enterprises in order to prevent their insolvency (bankruptcy) or inefficient spending of budget funds. This can be achieved by as-

sessing the state of receipt and expenditure of public funds. Confidence in the financial position and solvency of competitors, establishing the expediency of their activities, taking into account all threats and risks should be no less important areas of management. For all users of information, both internal and external, the most complete information in the system of accounting, analysis and control, taking into account the tasks and interests of the state, individuals and legal entities in order to minimize internal threats and non-disclosure of commercial secrets should be an important factor. Joining A. Loishyn & K. Kustrich (2022) and T. Kosova *et al.* (2022), it can be noted that one of the most important components of the modern model of state control should not be the control by external and internal audit units, but first of all internal control, which should be carried out by managers of budget funds on the basis of risk-oriented approach in the management of state resources.

The generalization of the experience of the organization of control over state resources made it possible to form and schematically present the structure of the management of state financial control of Ukraine, to single out its main components. These include control over state finances, the central body of which is the State Audit Service of Ukraine, which is subordinate to the higher authorities. It is important to have state internal financial control, which is carried out by managers of budget funds and units that implement internal audit in state institutions. Only the presence of internal control will make it possible to ensure effective state (independent) external financial control, which is carried out by the Accounting Chamber of Ukraine, which is accountable to the Verkhovna Rada of Ukraine (Law of Ukraine No. 576-VIII, 2015). V.M. Prasiuk (2019) believes that the system of state financial control in Ukraine is quite developed but has a number of shortcomings related to the inappropriate and inefficient use of budget funds, the lack

of an appropriate legislative basis for control and financial activities. The components of financial control of the state

sector of Ukraine, taking into account the level of subordination of the control bodies, are presented in Figure 3.



**Figure 3.** Components of financial control in the state sector of Ukraine

**Source:** developed by the author based on the research by T. Kochyn (2020)

A schematic presentation of the components of state financial control in Ukraine shows that the central bodies that exercise state control over the effective receipt and expenditure of budget funds are as follows: the State Audit Service of Ukraine, which operates in the form of inspection and ensures the implementation of state policy functions in the field of state financial control and the Chamber of Ukraine, a state body, the main functions of which are control over the direct receipt and use of state budget funds and other operations that have financial and economic consequences, as well as control over compliance with legislation.

According to N.V. Shevchenko (2018), in order to understand the state financial audit of the implementation of budget programs, it is necessary to find out its relationship with the state financial audit and the audit of state finances. Quite often in the scientific literature, you can find the identification of such two concepts as “state financial audit” and “audit of state finances”. These concepts are new for Ukraine and not yet sufficiently studied. O. Shevchuk & A. Lisovyi (2020) gave the following definition: state financial audit is a process of control, verification and analysis of issues related to the legal and effective use of state funds, as well as property and other assets belonging to the state, reliability of accounting and financial reporting, functioning of internal control. A similar difficult situation arose with the definition of the concept of audit of state finances. In scientific works, the concepts of “audit of state finances” and “state financial audit” are often equated. Auditing public finances can be seen as the process by which the auditor provides assurance to the client that the information being audited is reliable and the decisions themselves can be recognized as correct.

It should be noted that as of 2023, there is a significant difference in the opinions of scientists regarding the

definition of “state financial audit” and “audit of state finances”, which are the basis of state control. In his works, S.V. Zlyvko *et al.* (2021) also notes the significant differences between the state financial audit and the audit of state finances and stresses the need to take into account subjects of state control during audits. In contrast to these works, the peculiarities of the normative and legislative regulation of state financial audit in Ukraine and its identification with the concept of state financial audit were considered in the article by A.M. Shtangret & L.P. Stetsiv (2019), who believe that these two concepts should not be distinguished because they share many common characteristics. A. Khmelkov (2022) summarized the experience of international institutions in matters of state financial audit and provided practical recommendations for its application. He devoted his attention to international organizations as the leading institutions of the control function of finance in the world. He also considers these concepts quite close and equivalent.

The author of the current article believes that it is necessary to distinguish between these concepts, as European countries do. In particular, one should agree with the opinion of N. Ljubisavljević & M. Grbić (2017) that these two concepts should not be confused and should be distinguished. Despite the fact that they have many common features, they also have a fundamental difference that concerns the subjects conducting the inspection. State financial audits are conducted only by state authorities, while the audit of state finances include those audit components that can be conducted by independent auditors and organizations. As a result of the generalization of scientific research, the author formulated a new vision regarding the definition of the audit of state finances. The audit of state finances is a systematic, comprehensive process of

independent verification (obtaining and assessing) of objective data on receipts and expenditures of state finances, which makes it possible to determine the level of their compliance with established criteria.

The scientist N. Çeku (2021) believes that for the effective functioning of the audit of state finances, it is necessary to take legal measures and find specialized authorities or develop effective mechanisms that would have the authority to exercise control and prevent possible abuse of power. These mechanisms should be an integral part of public administration and most countries have already developed institutional mechanisms that provide financial and legal control and assessment of government performance. The documentation of Serbia discusses the legal framework and the relationship of financial audit with other branches of government, as well as the challenges and prospects for the implementation of its recommendations by the state sector in the future. One cannot but agree with the opinion of B. Peci (2017), who believes that the state financial audit contributes to a significant reduction of the shadow economy and is an effective mechanism for combating non-payment of taxes to the state. C.J. Cordery & D. Hay (2019) draw attention to the fact that the main activity of audit firms should be aimed at verifying financial statements and conducting efficiency audits.

Summarizing the different opinions of scientists shows that the system of state funds management in Ukraine and other countries has many common features and management functions. A common feature of the building of the management system is that in all countries, in particular in Ukraine, audit is clearly defined by legislative and normative rules and regulations. In foreign countries, higher control bodies bear full responsibility for the reliability, timeliness and rationality of the distribution of state funds and ensuring an effective management system. Ukraine is a member of INTOSAI, which is the most important organization on audit issues in most countries of the world for more than 60 years and it establishes rules, develops scientific and methodological support for other supervisory bodies with the aim of promoting the development and transfer of knowledge, improving public auditing worldwide and increasing professional opportunities (INTOSAI, n.d.). According to the INTOSAI strategic plan for 2017-2022 (2017), this organization is autonomous, independent, professional and non-political. It promotes the exchange of ideas, knowledge and experience and also acts as the voice of higher financial control bodies in the international community, ensures high quality of audit. Ukraine is actively developing cooperation with its structural organization EUROSAI, which was established in 1990 (About EUROSAI, n.d.). This organization implements its policy through the development of various recommendations, proposals and the provision of consultations to the regulatory bodies of various countries. In addition, it also developed and effectively put into practice the International Standards of Supreme Audit Institutions (ISSAI), which contain guidelines for the organization of an effective audit, which are common to all types and forms of audits (EUROSAI professional standards, n.d.). Ukraine also effectively implements all these standards in its audit practice.

The number of enterprises that provide audit services is increasing every year, the sphere of audit is constantly developing. However, there are many difficulties in conducting audit procedures. This is due to a number of reasons, in particular: the state of war, the limitation of control procedures, the low level of the legislative framework in the specified area, the low quality of the provision of audit services and the excessively high price policy for conducting audits, layoffs, budget cuts, changes in regulatory requirements (Kulyk, 2022). Despite a fairly effective established system of state funds management that meets international requirements, long-term existence and constant improvement of audit procedures, auditing companies have a number of problems, shortcomings and unresolved issues that require further research and regulation at the legislative level. Joining the opinion of T. Kosova & V. Shevchenko (2018), it can be stated that the government should promote the transparency and openness of the external independent audit, since the audit report is an effective mechanism of the legitimacy of socio-economic decisions of state authorities.

An important problem is that clients often underestimate the volume of the work performed by the auditor and cannot explain the pricing policy of audit services. As a result, the inspection is of poor quality in the customer's opinion and there are many conflicts. An issue that also needs to be resolved is the lack of uniform norms and regulations on how the auditor should act in one or another case. The problem is getting worse in particular by the lack of a clear regulation and outline of the audit mechanism at the legislative level. Vagueness, variety of techniques and methods of conducting an audit result in the inaccuracy of the audit report. Another problem is the pricing policy for the provision of audit services, which currently takes place mainly at the level of contractual relations, differs significantly in different audit firms and is practically not controlled by the state. Distrust in auditing is also caused by the quality of inspections by most Ukrainian auditing firms and the extremely low qualification of auditors.

On the basis of the conducted research, a number of recommendations can be formulated for solving the most important audit problems: the presence of a clearly concluded and agreed contract for conducting audit inspections or providing services, where the entire amount of the auditor's work must be outlined and agreed with the customer. This is due to the fact that during the provision of audit services there are circumstances that are peculiar only to the field of audit, they cannot be completely tied to the existing general recommendations of The Civil Code of Ukraine (2003). When organizing an audit or providing related audit services, it is suggested to include in the contract, in addition to the basic general information, additional circumstances of cooperation, in particular: the auditor's mode of operation, his expenses, the procedure for refusing to provide services or suspending work, the auditor's clear tasks and the procedure for resolving disputes that will ensure complying with the proper conditions for the fulfilment of the terms of the contract and reducing the risk of conflict situations. It is recommended to increase control at the stage of obtaining auditors' certificates and increase state control over auditing activities, development of new and improvement of existing programs and the latest technologies, in which

the auditor could perform a number of technical aspects. On the Ukrainian market, such programs already exist, are being tested and are massively involved in the work of auditors, but they need improvement. For example, as O. Kudirko (2018) notes in his work, the first Ukrainian automated audit management information system that provides quality control of audit services is KIT.Audit, which automatically saves a document in its database. In addition, the Concept from the Ministry of Finance regarding changes to the Tax Code, which provides for the introduction of e-audit from January 1, 2023 for taxpayers using a standard audit file (SAF-T), was a big step towards the introduction of electronic audit (e-audit) which will be submitted at the request of the controlling authorities during the inspection. Draft Law of Ukraine No. 6255 "On Amendments to the Tax Code of Ukraine on the Implementation of Electronic Audits (E-audit)" (2021) was registered in the Verkhovna Rada.

Sharing the view of M.O. Knir *et al.* (2019), in the modern world it is impossible to find a country that does not use external borrowing to finance its own needs. However, it is the insufficient amount of funds that slows down the process of computerization of the audit, in particular, the high cost of computer programs and the need for their constant updating, as well as the low computer literacy of users, who need time and money to master them. In this context, joining the opinion of N. Elommal & R. Manita (2022), it is recommended to use blockchain technology when conducting an audit, which is a database in which it is possible to check and transfer information in real time, which can lead audit firms to creation of potential opportunities for the development of better services. According to A.M. Rozario & C. Thomas (2019) and Z. Tenyukh *et al.* (2022), blockchain, associated with the latest digital technologies and applications, can completely change the audit process by modifying the way the auditor accesses data, collects evidence and analyses data. When applying this technology, the auditor will have the opportunity to automatically process large arrays of information and direct efforts to verify more complex operations. Agreeing with V.Yu. Fabiianska & A.M. Beldii (2019), authors of the present research believe that the audit must be carried out using the latest computer technologies, and, as noted by V. Nevidomyi & K. Kanonishena-Kovalenko (2019) and M. Kuzub *et al.* (2022), any European integration processes in Ukraine should include not only carrying out reforms and approaching EU requirements, but also improving the image of all state institutions and the country as a whole.

In 2023, it is still quite early to predict any positive changes in the process of using blockchain technology when conducting audits in Ukraine. This is due to the martial law, the decrease in demand for auditing services and the lack of a legislative and regulatory framework in this area. Solving all these problems requires a lot of time and attention from the state authorities. However, scientific research suggests that the auditor profession will continue to develop and move along the vector of narrow specialists and digitalization, because reporting and the movement of state funds must be constantly controlled, in particular through the introduction of the latest technologies and programs.

## ■ CONCLUSIONS

The audit of state finances occupies an important part in the process of organizing accounting and analytical support for the management of state funds and contributes to their efficient and rational distribution. In accordance with the goal set in the work and based on the analysis of the basic conditions of the organization of the accounting and analytical support system, the main components that participate in the process of preparing the accounting and analytical support of the management system were singled out, in particular accounting, reporting, audit and analysis, which will enable to analyse timely the receipt and expenditure of state funds, check the conduct of business operations in various areas and directions, monitor the use of state funds and form analytical reports. The management structure of state financial control was built, its main departments, subdivisions and structures were established, positive and negative signs of the organization of state funds management in Ukraine were outlined based on foreign experience. The scientific achievements of scientists are summarized and common features and functions of state funds management in Ukraine and other countries are revealed, in particular, clear regulation of auditing activities by state authorities, application of International Auditing Standards and Methodological Recommendations developed by well-known international organizations INTOSAI and EUROSAI. The main international organizations that are engaged in providing methodological guidelines and developing practical recommendations for the effective organization and conduct of audits, in particular INTOSAI and EUROSAI, are considered, the main problems and incompletely studied scientific issues on this topic are outlined. These include the need to carefully study and agree on the terms of the audit contracts; regulation of the audit mechanism at the legislative level by approving a clearly established normative-legislative framework and regulation of price policy issues regarding the audit through legislatively based norms; restoring trust in auditors, which can be achieved by improving the quality of auditing services, auditors' qualifications, reviewing and improving the conditions for issuing certificates; increasing the level of audit automation. The theoretical and methodological principles of the audit of state finances are summarized by considering the evolution of the main concepts of audit activity, such as "audit of state finances" and "state financial audit", the contradictions of the opinions of various scientists regarding their essence and subjects and the presentation of one's own vision and definition of these terms are identified. The application of blockchain technology in auditing is proposed, which will make it possible to reduce the time and energy spent by auditors in the process of auditing. All these recommendations will contribute to increasing the efficiency of the audit organization; therefore, they require further scientific research in this direction and support from state authorities.

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## ■ CONFLICT OF INTEREST

None.

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## Роль аудиту державних фінансів в системі обліково-аналітичного забезпечення системи управління державними коштами

■ **Анотація.** В період воєнного стану набула важливого значення проблема необхідності здійснення постійного контролю за державними фінансами у зв'язку з їх обмеженістю та важливістю ефективного використання. Питання діяльності аудиторських фірм та ефективної організації проведення аудиту постійно перебувають у центрі уваги науковців. Метою статті було обґрунтування теоретичних аспектів та надання науково-практичних рекомендацій, спрямованих на вдосконалення аудиту державних фінансів. Використано метод індукції на етапі збору, систематизації й обробки інформації для проведення дослідження, дедукції – у процесі теоретичного осмислення основних питань і проблем аудиту державних фінансів та пошуку першопричин їх виникнення, узагальнення – під час виокремлення основних ознак та властивостей системи обліково-аналітичного забезпечення аудиту державних фінансів, методи порівняння, аналізу, синтезу, абстрактно-логічний метод. Узагальнено та проаналізовано наукові праці з метою визначення сутності важливих складових наукового дослідження, зокрема: аудиту державних фінансів, державного фінансового аудиту, обліково-аналітичної інформації, обліково-аналітичного забезпечення, а також визначено основні складові ефективної системи управління та контролю за державними фінансами. Схематично відображено основні компоненти фінансового контролю в державному секторі України, визначено місце аудиту державних фінансів як складової державного фінансового контролю. Обговорено необхідність розмежування понять «аудит державних фінансів» та «державний фінансовий аудит». Виокремлено основні умови, які сприяють створенню ефективної системи управління та контролю за державними коштами. Визначено спільні та відмінні ознаки контролю за коштами держави в Україні та зарубіжних країнах. Визначено основні проблеми та недоліки системи управління за державними коштами та надано рекомендації для їх вирішення. Результати дослідження можуть бути використані усіма державними підприємствами, які здійснюють пошук нових підходів до управління та прагнуть до ефективного розподілу державних коштів в умовах воєнного стану

■ **Ключові слова:** стандарти; достовірна інформація; ефективний контроль; аудиторська діяльність; технології блокчейну

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## Public debt shocks and macroeconomic stabilization in Nigeria: A new Keynesian approach

■ **Abstract.** The study examined the impact of public debt shocks on Nigeria's macroeconomic stability. This study aimed to evaluate the role of increasing public debt on macroeconomic variables in Nigeria using a New Keynesian approach to evaluate the effect of both external and domestic debt on macroeconomic stability and the impact of debt service on revenue on Nigerian macroeconomic stability. The dynamic stochastic general equilibrium model was adopted as an analytical tool using the Bayesian approach in a Matlab R2021a in a Dynare 4.6.4 environment to determine the influence of public debt shock on macroeconomic stability in Nigeria. It was discovered that a positive relationship exists between output (economic growth) and foreign debt in Nigeria within the period under review. It was also found that debt service to revenue ratio, interest rate, and domestic debt have a negative relationship with output (economic growth). As a result, an increase in external debt will positively impact output (economic growth). In contrast, an increase in the debt service to revenue ratio, interest rate, and domestic debt will have a negative transmission effect on Nigeria's macroeconomic stability. High debt service would impede growth by reducing public resources and productive investment that would otherwise be used to encourage growth. According to this result, external debt is the best option for capital projects rather than domestic debt, which is likely to affect the business environment negatively. This study is practically relevant to government, investors, scholars, and policymakers, especially those around fiscal policy, to guide them in advising the government on where to borrow for its capital projects when needed

■ **Keywords:** domestic debt; dynamic stochastic general equilibrium; external debt; gross domestic product

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## ■ INTRODUCTION

The primary goal of any developing economy such as Nigeria is to achieve sustainable economic growth while also expanding infrastructure and reducing the poverty level in the society. When the government fails to satisfy these growing needs due to its limited resources, it is forced to accept financial help from both the external and domestic sectors, much of which takes the form of debt. As noted by S.R. Dey & M. Tareque (2020), and A.O. Adetayo (2021), Nigeria has had to and continues to rely on public debt for its savings-investment gap and fiscal deficit since its independence. It is critical to emphasize that foreign and domestic borrowing is not a negative issue for a country, mainly when it generates a better yield than the cost of borrowing. Still, it becomes dangerous if not used properly and responsibly for what such money is borrowed for, primarily to finance a capital project that will positively influence the economy.

Nigeria is suffering economic issues because of its high levels of public debt, which has slowed GDP (Gross Domestic Product) growth, slowed export growth, lowered income per capita, and increased poverty. J. Salmon (2021) noted that raising public debt by one percentage point reduces GDP growth by 0.012% the following year while decreasing yearly average growth over the next five years by 0.028 percentage points. High levels of public debt in Nigeria have contributed to continuous inflation, eroding the purchasing power of the country's citizens. Public debt, which consists of both external and domestic debt, has affected interest rates in Nigeria, which is the cost of borrowing money, and it is thus a severe concern confronting the country that has attracted much attention among policymakers.

M. Shuaibu *et al.* (2021) studied Public Debt and Inflation in Nigeria and claimed that debt is an essential source of revenue for governments in both developed and developing countries. Debt is an essential source of funds in developing countries for bridging the gap between government revenues and expenditures, particularly in countries with fiscal deficits like Nigeria. M. Shuaibu *et al.* (2021) discovered a long-run connection between public debt and unemployment in Nigeria, demonstrating that increasing public debt produces more unemployment. Still, external debt causes more unemployment than domestic debt. External debt, according to A. Yusuf & S. Mohd (2021), is a hindrance to long-term growth while promoting growth in the short term. Domestic debt had a significant positive impact on long-term growth while negatively impacting short-term growth. Debt service payments, both long-term and short-term, reduced growth, confirming the debt overhang effect. This debt crisis affects not only Nigeria but most African countries, as evidenced by A. Nduricimpa (2020) study on the threshold impacts of public debt on African economic growth. According to the research, the overall sample has a 62-66% debt threshold. Low public debt is determined to be growth-neutral. However, high public debt is proven to be growth negative.

According to S.R. Dey & M. Tareque (2020), external and domestic borrowing, sometimes known as public debt, if properly used, would boost capacity and enhance growth, making debt productive and justifiable for the reason it is acquired. On the contrary, this debt may result in a budget deficit and excessive foreign borrowing, increasing the country's vulnerability to numerous shocks and crises

(Trusova *et al.*, 2022; Abbasova *et al.*, 2023). It decreases the efficiency of fiscal initiatives and limits the Central Bank's ability to raise interest rates to achieve monetary policy goals due to its influence on the budget deficit and debt.

Even though the potential consequences of high public debt on economic growth pose a severe concern for policymakers and public opinion, empirical studies on public debt shocks and the growth nexus in Nigeria are scarce. The broad objective of this study is to look at the effect of increasing public debt on the macroeconomic variables in Nigeria. Specifically, to explore the impact of external and domestic debt on macroeconomic stability in Nigeria and examine the effect of debt service to revenue on macroeconomic stability in Nigeria.

## ■ LITERATURE REVIEW

There are several theories in this area of research, such as the Ricardian equivalence theory, the Laffer curve, and many others. Nevertheless, it is essential to look at the two mentioned above. The Ricardian equivalence theory, proposed by David Ricardo in the early nineteenth century, stated that deficits postpone taxation. Tax timing cannot influence an individual's consumption decisions because it does not affect his lifetime budget limitations. The length of consumers' planning horizons determines the significance of this information. Fiscal policy that delays tax collection until after existing taxpayers have died may influence accurate economic decisions (Afonso & Ibraimo, 2020). The core premise (Adetayo, 2021) was that intergenerational benevolence might broaden planning horizons, reinstalling robust versions of Ricardian equivalence.

The Ricardian thesis's collection of implicit and explicit assumptions has lately been explained via theoretical work. Theoretically, both aspects of this claim are doubtful. According to one school of thinking, many parents will leave nothing to their children if fair inferences about preferences, productivity development, and wealth sharing are made (Philip, 2021; Hilton, 2021). The fundamental difficulty is that transfers may not flow from parents to their kids or from kids to parents. Several researchers have investigated models that allow both gifts and inheritances. Typically, there is a set of parameters for which transfers do not occur (Abubakar & Mamman, 2021). Scholars dispute the logic of rejecting preference specifications based on characteristics such as dynamical inconsistency (between members of succeeding generations) or utility stream divergence because they are founded on a priori assumptions. While consistency and convergence are analytically valuable properties, they cannot be justified as fundamental choice axioms.

The Laffer Curve is an economic theory examining tax cuts' effects on public expenditure, revenue, and long-term growth. In 1974, economist Arthur Laffer proposed the Laffer curve or theory. Tax cuts have two consequences on the federal budget, he claims: mathematical and economic. The arithmetic effect is one-to-one and immediate. Every dollar saved in taxes translates into one dollar less in government revenue. It also diminishes by one dollar the stimulating effect of government spending. The economic impact is long-term and compounding. Its impact may be more significant or less than the tax cuts (Hobela, 2020;

Stender, 2023). The Laffer Curve is a tax hypothesis that proposes an inverted U-shaped relationship between tax rates and government revenue. The best or optimal tax rate for an economy is precisely at the top of the inverted U (Ndoricimpa, 2020).

An examination of the existing literature reveals several trends in the findings. A. Afonso & Y. Ibraimo (2020), P. Burriel *et al.* (2020), and J. Jacobs *et al.* (2020) showed a negative connection between public debt and macroeconomic variables. However, L. Donayre & A. Taiwan (2017), S.R. Dey & M. Tareque (2020), and S.K. Hilton (2021) discovered a constructive impact connection between public debt and macroeconomic variables. Some studies, such as A. Imoisi (2021), K.O. Onyele & E.C. Nwadike (2021), and F.F. Adegbie *et al.* (2022), also found mixed results between public debt and indicators of macroeconomics in Nigeria. The general conclusion from these studies is that the results vary depending on various factors such as sample periods, methodology used, estimation techniques, variables used, and countries considered (developing or developed countries). Even though the results have been mixed, some omissions may have prompted additional research in this area. This study separately looked at external and domestic debt and Nigeria's debt service to revenue ratio amidst increasing public debt.

## ■ MATERIALS AND METHODS

The dynamic stochastic general equilibrium (DSGE) model is applied in this work. The DSGE is based on the micro foundation and price rigidity, among other basic assumptions. This work used the following procedures to solve the New Keynesian Model. The model was log linearized, solving the linear equations derived from the model, and the Bayesian technique was applied to the model. On the other hand, the study used the Euro Area and Global Economy (EAGLE) and European System of Central Bank (ESCB) models 2020 to assess the effects of public debt shocks on Nigerian macroeconomic stability. They modified the EAGLE and ESCB model to account for the country's unique characteristics. The EAGLE and ESCB model is calibrated for Nigeria and considers the rest of the world. On the fiscal side, all the model features improved the government sector, particularly the public debt. In the EAGLE and ESCB model, Income taxation on labour ( $\tau_t^L$ , in deviation from its steady state  $\tau^L$ ) is assumed as the primary fiscal instrument. It responds to changes in the debt-to-GDP ratio ( $B_t$ ) from the target ( $B^*$ ) with the sensitivity of ( $\zeta_B$ ) and the output gap where  $Y_t$  and  $Y^*$  reflect potential output. More formally, the equation is expressed as below:

$$\tau_t^L - \tau^L = \rho(\tau_t^L - \tau^L) + \zeta_B(B_t/B^* - 1) + \zeta_Y(Y_t/Y^* - 1). \quad (1)$$

For government spending (considered a general expenditure  $X_t$  in deviation from its steady state value):

$$X_t - \bar{X} = \rho(X_t - \bar{X}) + \zeta_B^X \log(B_t/B^*) + \zeta_Y^X \log(Y_t/Y^*). \quad (2)$$

The DSGE model must contain a sovereign risk premium to impact the debt level significantly. In a basic DSGE model, the starting level of debt has no effect on the size of multipliers. However, substantial evidence of an obstructive correlation between public debt and output exists. To

account for such consequences, this study allows for sovereign default due to the government's inability to raise the necessary cash to pay its debts.

As a result, because the likelihood of sovereign default is inextricably and nonlinearly linked to the level of public debt, the sovereign risk premium reacts to changes in the fiscal outlook. Sovereign default is related to the concept of a fiscal limit in the same way that G. Corsetti *et al.* (2013) do, with default occurring whenever the debt level exceeds the fiscal limit. A stochastic process represents the uncertainty surrounding the political process in the context of sovereign default to compute the budgetary limit. The government cannot raise additional tax revenue by raising tax rates if the tax rate is on the lower side of the Laffer Curve. P. Burriel *et al.* (2020) assume that the probability of default is proportional to the distance between a country's actual debt-to-GDP ratio,  $B_t$ , and its debt ceiling,  $\bar{B}$ . If the debt-to-GDP ratio surpasses the debt ceiling, the government will default with certainty, and the borrower will face a 30% ( $1 - \chi$ ), recovering just 70% ( $\chi$ ) of the total repayments. According to G. Corsetti *et al.* (2013), P. Burriel *et al.* (2013), and P. Burriel *et al.* (2020), the default probability  $\delta_t$  is defined by a two-parameter distribution function ( $F$ ):

$$\delta_t = F\left(\frac{B_t}{\bar{B}}, \alpha_1, \alpha_2\right). \quad (3)$$

The default probability's lean is determined by  $\alpha_1$  and  $\alpha_2$ . The closer the debt-to-ratio gets to the debt ceiling, the faster the default likelihood rises after another rise in public debt. As a result, the Euler equation for a family investing in public debt with a fixed gross interest rate of  $R_t$  must be updated to:

$$\lambda_t = \beta E_t \left[ \frac{R_t}{\pi_{t+1}} \lambda_{t+1} (1 - \delta_{t+1} (1 - \chi)) \right], \quad (4)$$

where  $\lambda_t$  is the marginal utility of household consumption,  $\pi_{t+1}$  determines (expected) CPI inflation, and  $\beta$  beta is the discount factor. The interest rate at which households are willing to invest in government debt grows in direct proportion to the likelihood of default. As a result, the government's interest payments must be adjusted accordingly. Equation 5 is built to modify the model equations that are used to compute the rate of return on physical capital investments, such as:

$$R_t^k = \pi_t [Q_t (1 - \tau_t^k) (1 - \bar{\omega} \delta_t (1 - \chi)) + \tau_t^k \delta_t^k] / Q_{t-1} - 1. \quad (5)$$

This is the conventional equation for estimating the return on capital private investment in the concept,  $R_t^k$ , in the investment adjustment cost, where  $Q_t$  is Tobin's  $Q$ ,  $\delta^k$  is capital depreciation,  $\tau_t^k$  the tax rate on capital returns (which implies that capital depreciation is tax-exempt), and  $\pi_t$  is CPI inflation. The term  $(1 - \bar{\omega} \delta_t (1 - \chi))$  is non-standard in this equation. It states that when the parameter  $\bar{\omega} = 1$ , the public sector's default probability overlaps with the private sector's default probability. This means that when the chance of a state default increases, the private sector and households will receive a higher interest rate on private investment to compensate for the (higher) estimated potential losses. In most cases, equation 6 is the Taylor rule, which is written as follows:

$$R_t = \phi R_{t-1} + (1 - \phi)[\bar{R} + \phi_\pi(\pi_t - \pi^*)] + \phi_Y \left( \frac{Y_t}{Y_{t-1}} - 1 \right). \quad (6)$$

When the forward guidance applies (equation 7), the extra dummy variable  $\|_{FG}$  controls for the duration of fixed nominal interests:

$$R_t = (1 - \|_{FG}) \left[ \phi R_{t-1} + (1 - \phi)[\bar{R} + \phi_\pi(\pi_t - \pi^*)] + \phi_Y \left( \frac{Y_t}{Y_{t-1}} - 1 \right) \right] + \|_{FG} \bar{R}. \quad (7)$$

The Taylor rule followed monetary authority. The private sector and long-term private debt must be investigated to determine its role, which is reducing in a high-debt economy. Private sectors can only borrow up to the value of their collateral, which is  $m_t$  (the loan-to-value ratio, which is thought to be exogenously time-varying) proportion of the predicted discounted value of the household's housing stock ( $p_t^h h_t$ ):

$$b_t^h \leq m_t E_t \frac{p_{t+1}^h h_t}{R_t / \pi_{t+1}}. \quad (8)$$

As a result, a high level of public debt exacerbates private-sector borrowing limits by lowering the value of the housing stock. Long-term loans need an annual repayment of  $\gamma \frac{b_{t-1}^h}{\pi_t}$ . This lowers the private debt limit since agents refund their debt when the collateral value falls below it. As a result, agents' borrowing limitations are dual and asymmetric in that collateral value only controls borrowing when it is more significant than annual loan payments. In contrast, agents still service their debt when it is less:

$$b_t^h \leq \begin{cases} E_t \frac{m_t}{R_t / \pi_{t+1}} p_{t+1}^h h_t & \text{if } E_t \frac{m_t}{R_t / \pi_{t+1}} p_{t+1}^h h_t + h_t \geq \gamma \frac{b_{t-1}^h}{\pi_t} \\ \gamma \frac{b_{t-1}^h}{\pi_t} & \text{if } E_t \frac{m_t}{R_t / \pi_{t+1}} p_{t+1}^h h_t < \gamma \frac{b_{t-1}^h}{\pi_t} \end{cases} \quad (9)$$

$$\gamma \frac{b_{t-1}^h}{\pi_t} \quad (10)$$

As a result, long-term debt functions as a buffer in the economy, restraining the fall in private lending but also delaying the decreasing process. The research has six exogenous shocks, which are presented in the form of equations below:

Technology:

$$\alpha_t = \rho_\alpha \alpha_t + \varepsilon_t^\alpha. \quad (11)$$

External Debt:

$$d_t^{ed} = \rho_e d_{t-1}^{ed} + \varepsilon_t^{ed}. \quad (12)$$

Domestic Debt:

$$p_t^{dd} = \rho_d p_{t-1}^{dd} + \varepsilon_t^{dd}. \quad (13)$$

Interest rate:

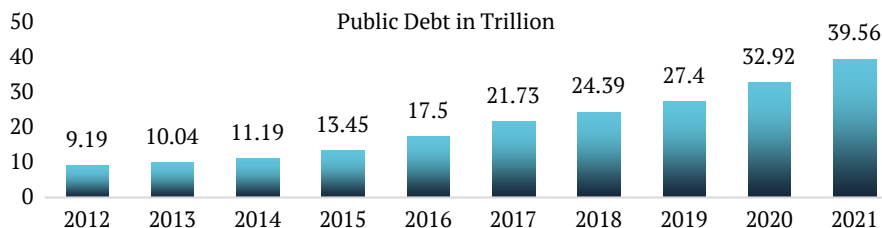


Figure 1. The trend of public debt in Nigeria

Source: made by the authors based on the data Total public debts (2021), Nigerian domestic & foreign debt (2022)

$$s_t^{sf} = \rho_s s_{t-1}^{sf} + \varepsilon_t^{sf}. \quad (14)$$

Output:

$$z_t^y = \rho_y z_{t-1}^y + \varepsilon_t^y. \quad (15)$$

Debt Service to Revenue Ratio:

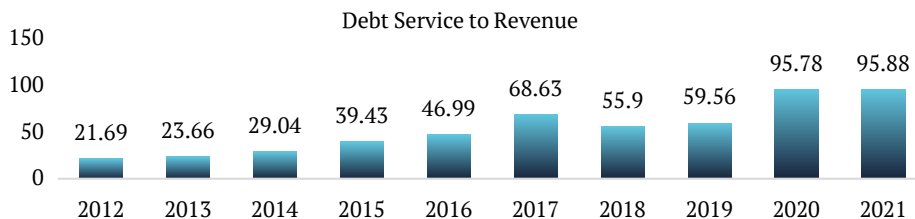
$$r_t^r = \rho_r r_{t-1}^r + \varepsilon_t^r. \quad (16)$$

where:  $\varepsilon_t^j \sim \text{iil}(0, \sigma_j^2)$ ;  $j = \alpha, d, p, r, y, rt$ . The study is based on the concept of a Small Open Economy. The economy trades with the rest of the world, but it is so small that it does not affect global prices, interest rates, or income, and the study has five optimizing economic agents. The estimated system of equations was derived from the following sources: the results of the decentralized optimization of each agent in the economy, the market clearing condition, and the shock processes. After getting the decentralized optimization of each economic agent, the market clearing condition and the shock processes result in an approximated system of equations. This collection of equations should have a single solution. This demands the same number of equations and endogenous variables. This circumstance is known as the Blanchard-Khan condition. This study also meets this requirement. The DSGE model simulation was achieved using Dynare 4.6.4 in a Matlab R2021a environment. This study used quarterly data from 1981Q2 to 2022Q1. The data was collected from the Central Bank of Nigeria Statistical Bulletin (Annual statistical bulletin, n.d.) and the World development indicators (n.d.).

## RESULTS AND DISCUSSION

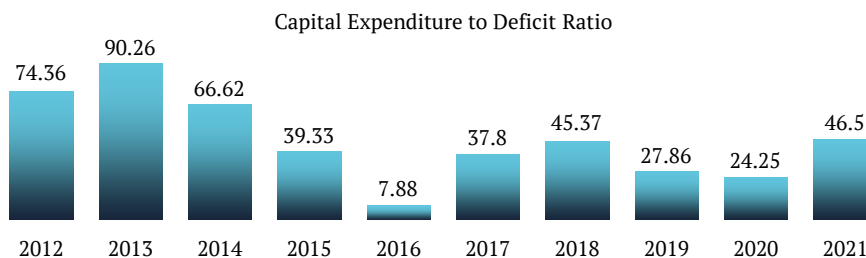
African countries such as Nigeria, Ghana, and Kenya have incredibly high public debt levels (Akhanolu *et al.*, 2014). Even with advances in reducing debt, levels will remain elevated for some time. The negative consequences of excessive debt levels go beyond the impact of decreasing. High debt can magnify and propagate shocks, limiting households and firms' ability to moderate consumption and investment and the government's ability to cushion unfavourable shocks (Sutherland & Hoeller, 2012; Ighodalo *et al.*, 2020).

The Public debt, debt service to revenue ratio, and capital expenditure to deficit in Nigeria have taken different trends, which has a transmission impact on macroeconomic variables in Nigeria. To ensure macroeconomic stabilization, the following indicators are essential to achieving that. From 2012 to 2021, these indicators have taken different trends, as shown in the Figures below (Fig. 1-3):



**Figure 2.** Debt service to revenue ratio

**Source:** made by the authors based on the data Total public debts (2021), Nigerian domestic & foreign debt (2022)



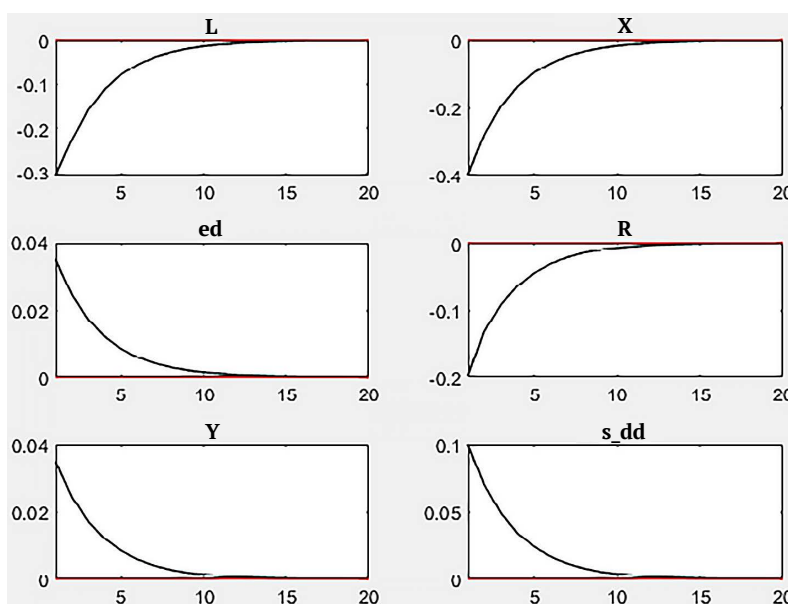
**Figure 3.** Capital expenditure to deficit proportion

**Source:** made by the authors based on the data Total public debts (2021), Nigerian domestic & foreign debt (2022)

This section presents the empirical results of the dynamic stochastic general equilibrium model simulation. Results are obtained using Dynare 4.6.4 on Matlab R2021a to run the codes from the system of equations and the exogenous processes. Model Summary:

- The variables in the model: 13
- The stochastic shocks in the model: 6
- The state variables in the model: 8
- The jumpers in the model: 1
- The static variables in the model: 4

The New Keynesian school pioneered the DSGE macro-economic modeling (Alege, 2012; Oye, 2018). The DSGE is based on fundamental assumptions like price rigidity, economic uncertainties, and competition. An essential phase in the DSGE model is impulse response function output. The main goal is to explain how variables in a model change due to the shocks in the model under investigation. This feature allows us to trace the spread of a single shock within a complicated system of equations, making them handy tools for evaluating economic strategies (Fig. 4).



**Figure 4.** Impulse responses to shock

**Note:** L – Technology; X – Debt Service to Revenue Ratio; ed – External Debt; R -Interest Rate; Y – Output; dd – Domestic Debt

**Source:** made by the authors using Matlab R2021a and Dynare 4.6.4

Examining links between Nigeria's public debt shocks and macroeconomic stability entails investigating the direction and magnitude of the relationship between public debt and macroeconomic indicators in Nigeria, such as output (GDP growth rate). Numerical simulation was performed on the system of equations using the first-order Taylor's approximation approach. The simulation was carried out using Dynare software in a Matlab environment. Dynare software outputs in a Matlab environment are given in tabular form.

The covariance matrix quantifies how much two random variables fluctuate in tandem. It calculates the covariance between each column of the data matrix. The dispersion matrix and variance-covariance matrix are other names for the Covariance Matrix. A covariance matrix is valuable for separating structural relationships in a random variable matrix. This can be used for conventional mode variables or to transform other variables. This process was achieved in a Matlab R2021a environment since it is a complex process that cannot be achieved manually (Table 1).

**Table 1.** Matrix of exogenous shocks

Shocks	eps_ed	eps_dd	eps_r	eps_y	eps_x
eps_ed	0.010000				
eps_dd	0.000000	0.010000			
eps_r	0.000000	0.000000	0.010000		
eps_y	0.000000	0.000000	0.000000	0.010000	
eps_x	0.000000	0.000000	0.000000	0.000000	0.010000

**Note:** eps: Shocks, ed - External Debt; dd - Domestic Debt; R - Interest Rate; Y - Output; X - Debt Service to Revenue Ratio  
**Source:** calculated by the authors using Matlab R2021a and Dynare 4.6.4 output

The sample moments are the theoretical moments of the sample distribution. Statistics such as production, foreign debt, domestic debt, debt payment to revenue ratio, and

interest rate were examined because they are required to verify the results of the numerical simulations in the DSGE model. The result of the theoretical moments is presented in Table 2.

**Table 2.** Theoretical moments result

Variables	Definition	Mean	Standard Deviation	Variance
X	Debt Service to Revenue Ratio	0.0000	0.4552	0.2072
R	Interest Rate	0.0000	0.1136	0.0129
Ed	External Debt	0.0000	0.0398	0.0016
Y	Output	0.0000	0.0397	0.0016
Dd	Domestic Debt	0.0000	0.0021	0.0000

**Source:** calculated by the authors using Matlab R2021a and Dynare 4.6.4 output

The degree of correlation of the same variables between two consecutive time intervals is defined as autocorrelation. Statistics are also required to examine the outcomes of numerical simulations in the DSGE model. This study

examined output, external debt, domestic debt, debt service to revenue ratio, and interest rate. Table 3 presents the coefficients of the autocorrelation result. The matrix result in Table 4 results from the DSGE model's dynamic simulation.

**Table 3.** Coefficients of autocorrelation

Variable	Definition	1	2	3	4	5
X	Debt Service to Revenue Ratio	0.5476	0.2447	0.0461	-0.0785	-0.1513
R	Interest Rate	0.5493	0.2456	0.0465	-0.0786	-0.1515
Ed	External Debt	0.5476	0.2447	0.0461	-0.0785	-0.1513
Y	Output	0.5493	0.2456	0.0465	-0.0786	-0.1515
Dd	Domestic Debt	-0.0742	-0.0709	-0.0661	-0.0604	-0.0541

**Source:** calculated by the authors using Matlab R2021a and Dynare 4.6.4 output

**Table 4.** Matrix of Correlations

Variables	Debt Service to Revenue Ratio (X)	Interest Rate (P)	External debt (ed)	Output (Y)	Domestic debt (dd)
Debt Service to Revenue Ratio (X)	1.0000	0.0998	-0.995	-0.9937	0.0519
Interest Rate (R)	0.0998	1.0000	0.0000	0.0000	0.0000
External debt (ed)	-0.7950	0.0000	1.0000	0.8986	-0.0522
Output (Y)	-0.8937	-0.7890	0.7986	1.0000	-0.0000
Domestic debt (dd)	0.0519	0.0000	-0.0522	-0.0000	1.0000

**Source:** authors' computation using Matlab R2021a and Dynare 4.6.4 output

The results demonstrate that output is positively related to external debt. In contrast, debt service to revenue ratio, interest rate, and domestic debt are negatively related to output, which was used to present gross domestic product. As a result, a rise in the debt service to revenue, interest rate, and domestic debt will have a negative transmission effect on Nigeria's macroeconomic stability. It is critical to remember that high debt service would impede growth by reducing public resources and productive investment that would otherwise be used to encourage growth. Lower financing costs can also boost borrowing and investment, allowing the government to lower interest rates to stimulate economic growth. However, when interest rates are high, it discourages borrowing, which has a negative impact on the business environment and can impair economic growth. Furthermore, domestic debt can quickly and severely crowd out private credit.

After an in-depth study of public debt shocks and macroeconomic stabilization in Nigeria, it was discovered that there is a positive relationship between output and external debt, whereas debt service to revenue ratio, interest rate, and domestic debt have a negative relationship with output (economic growth). The implication of increasing the debt service to revenue ratio, interest rate, and domestic debt will have a negative transmission effect on Nigeria's macroeconomic stability. The debt service to revenue ratio quantifies how much of a country's revenue is utilized to pay debt interest and principal. It reflects a country's financial viability and stability and its willingness to spend on public services and development. When a country's debt service to revenue ratio is high, it has some economic implications, such as the inability of a country to invest in productive and development projects. When interest rates rise, enterprises and individuals cut back on their spending. Customers and business owners will increase spending when interest rates decrease dramatically, causing stock prices to go up. This result explained the recent effect of rising interest rates in Nigeria (2010 to 2023).

Given this fact, Nigeria's external and domestic debt has recently been increasing. For example, according to the Debt Management Office (DMO), domestic debt increased to N26.23tn (\$63.24bn) due to new borrowings by the government to partially finance the deficit in the 2022 Appropriation, while external debt remained constant at N16.61tn (\$40.06bn) from Q1 to Q2 2022, bringing the total public debt to N42.84tn (\$103.30bn) as of September 2022. This high public debt profile also transmits government revenue through the debt service to revenue ratio. It is worth noting that as the public debt keeps rising, it also has a transmission effect on Nigeria's debt service to revenue ratio. The implication of increased levels of public debt shifts income from future generations to those alive now, while the cost of servicing that debt increases the burden on current and future taxpayers while providing an opportunity cost that prevents governments from spending in other areas or lowering the tax burden.

J. Jacobs *et al.* (2020) evaluated the link between public debt ratios and economic growth rates in 31 European Union and OECD (Organisation for Economic Co-operation and Development) countries. In the study, panel VAR (vector autoregressive) model, the long-term real interest rate on government bonds was used to transfer shocks in both the

public debt-to-GDP ratio and the pace of economic growth. Regardless of the public debt ratio level, the study found no causality between public debt and growth. The study, on the other hand, revealed a relationship between government debt and growth. According to the study, exploring why one country's long-term interest rate remains relatively low despite sizeable public debt while another grows dramatically under comparable conditions is vital. Using the same model, A. Chudik *et al.* (2017) find no evidence for a generally applicable threshold effect in the link between debt and growth. A. Imoisi (2021) used the autoregressive distributed lag (ARDL) bounds test to examine the impact of public debt sustainability in Nigeria within a multivariate framework and discovered a positive and significant impact on public debt both in the short and long run, while interest rates and inflation rates were negative and statistically insignificant. K.O. Onyele & E.C. Nwadike (2021) used the ARDL model to explore the influence of Nigeria's national debt load on economic stability and identified a diminishing impact on economic stability in the long run, with revenue adequacy having a negative and significant impact. All components of the debt burden negatively and substantially influenced economic stability in the short run. In contrast, the exchange rate positively and considerably impacted economic stability in the long term.

In the study by A. Yusuf & S. Mohd (2022) the ARDL Bounds Test for Co-integration was used to examine the growth and fiscal effects of insecurity on the Nigerian economy, focusing on public debt. They discovered that high unemployment, domestic capital formation, foreign direct investment, and government spending on education and security are negatively affected by rising levels of insecurity, slowing growth in both the long and short run. On the other hand, improved health care, equal income distribution, and productive use of public borrowing were positively connected with security and boosted growth in both the long and short run. E.O. Ogbaro *et al.* (2022) used threshold regression methodology to examine Nigeria's nonlinear relationship between public debt and economic growth. They discovered that the debt-to-GDP ratio and the level of corruption have a negative impact on growth, while public debt has a positive and significant impact. A. Akanbi & S.A. Olaoluwa (2022) used the Ordinary Least Square (OLS) approach to study the association between sub-national public debt and economic growth in Nigeria. The study found a positive but non-significant association between Nigeria's sub-national public debt, capital spending, and economic growth, while the sub-national government budget deficit had a negative but non-significant impact on economic growth. F.F. Adegbe *et al.* (2022) used OLS to investigate Nigeria's public debt management and economic growth. The findings suggested that public debt management and actual gross domestic product (RGDP) had a positive significant effect, while RGDP and interest rate had a negative effect.

The findings of this investigation were mixed. The study discovered that output is positively related to external debt, whereas debt service to revenue ratio, interest rate, and domestic debt are negatively related to output. This analysis differs from the previous analyses in that it separates public debt components. This will aid the study in determining the impact of each component

of state debt (both external and domestic debt). This is to determine the true impact of each component of state debt (external and domestic debt) on Nigeria's macroeconomic stability. The dynamic stochastic general equilibrium (DSGE) was also used in this investigation. The DSGE model is beneficial in this study because it describes how external and domestic debt shocks operate as drivers of economic dynamics, which differs from the methods used in the previous studies.

## ■ CONCLUSIONS

Nigeria has had to rely on debt recently and continues to rely on public debt to manage its savings-investment gap and fiscal imbalance since its independence. Since evaluating how this rising public debt has contributed to macroeconomic stabilization in Nigeria is imperative, the study separately examined both external and domestic borrowing in Nigeria. The study also used the debt service to revenue proportion as one of the variables in the model amidst rising debt and debt service to revenue ratio. The DSGE model was used as an analytical tool in the study to determine the influence of public debt shock on macroeconomic stability in Nigeria. It was discovered that output has a positive relationship with external debt, whereas debt service to revenue ratio, interest rate, and domestic debt have a negative relationship with output. As a result, an increase in the debt payment to revenue ratio, interest rate, and domestic debt will have a negative transmission effect on Nigeria's macroeconomic stability.

Interestingly, it is essential to point out that previous studies also indicated mixed results, similar to this study. It has been discovered that some independent variables

are positively related to output, while some are negatively related to output. Others found a negative relationship between the independent variables and output, and some found a positive relationship in Nigeria. The general observation is that the result of such a study has been mixed. This might result from the method used, variables in the model or the scope of the study. These results have implications for the economy. It is imperative to note that high debt service would impede growth by reducing public resources and productive investment that would otherwise be used to encourage growth. According to the study's results, the government should direct the borrowed funds toward diversifying the economy's productive base. This will contribute to long-term economic growth, broadening the income base and increasing the ability to repay the present debt when it becomes due. The study's primary contribution is fiscal measures that stimulate domestic resource mobilization, efficient debt management procedures, and dependence on domestic debt rather than external debt to finance more significant deficits to accelerate growth. It will be interesting to conduct a study that will use the new methods in executing the DSGE model, namely significant data approaches such as Machine Learning, and other derived methods such as the Heterogeneous Agent New Keynesian (HANK).

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## ■ CONFLICT OF INTEREST

None.

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## Шоки державного боргу та макроекономічна стабілізація в Нігерії: новий кейнсіанський підхід

■ **Анотація.** У дослідженні проаналізовано вплив шоків державного боргу на макроекономічну стабільність Нігерії. Метою дослідження було оцінити вплив зростання державного боргу на макроекономічні змінні в Нігерії, використовуючи новий кейнсіанський підхід для оцінки впливу зовнішнього та внутрішнього боргу на макроекономічну стабільність, а також впливу обслуговування боргу на доходи на макроекономічну стабільність Нігерії. Для визначення впливу шоку державного боргу на макроекономічну стабільність в Нігерії застосовано динамічну стохастичну модель загальної рівноваги як аналітичний інструмент з використанням байєсівського підходу в середовищі Matlab R2021a в пакеті Dynare 4.6.4. Виявлено, що протягом розглянутого періоду існує позитивний зв'язок між обсягом виробництва (економічним зростанням) та зовнішнім боргом Нігерії. Також встановлено, що відношення обслуговування боргу до доходів, відсоткова ставка та внутрішній борг мають негативний зв'язок з обсягом виробництва (економічним зростанням). Як наслідок, збільшення зовнішнього боргу позитивно вплине на обсяги виробництва (економічне зростання). Натомість збільшення співвідношення обслуговування боргу до доходів, відсоткової ставки та внутрішнього боргу матиме негативний трансмісійний ефект на макроекономічну стабільність Нігерії. Високі витрати на обслуговування боргу перешкоджатимуть зростанню через скорочення державних ресурсів та виробничих інвестицій, які могли б бути використані для стимулювання зростання. Відповідно до цього результату, зовнішній борг є кращим варіантом для капіталовкладень за внутрішній борг, який, найімовірніше, матиме негативний вплив на бізнес-середовище. На практиці дане дослідження є важливим для урядовців, інвесторів, науковців та політиків, зокрема тих, що працюють у сфері фіскальної політики, оскільки дослідження може допомогти у наданні рекомендацій уряду щодо того, де у разі потреби запозичувати кошти для фінансування капітальних проєктів

■ **Ключові слова:** державний борг; динамічна стохастична загальна рівновага; зовнішній борг; валовий внутрішній продукт

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## Implementation of modern marketing tools in entrepreneurial activity

**Abstract.** Marketing activity focuses on new forms of relations with consumers, and marketing communications determine the current research topic and its relevance. The purpose of the study was to substantiate the use of modern marketing tools in business activities to ensure the sustainable development of the enterprise. During the research, empirical methods were used to review and comprehensively present indicators and features of marketing activity and marketing tools, analysis, and synthesis for a visual representation of the features of marketing tools in use in modern conditions of entrepreneurial activity. Objective information on the state of the industrial products market and the presented elements of the industrial enterprise's marketing activities have been systematized and analysed. A detailed analysis of current trends in the development of marketing activities and the impact of information technology on the development of entrepreneurship is carried out, which is now the basis for the formation of the necessary set of marketing tools that can be used to improve the efficiency of the enterprise. It was determined that in the transition to market mechanisms of functioning, Ukrainian machine-building enterprises needed to optimize their activities, considering the mutual influence of the components of each enterprise's external market and internal marketing environment. It was concluded that Ukrainian enterprises are forced to pay great attention to the processes in a rapidly changing external

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environment to adapt and adapt to them promptly; this is especially important for industrial enterprises focused on marketing activities. The presented research in the form of recommendations for using marketing tools has practical significance for modern business structures

■ **Keywords:** marketing complex; marketing activity; Internet marketing; marketing technologies; a set of marketing tools

■ **INTRODUCTION**

Modern enterprises stand on the path of rapid information space and environment development. The formation of the era of the information society provides restructuring in adopting management decisions on organizational structures at all enterprises. Stable operation on the market is only possible with gradual and coordinated marketing. Under such conditions, the problem of obtaining, collecting, accumulating, analysing, organizing, and rationally using a significant amount of operational and reliable information for decision-making related to various marketing functions is becoming more and more relevant. Therefore, the most important goal of modern marketing activity is to identify new, not yet satisfied needs or new forms of meeting already known needs, orienting production to meet the existing demand, and, thanks to this, staying ahead of competitors. Modern entrepreneurial thinking proceeds from the fact that the sales market is the starting point of all enterprise business activity. Y.-C. Huang (2022) claimed that every enterprise, firm, or organization lives thanks to the market and for the sake of the market. In this regard, marketing activity integrates and coordinates all management functions at the enterprise and directs them to the object of marketing activity – the sales market.

W.G. Zikmund & M. D’Amico (1998), Ye.V. Saveliev *et al.* (2008), P. Kotler *et al.* (2016) determined that the priority directions for the development of marketing activities of enterprises shortly will be focused on increasing the efficiency and optimization of data collection, storage, processing, and analysis, establishing individual sustainable relationships and communications with consumers. Under such conditions, it is necessary to determine the indicators of marketing activity, which will reflect modern trends in marketing development. H. Krchova & K. Švejnová Hoesová (2021) considered that the problem of developing marketing indicators covers a relatively wide range of research and practical aspects of marketing, for example, evaluating the profitability of marketing investments, describing the structure and relationships between internal marketing and financial indicators, evaluating client assets, brand assets, long-term and short-term effects

of marketing expenses, etc. Marketing theorists and practitioners have developed many indicators for evaluating marketing. The researchers (Kotler, 2003; Ambler, 2004; Evans & Berman, 2009) studied how the leading marketing researchers use 15 indicators that allow a comprehensive assessment of marketing effectiveness: 1) brand awareness; 2) consumers who tried the product before purchase (test-drive); 3) the level of customer churn (churn); 4) level of satisfaction; 5) take rate; 6) profit; 7) net discounted value; 8) internal rate of return (IRR); 9) payback lesson; 10) customer lifetime value (CLTV); 11) cost per click; 12) conversion ratio (TCR – transaction conversion ratio); 13) return on investment in advertising; 14) bounce rate; 15) word-of-mouth marketing.

The famous American marketing scientist, P. Kotler (2003), defined Marketing as a social and managerial process aimed at satisfying the needs and needs of individuals and groups through the creation, supply, and exchange. Companies create value for consumers (in the form of a product or service) and develop a strong relationship with them to receive value from them in return (cash). According to P. Kotler *et al.* (2016), the definition of marketing is based on the exchange process and recognizes the importance of the “value” of the product for the end consumer. In works (Ambler, 2004; Kotler *et al.*, 2016; Flaig *et al.*, 2021), the following conclusion was made that marketing activity can be understood as a social-management process, with the help of which individuals and groups of people, through the creation of products and their exchange, get what they need. Thus, the purpose of the study was to determine the features of the implementation of modern marketing tools in business activities.

■ **THEORETICAL FRAMEWORK**

The target setting of the enterprise, which requires systematic analysis, includes five parameters presented in Figure 1 – market products, market, customer needs, turnover and market share, and market position. Parameters of marketing goals will now be examined from the point of view of small and medium-sized enterprises.

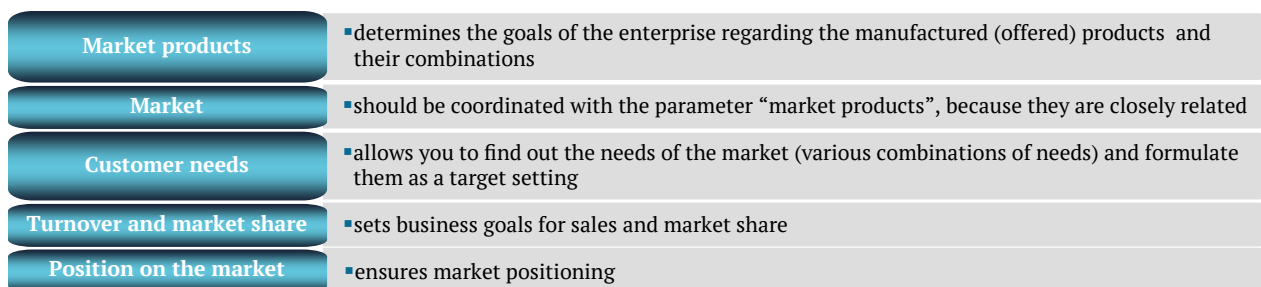


Figure 1. Parameters of marketing activity

Source: formed based on sources T. Ambler (2004), J.R. Evans & B. Berman (2009), P. Kotler *et al.* (2016)

Market products. Production of marketable products is the main task of any enterprise. As a rule, the market is offered not one type of product (one product or one service) but some combination of them. These goods and services exist next to each other or are closely related. In the first case, the company manufactures and/or sells various products: the carpenter is also a glazier and produces not only furniture and interior items but also window frames and doors; the bookseller includes electronic computing equipment and software in his assortment; the company engaged in the sale and installation of household electrical appliances also deals with some types of sanitary and hygienic equipment, etc. (Ambler, 2004; Evans & Berman, 2009; Kotler et al., 2016). In the second case, the primary services are offered with additional and auxiliary services: the dealer not only sells cars but can also provide financial services at the client's request; the trust company simultaneously provides consultations to enterprises; the seller of household electrical appliances supplies not only new refrigerators but also helps the buyer get rid of old equipment.

Market. When a company offers its products or combinations to the market, it is rarely a single market (in a geographic or demographic sense) (Nesterenko, 2023). Usually, a construction company develops several local markets by creating branches. The house of ready-made clothes offers it to both women and men, is engaged in the search for new, additional groups of buyers, and opens a children's clothing department. The grocery store serves individual families and wholesale customers (Bozhkova et al., 2018; Khaminich et al., 2019). Market products and the market are naturally very closely related. Only some things that can be put on the market should be produced immediately by a small or medium-sized enterprise. In some areas, competitors may be more assertive. In other areas, well-thought-out market segmentation may be required because otherwise, too wide a range of products will be supplied to too small markets, leading to weakening and irreparable losses in small and medium-sized enterprises.

Customer needs. The needs of the clientele determine demand in the market. Market research and market forecasting are primarily used for their analysis. The need is a feeling of lack of something and a desire to eliminate it. Primary, additional, and secondary needs are distinguished. The main ones are initial, causal needs that reflect a feeling of scarcity in essential goods and services: hunger causes a need for food, fatigue – for comfortable furniture (chairs, beds), a sense of shame or bad weather – for clothes, etc. In today's markets, only basic needs no longer determine a customer's purchase decision (Rüßmann et al., 2015; Krysovaty et al., 2018; Shtal et al., 2018a). Additional needs are inextricably linked (in the consumption process) with basic needs. There are psychological, technological, and economic additional needs.

Psychological ones are, for example, the need for beauty and aesthetics, the desire for prestige or power, the desire for completeness in something (collecting), entertainment, a sense of responsibility for others (parental concerns), and passion for new sensations. Security needs are critical, expressed, in particular, in the demand for services in the form of insurance, competent advice, protection of valuables, and physical means of life protection. Technological additional needs related to the operation of technical

means (machines, devices, equipment). They are related to convenience in handling equipment. This also includes the need for complex furniture or word-processing programs (Shtal et al., 2018a; Shtal et al., 2018b). Finally, additional economic needs include economical handling of goods and services, for example, economical electricity consumption, ensuring a high residual value, increasing the necessary intervals between maintenance, purchasing service subscriptions, etc. Secondary needs are not related to primary needs. This includes needs for home delivery of goods, providing loans, training and special training, maintenance and repair, information, etc.

Turnover and market share. This setting sets the company's sales and market share goals. Such quantitative goals should be determined for long periods. Market share can be a significant indicator for small and medium-sized enterprises. These enterprises must pursue a clearly expressed policy of finding market niches to achieve a high market share, even with small sales volumes. Under normal conditions in general markets, in competition with large companies, they cannot do this. Small and medium-sized enterprises usually specialize in a single isolated market and can achieve a high share in specific market segments (Kotler, 2003; Kotler et al., 2016; Reznikova et al., 2019).

Position on the market. This parameter establishes a goal regarding the desired position of the enterprise in the market. It depends on the degree of horizontal and vertical integration of the offered services, the readiness to ally with someone, the amount of desired autonomy, industry specifics, and the company's image. Marketing goals should be formulated taking into account all five goal-setting parameters. None of them can be considered in isolation from the others. Moreover, all of them must be connected or dependent on each other. Therefore, coordination between them is necessary. The specified parameters, related to each other in all directions, form a "five-pointed star". This analytical and systemic view of the path to marketing goals can seem overly abstract and complex. However, any enterprise must collect information about itself and its business environment and consider the future. Moreover, if the entrepreneur is seriously engaged in this, then formulating marketing goals seems easy to him.

## ■ MATERIALS AND METHODS

During the research, empirical methods were used. Observation, forecasting – for an overview and comprehensive presentation of indicators and features of marketing activity and marketing tools. Analysis, synthesis, and abduction were used for a visual representation of the features of marketing tools in application in modern conditions of entrepreneurial activity. Each method is used at a particular stage of solving the tasks. That is why it was advisable to move on to consider each of the indicated methods separately. For example, using the descriptive research method to describe the enterprise's marketing processes was advisable, which would speed up the adoption of marketing and management decisions. The method of forecasting was used to determine scientifically based prospects of the general dynamics of events in the future, for example, the sequence of using marketing tools to promote the company's products on the market or the company itself as a whole. The abduction method helped build

several hypotheses, that is, proposals based on assumptions about the specific problem of marketing activities and the relationship with entrepreneurship. For example, to form a hypothesis regarding adapting marketing tools to the requirements of the modern world market. The graphic method was used to visually display the sequence of implementation of marketing tools and a set of actions for promotion on the market. The presentation of research results was more systematized in tables and figures. The analysis method was used to study the experience of using marketing tools and their possible adaptation to environmental changes in the conditions of globalization. It also considered the main obstacles to using marketing tools.

The method of synthesis, combining phenomena and knowledge, was used to expand previous experience and ascertain new results of expertise. A distinctive feature of synthesis was that this method was implemented outside of existing frameworks. For example, using some marketing tools in a new variation. Also, when studying the behaviour of consumers of innovative goods and services. This, in turn, leads both to the modernization of modern marketing tools and to the design and specification of the changing needs of consumers of goods in the newest products on the market. A general indicator based on quantitative characteristics was obtained based on multivariate analysis methods. The taxonomic method was used to calculate integral indicators of the financial and economic state of the enterprise and the use of information technologies in marketing activities for 2021 for ten industrial enterprises of the Kharkiv region. Thus, each of the considered methods helped solve a separate research task. In their aggregate, they helped formulate appropriate marketing and management solutions, increasing the enterprise's competitiveness.

## ■ RESULTS AND DISCUSSION

Characterizing marketing activity, the following trends in its development can be noted (Zikmund & D'Amico, 1998; Evans & Berman, 2009; Kotler *et al.*, 2016). If unsaturated markets are characterized by "product-oriented" marketing activity, then modern marketing activity is "consumer-oriented marketing activity", and the most advanced enterprises can carry out "mixed marketing activity" oriented both on the product and on the consumer. Modern marketing activity can be called "innovative" and strategic. The innovative approach is an operational marketing activity consisting of strategic marketing activities, namely, analysis of segmentation, attractiveness, level of competitiveness, portfolio studies, careful study of the budget, and control of strategy and development (Gorb *et al.*, 2022).

Among the initial tasks of strategic innovative marketing activities, the leading place is developing a system of measures to penetrate innovations into the market. Therefore, the basis of strategic marketing research is market analysis with improving market segments, organization and formation of demand, and modelling of buyer behaviour (Shtal *et al.*, 2018a; Zuliyati & Rusdianto, 2021; Penkova & Kharenko, 2023). According to the authors, strategic innovative marketing reduces the negative impact of external factors and the possibility of the enterprise manufacturing competitive products. However, creative marketing activity in Ukraine must be sufficiently developed because

innovativeness consists of constantly seeking product improvement. Ukrainian manufacturing enterprises spend only a little money to improve production.

Modern marketing activity can be characterized as joint, which appeared under the influence of the development of information technologies (online means of information exchange). Marketing activity focuses on new forms of relationship with consumers since the company can no longer control the demand for its products. Thus, the enterprise directs its efforts to cooperating with consumers on developing and managing its products, goods, or services. In addition to technology, modern marketing activity has been significantly influenced by globalization processes caused by technological development. Internet technologies enable the exchange of information between countries, economic regions, businesses, and individuals worldwide, and transportation technologies facilitate trade and other physical discussions. Like technology, globalization reaches everyone and everywhere, creating an interconnected economy (Kanishchenko, 2007; Korzh, 2010; Reznikova *et al.*, 2019). The main effect is that enterprises compete with each other for the opportunity to demonstrate their efforts to ensure integrity, commonality, and directions for social, economic, and environmental problems of society.

At the current stage, conditions have arisen for the development of a new type of marketing activity, which is often called "socially responsible", "socially ethical" (Ambler, 2004; Kotler *et al.*, 2016; Chi, 2021), or "spiritual". This marketing activity contributes to the fact that companies are forced to consider the product's value in their corporate culture because consumers choose products, goods, or services that satisfy their needs and impressions regarding their spiritual, social, and cultural aspects. Thus, the profit of the enterprise is the result of its high evaluation by the consumer. The development of marketing activity in the conditions of a modern market economy is constantly accompanied by the development of its information support and information technologies, which allows solving the problems of increasing the effectiveness of its influence on the work of the enterprise. As consumers become more cooperative, cultural, and spiritual, the nature of marketing activities changes. Based on the above analysis, the integration process of marketing activity is decisive for the enterprise since, in the dynamic, entrepreneurial environment in which it operates, it is necessary to direct all its spheres of activity, especially marketing, to achieve final goals.

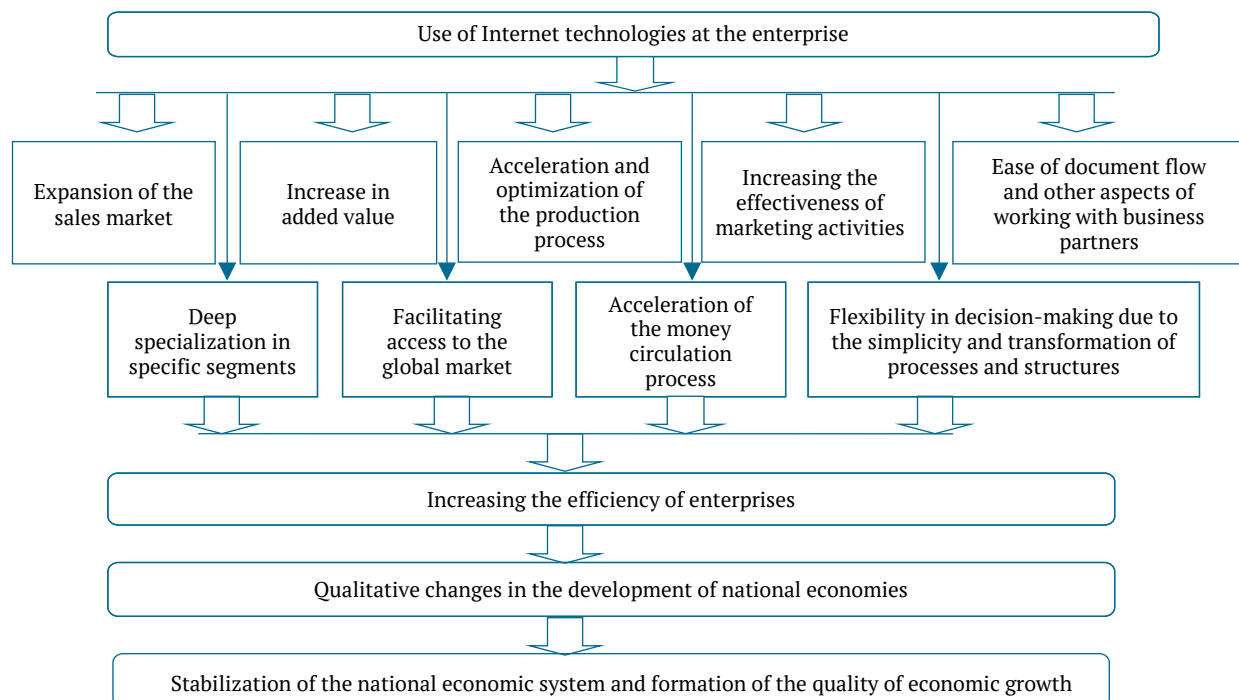
In connection with the rapid development of modern information technologies and the widespread spread of the Internet computer network, many fundamentally new opportunities in marketing activities are of particular importance. Marketing activity focuses on new forms of consumer relations and marketing communications. The enterprise's success in the market today is determined by the need to ensure an effective relationship between the producer and the consumer, which is an obvious fact for the formation of its competitiveness. Scientific and technical progress determines one of the effective ways of solving such a task is the use of communication channels of the global Internet network. At the same time, the effective use of Internet technologies at the enterprise is not possible without the formation of a marketing information system

that would include all the information necessary for the enterprise's activities, would enable a quick response to changes in the surrounding information environment, and would be an essential lever for the formation of the enterprise's information security. Since information acts as one of the most valuable resources of society, the process of its processing can, by analogy, be perceived as technology.

The formation of the global network economy and the expansion of its scope was due to the development and spread of Internet technologies, the transfer of various types of social and economic activities to the electronic environment of the Internet, and the process of transforming traditional organizations into network structures. Thus, the innovative development of the "new economy" is characterized by the socialization of the latest scientific and technical developments, primarily in the field of information technologies, i.e., their introduction and use on the scale of the entire society, production of innovative goods

and services using information technologies, as well as to develop industries that use these technologies; production of goods and services using and for the Internet.

Innovative changes in the world market depend on the level of innovative development of national economies – subjects of this market. Innovative development of industries, in turn, constitutes the national economy's development level. Furthermore, the innovative development of each sector largely depends on the actions of enterprises, management entities, the level of competitiveness, and the amount of profit received in the process of implementing the innovative strategy (Sony, 2018; Krysovatyty *et al.*, 2018; Hausman, 2021). In authors opinion, at the current stage of the development of society, the main directions of innovation are Internet technologies, which allow qualitatively increase in the key performance indicators of enterprises. Thus, Internet technologies significantly affect both the activities of enterprises and the national economy (Fig. 2).



**Figure 2.** The influence of Internet technologies on the activities of enterprises and the national economy

**Source:** developed by the authors

There is a need to consider the stages of transformation of foreign companies depending on the degree of their technological development and the chosen strategy:

- creation of an internal information system – an Intranet-type system – at this stage, the Internet is used as a tool for implementing an effective system of internal communications at the enterprise;
- the appearance of an information system of the Extranet type – transparent for partners but closed to third parties, the customer service system works as a business card or a directory of the enterprise;
- involving consumers to work directly in the information system, the emergence of feedback from the consumer through the electronic order system;

- full automation of many business processes, simplification of interaction schemes, expansion of opportunities, and improvement of speed and quality of work coordination;

- a combination of the electronic ordering system, the procurement process automation, and the promotion of goods to the final consumer through electronic stores (Allison, 2019; Blass, 2019; Bilovodska *et al.*, 2020).

To establish the relationship between scientific presentation and practical application, namely for a more detailed representation and systematization of information about the types of information technologies in marketing activities, their typology is proposed in Table 1.

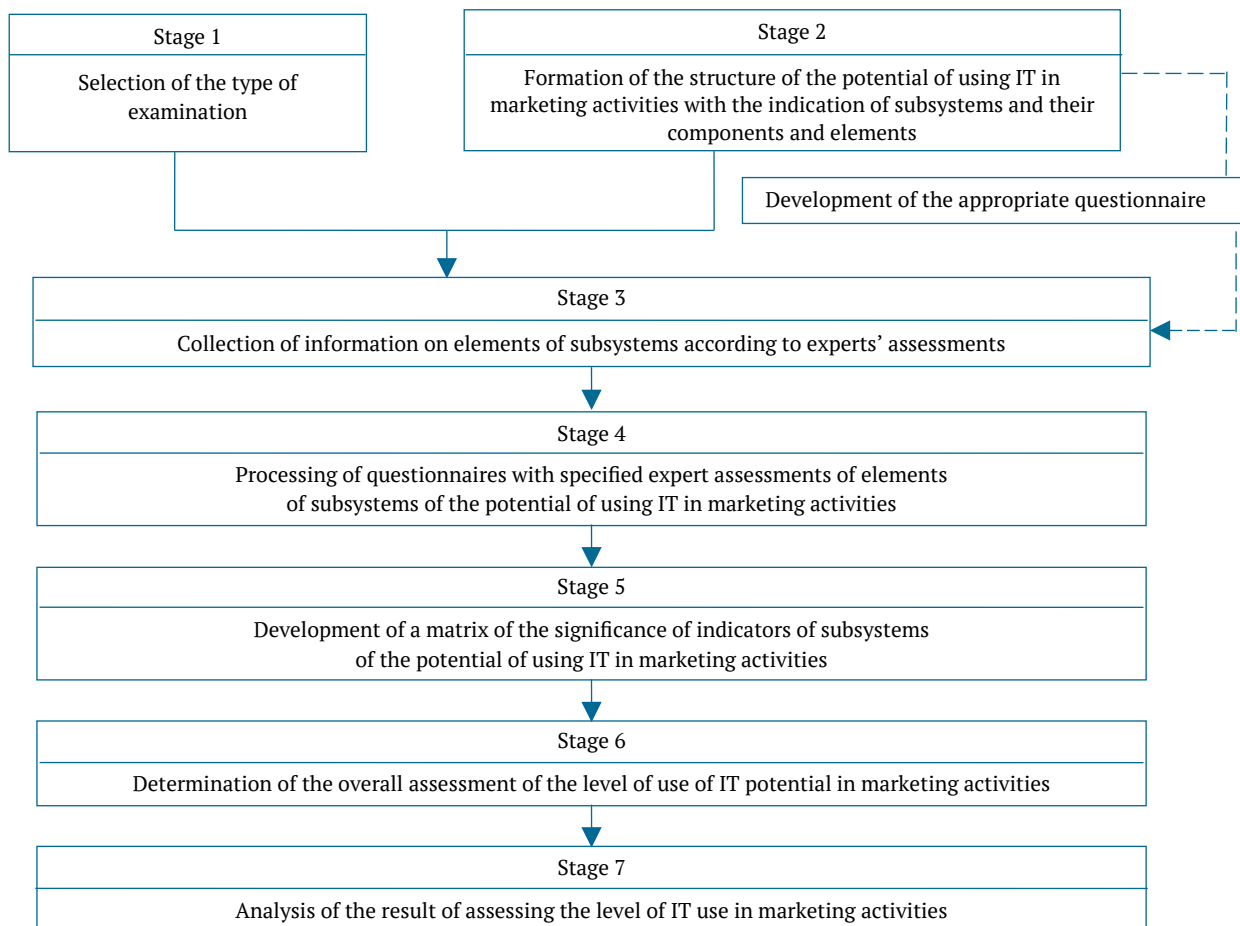
**Table 1.** Typology of types of information technologies in marketing activities

Typological features	The essential content of typological signs
<i>1. Mobile marketing</i>	
1.1. SMS services	The process of sending mobile messages from the program to the mobile user. A messaging system is a professional or business system. Businesses can use several technical modes to communicate with consumers, authenticate users of online services, and deliver instant messages.
1.2. voice interactive services	This is a technology for creating an interactive voice menu, which can be used both individually as an auto-informant and as part of a software-hardware complex, identifying and directing customer requests. In marketing activities, this technology solves several essential tasks: it increases the rating of the enterprise and the popularity of the brand, allows it to receive additional income, provides prompt feedback to consumers, expands the target audience and increases its loyalty, allowing it to receive valuable statistical marketing data.
1.3. wireless data transfer protocols	A set of logical layer interface agreements defining data exchange between different programs. These agreements specify the same way of transmitting messages and handling errors during the interaction of software distributed in the space of a hardware platform connected by one or another interface.
<i>2. Marketing in social networks</i>	
2.1. teaser advertisement	This is an advertising format that combines the text of an advertisement with a small picture that thematically corresponds to the content of that advertisement.
2.2. promotion in social networks	Activities aimed at familiarizing the maximum number of social network participants (social media) with the promoted resource. Conceptually, sites are advertised in social networks in two ways – SMO (social media optimization) and SMM (social media marketing).
2.3. monitoring of social networks	Social media monitoring tracks mentions of an enterprise, brand, public figure, product, or service in social networks. The activity's main task is searching for information about the brand and its segmentation from the point of view of the following factors: tonality, distribution by resources, authors, and publication time.
<i>3. Internet marketing</i>	
3.1. contextual advertising	Contextual advertising is an advertising banner or text ad on a web page; its appearance immediately makes it clear that it is advertising. Such banners or ads are located directly under the site header, on the sidebars of the web page, or at the bottom.
3.2. search engine optimization and promotion	The process of adjusting the HTML code, text content (content), site structure, and control of external factors to meet the requirements of the algorithm of search engines, to raise the position of the site in the search results of these systems according to particular user requests. The higher a site's position in search results, the more likely a visitor will go to it from search engines since people usually follow the first links.
3.3. marketing research on the Internet	The Internet makes it possible to conduct both primary research, based on data obtained from the company's research on the Internet, and secondary research, based on information published on the Internet and taken from other sources. The Internet can be used to research product markets, to study the firm structure of the market, or to study consumers.
3.4. e-mail marketing	This is a form of direct marketing, the characteristic feature of which is the use of e-mail as a channel for transmitting a marketing message to the target audience.
3.5. viral advertising	This is one of the leading marketing tools used in brand promotion on the Internet and social networks. The method involves creating content that will be of maximum interest to users. Launched on the network, viral advertising will spread at the initiative of the target audience. All potential clients will familiarize themselves with the information as much as possible.
<i>4. Means of software and marketing automation</i>	
4.1. customer relationship management system	Automating the process of tracking consumer behaviour allows it to more accurately influence potential consumers and, following their interests, carry out targeted marketing influence.
4.2. marketing intelligence	Software for marketing intelligence is mainly focused on studying the behaviour of potential consumers on the Internet (in social media, on mail servers, web pages, etc.), which allows analysing information about the most visited user groups in social networks. An essential source of information is links by which a person goes to sites from search engines or mail servers, as well as his search queries.
4.3. marketing automation	Marketing automation software focuses on target customers. To manage the consumer's awareness and interest in the products, a comprehensive marketing influence is carried out – from the beginning of the advertising campaign to the moment of sale and after-sales service.
4.4. automation of marketing document flow	Automation of document flow involves the use of specialized software for working with internal marketing information and internal marketing processes. As a rule, it includes implementing budgeting and planning functions, document flow and internal approvals, and all work related to internal marketing.
<i>5. Marketing information systems</i>	
5.1. geoinformation marketing systems	Geomarketing systems are a form of marketing research that allows it to visually analyse the external and internal indicators of the company, and various aspects of its past, current and future activities, including infrastructure and competitive environment concerning its geographical location.
5.2. industry marketing information systems	Industry marketing information systems are designed to provide managers in various industries with marketing information and support management decision-making in a specific market. They contain tools for transforming marketing data into valuable management information.
5.3. regional information marketing centres	Provision of information centres at the local level and acceleration of local marketing and management decisions.
5.4. interstate information marketing centres	The Interstate IMC (integrated marketing communication) is engaged in creating and maintaining an information fund; analytical activity; user information service; comprehensive market research, analysis of production and sales opportunities of enterprises, providing information interaction with national IMCs, etc.

**Source:** developed by the authors based on V.V. Bozhkova *et al.* (2018), A. Krysovatty *et al.* (2018), T.V. Shtal *et al.* (2018b)

The proposed classification considers new technologies of information marketing, which are actively developing and being implemented in the business practice of Ukrainian enterprises. The main task is to create integrated information marketing services combining the advantages of most technologies. Such an approach will make it

possible to significantly increase the effectiveness of marketing activities of enterprises, increase labour productivity in the field of market relations, and bring the interests of consumers and the capabilities of producers even closer together. The stages of assessing the use of IT potential in the enterprise's marketing activities are presented in Figure 3.



**Figure 3.** Stages of expert assessment of the level of IT use in the enterprise's marketing activities

Source: developed by the authors

The purpose of assessing IT potential in the enterprise's marketing activities is to identify all its opportunities to ensure effective functioning in conditions of globalization and increased competition. Its activity on the market and competitive position depend on the extent to which the potential of IT is fully used in the marketing activities of the enterprise. Therefore, as

subsystems of using IT potential in the marketing activity of the enterprise, it is proposed to choose the conceptual foundations of the marketing complex: marketing research; product policy; pricing policy; sales policy; communication policy. Table 2 shows a variant of the summary table, which should be formed based on the algorithm's results.

**Table 2.** Assessment of the level of IT use in the enterprise's marketing activities

The subsystem of IT potential in marketing activity	General expert evaluation of the subsystem	Component subsystems	General expert evaluation of the component of the subsystem	Significance of the constituent subsystem	Balanced assessment by component, in points
Marketing researches	5	Interactive market research	5	4	5
		Research of competitors' websites	3	5	5
		Consumer research (interactive survey)	5	4	5

Table 2. Continued

The subsystem of IT potential in marketing activity	General expert evaluation of the subsystem	Component subsystems	General expert evaluation of the component of the subsystem	Significance of the constituent subsystem	Balanced assessment by component, in points
Commodity policy	4	Testing of new products in interactive mode	4	4	3
		Formation of the marketing environment of goods on the Internet	5	3	4
		Organization of service on the Internet	4	3	5
Pricing policy	5	Building a flexible pricing system based on Internet auctions and electronic trading platforms	5	5	5
Allocation policy	4	Sale of goods via the Internet	4	5	3
		Creation of electronic platforms	3	5	4
		Calculation system (electronic signature)	4	4	4
Communication policy	3	Formation of the Internet communications system	4	3	3
		Conducting advertising campaigns	3	2	4
		Sales promotion	3	3	4
		PR network Internet	2	2	5
		Internet branding	4	4	4
The general assessment of the level of use of IT potential in the enterprise's marketing activities					4

**Source:** developed by the authors

The proposed assessment will allow the enterprise to identify the level of use of IT potential in its marketing activities. Thus, a systematization, theoretical, and practical analysis of the factors determining the trends in the development of Internet technologies in the marketing activities of enterprises was carried out. The action and impact of each element in ensuring the sustainability of the system of marketing activities of enterprises is considered in detail. The obtained results deepen the theoretical and applied foundations of forming an effective marketing policy for the enterprise. Comprehensive accounting and thorough analysis of the factors that are decisive in the development of the Internet in Ukraine allows to qualitatively improve the complexity of strategic and operational marketing of the enterprise with minimal financial costs (Dmytriiev *et al.*, 2022). The proposed typology and classification of information technologies in marketing systematizes and expands the theoretical vision and institutional foundation of the chosen research problem and forms the basis of their practical application in the activities of enterprises.

The origin of the term multidimensional analysis is explained by the use both in taxonomic methods and in factor analysis of the concept of a multidimensional object, which is understood as either a statistical unit (often called a structural unit) determined by a set of attribute values, or an attribute defined by its values on separate statistical units. However, most often, a statistical unit acts as such an object. Therefore, the concept of multivariate comparative analysis in economic research refers to several heterogeneous methods that identify regularities in statistical populations, the units of which are described by a relatively large set of features. Knowledge of these methods expands the possibilities of conducting various comparisons on multidimensional objects. In taxonomic methods, comparisons are made using a distance matrix. The name of taxonomic methods comes from two Greek words: taxis (meaning arrangement, order) and nomos (law, rule, principle). Taxonomy is the science of the rules of structure and classification.

The central concept used in taxonomic methods is the so-called taxonomic distance. This is the distance

between points of a multidimensional space, calculable, most often, according to the rules of analytical geometry. The dimensionality of the space is determined by the number of features characterizing the units of the studied population. In another task, in which signs act as research objects, the dimension of space is determined by the number of structural units. The taxonomic distance is calculated between units or feature points in a multidimensional space. The calculated distances make it possible to determine the position of each point in relation to other points and, therefore, to determine the place of this point in the whole population,

which makes it possible to arrange and classify them (Krchova & Švejnová Hoesová, 2021; Paying the price of war, 2022; Eurostat, n.d.). Multivariate analysis methods are reasonably simple methods of obtaining a general indicator. They allow it to get the required indicator quite quickly. The economic interpretation of the taxonomic indicator of the level of development is as follows: the closer the value is to 1, the better the level of the economic and financial condition of the enterprise and the level of implementation of Internet technologies in marketing activities. The results of calculations for 2021 for ten enterprises of the Kharkiv region are shown in Table 3.

**Table 3.** The results of the calculation of integral indicators of the economic and financial state of the industrial enterprise and the use of information technologies in marketing activities for 2021

Name of Company	A crucial indicator of financial and economic activity	A critical indicator of the use of information technologies in the marketing activities of the enterprise
PJSC "Kharkiv Order 'Znak poshany' Engineering factory 'Chervonyi Zhovten'"	0.623575	0.692308
PJSC "Elektromashyna"	0.14248	0.538462
PJSC "KhTZ"	0.566799	0.538462
SE Kharkiv Machine-Building Plant "FED"	0.242577	0.461538
PJSC "Interkondytsioner"	0.289653	0.538462
SE "Izyum state instrument-making plant"	0.375236	0.461538
PJSC "Kharkiv Machine-Building Plant named after S.V. Kosior"	0.298347	0.692308
LLC "Loziv Forging and Mechanical Plant"	0.163715	0.461538
PJSC "Manometr-Kharkiv"	0.4754	0.461538
PJSC "Kharkiv Machine-Building Plant "Svitlo Shakhtaria"	0.206301	0.461538

**Source:** developed by the authors

The results of the calculations prove that there has been a significant improvement in implementing marketing tools of information support and systems and technical means of automation at machine-building enterprises of the Kharkiv region in five years. Even the negative consequences of the pandemic became an impetus for introducing information technologies on an even larger scale. The integral indicator of the use of information technologies in the marketing activities of 10 Kharkiv machine-building enterprises increased by 0.130952 on average from 2016 to 2021 (10.5%).

## CONCLUSIONS

New communication technologies and, in particular, Internet technologies have made marketing activities much more measurable and, accordingly, much more controllable. Thus, one of the main tasks facing company managers today is assessing and analysing the effectiveness of marketing activities and their improvement. Furthermore, this is where unique systems, software solutions, and technical tools designed to automate marketing departments' work to increase marketing efficiency come to the rescue.

Data on marketing tools of information support can be obtained in the same way as indicators that determine the level of automation of machine-building enterprises. Such marketing tools can include the Internet, a website with its

home page, and other types of electronic data exchange. Thus, Ukrainian enterprises in the machine-building industry found themselves in difficult operating conditions, which, along with the complication of the technological, economic, and competitive environment in the market of machine-building products, are inherent in the difficult situation in the country. Crisis phenomena force Ukrainian machine-building enterprises to significantly save money and direct their activities to identify alternative solutions for maintaining competitive positions. Therefore, one of the priority directions should be cost optimization, which can be carried out by finding and investing the smallest amount of investment funds, leading to the most significant economic effect. Further research should focus on practical principles in developing marketing activities of machine-building enterprises based on Internet technologies, considering their specifics of management, defining features, and the level of development in the Ukrainian market and positions at the macro level.

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None.

## CONFLICT OF INTEREST

None.

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## **Імплементация сучасного маркетингового інструментарію в підприємницьку діяльність**

■ **Анотація.** Маркетингова діяльність орієнтована на нові форми взаємин зі споживачами та маркетингові комунікації обумовлюють тематику поточного дослідження та її актуальність. Метою дослідження було обґрунтування використання сучасного маркетингового інструментарію в підприємницькій діяльності для забезпечення сталого розвитку підприємства. Під час дослідження використовувалися емпіричні методи для огляду та комплексного представлення показників та особливостей маркетингової діяльності та маркетингового інструментарію, аналіз, синтез для наочного уявлення про особливості інструментарію маркетингу в застосуванні в сучасних умовах здійснення підприємницької діяльності. Систематизовано і проаналізовано об'єктивну інформацію про стан ринку промислової продукції та представлених особливостей маркетингової діяльності промислових підприємств. Проведено докладний аналіз сучасних тенденцій розвитку маркетингової діяльності та впливу інформаційних технологій на розвиток підприємництва, що є сьогодні підґрунтям для формування необхідного комплексу маркетингового інструментарію, який можливо використовувати для підвищення ефективності діяльності підприємства. Визначено, що в процесі переходу на ринкові механізми функціонування, українські машинобудівні підприємства опинилися перед необхідністю оптимізації своєї діяльності з урахуванням взаємного впливу складових зовнішнього ринкового і внутрішнього маркетингового середовища кожного підприємства. Зроблено висновок, що українські підприємства змушені приділяти величезну увагу процесам, що відбуваються в мінливому зовнішньому середовищі, щоб своєчасно адаптуватися і пристосуватися до них, особливо це має значення для промислових підприємств, орієнтованих на маркетингову діяльність. Представлене дослідження у вигляді рекомендацій щодо застосування маркетингового інструментарію має практичне значення для сучасних підприємницьких структур

■ **Ключові слова:** маркетинговий комплекс; маркетингова діяльність; Інтернет-маркетинг; маркетингові технології; комплекс маркетингового інструментарію

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