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INTERNATIONAL EXPERIENCE IN SCIENTIFIC RESEARCH



**PROCEEDINGS OF XIII INTERNATIONAL
SCIENTIFIC AND PRACTICAL CONFERENCE
AUGUST 6-8, 2026**

**CHICAGO
2026**

INTERNATIONAL EXPERIENCE IN SCIENTIFIC RESEARCH

Proceedings of XIII International Scientific and Practical Conference
Chicago, USA
6-8 August 2026

Chicago, USA

2026

UDC 001.1

The 13th International scientific and practical conference “International experience in scientific research” (August 6-8, 2026) BoScience Publisher, Chicago, USA. 2026. 235 p.

ISBN 978-1-73981-121-1

The recommended citation for this publication is:

Ivanov I. Analysis of the phaunistic composition of Ukraine // International experience in scientific research. Proceedings of the 13th International scientific and practical conference. BoScience Publisher. Chicago, USA. 2026. Pp. 21-27. URL: <https://sci-conf.com.ua/xiii-mizhnarodna-naukovo-praktichna-konferentsiya-international-experience-in-scientific-research-6-8-08-2026-chikago-ssha-arhiv/>.

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ECONOMIC SCIENCES

UDC 338.24:378

SCIENCE–BUSINESS INTEGRATION AS A PREREQUISITE FOR HIGHER EDUCATION DEVELOPMENT

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Abstract. This study explores how integrating science and business drives the transformation of modern universities. By mapping the primary mechanisms of cross-sector collaboration, the paper demonstrates their capacity to amplify research output, catalyze academic entrepreneurship, and update educational curricula. The insights underscore that university–business alignment is no longer optional but essential for institutional sustainability and global economic competitiveness.

Keywords: science–business integration; higher education institution; academic entrepreneurship; knowledge and technology transfer; university–business collaboration; competitiveness.

The contemporary development of the knowledge economy, the digitalization of production processes, and the acceleration of innovation have significantly transformed the role of higher education institutions. Universities are increasingly performing not only educational and research functions but also acting as key participants in innovation ecosystems by facilitating knowledge transfer, technological development, and the preparation of highly qualified professionals capable of meeting the evolving demands of the economy [1]. Under these conditions, the integration of science and business has become one of the key drivers

of enhancing the effectiveness of higher education institutions. Such integration creates favorable conditions for the commercialization of research outcomes, the development of academic entrepreneurship, the strengthening of partnerships with employers, and the establishment of a practice-oriented educational environment.

Science–business collaboration has evolved beyond individual forms of cooperation and has become a comprehensive model for the development of higher education institutions. Its implementation encompasses joint research activities, knowledge and technology transfer, the promotion of academic entrepreneurship, the establishment of innovation infrastructure, the involvement of employers in curriculum development, and the diversification of university funding sources [2]. Such integration contributes to improving the quality of higher education, strengthening the practice-oriented nature of professional training, enhancing universities' innovation capacity, and increasing their competitiveness within both national and international higher education systems. A summary of the principal forms of science–business integration and their impact on higher education development is presented in Table 1.

Table 1

Forms of science–business integration and their impact on higher education development

Integration dimension	Implementation instruments	Outcomes for higher education institutions	Socio-economic impact
Research partnership	Joint fundamental and applied research, international grant projects, research consortia, public–private partnerships	Increased publication output, enhanced research infrastructure, improved quality of scientific research	Accelerated generation of new knowledge and technologies
Knowledge and technology transfer	Technology transfer offices, patenting, licensing, spin-off and spin-out companies, commercialization of research results	Enhanced university innovation capacity, diversified revenue streams, development of academic entrepreneurship	Strengthened innovation-driven competitiveness of the economy
Education–business partnership	Dual education, corporate departments, joint curriculum development, industrial placements, internships	Curriculum modernization, competency development aligned with labour market needs, improved quality of graduate training	Reduced skills mismatch between higher education and the labour market, increased graduate employability

Innovation and entrepreneurial ecosystem	Start-up schools, business incubators, accelerators, science and technology parks, innovation hubs, fab labs	Development of entrepreneurial competencies, support for student and faculty start-ups, promotion of an innovation culture	Creation of high-tech enterprises and new employment opportunities
Financial and investment cooperation	Endowment funds, venture capital financing, philanthropic foundations, corporate investment, joint research laboratories	Diversified funding sources, modernization of research and educational infrastructure, enhanced financial autonomy	Increased investment attractiveness of universities and regions
Strategic stakeholder partnership	Supervisory boards, sectoral employer councils, professional associations, international university networks	Improved institutional governance, expanded international cooperation, strategic alignment with economic development priorities	Strengthened role of universities as drivers of regional innovation and development

Source: compiled by the author based on the analysis of [1; 3-5].

The analysis of the principal forms of science–business integration indicates that their comprehensive implementation generates a synergistic effect for all stakeholders within the educational and innovation ecosystem. For higher education institutions, this is reflected in enhanced research capacity, diversified funding sources, the modernization of educational programmes, and improved institutional competitiveness. For the business sector, such collaboration facilitates access to innovation, promotes human capital development, and shortens the innovation cycle. Under these conditions, science–business integration is becoming one of the key drivers of innovation-driven higher education development and the advancement of the knowledge economy.

Contemporary research demonstrates that the effectiveness of science–business integration depends not merely on the existence of individual forms of cooperation but, above all, on the development of a comprehensive innovation ecosystem in which higher education institutions serve as knowledge generators, the business sector facilitates the practical application of research outcomes, and the state provides the necessary institutional and regulatory framework [3; 4]. This approach has evolved within the Triple Helix concept and has subsequently expanded into the Quadruple Helix and Quintuple Helix models, which incorporate the active

participation of civil society, the digital environment, and the principles of sustainable development in innovation processes.

In the contemporary environment, universities are no longer solely educational institutions; they are increasingly evolving into hubs of innovation and entrepreneurial activity. Alongside their traditional educational and research missions, greater emphasis is placed on technology transfer, the promotion of academic entrepreneurship, the establishment of start-ups, the development of university business incubators and science parks, and the commercialization of intellectual property. These activities enhance the socio-economic performance of higher education institutions and facilitate their integration into the global innovation landscape.

Digital transformation has become a key driver of university–business collaboration by creating new opportunities for joint research, the application of artificial intelligence technologies, big data analytics, the advancement of open science, and the development of digital collaboration platforms. According to the OECD, contemporary models of interaction among universities, industry, and government should be based on the principles of open innovation, co-creation of knowledge, and the active engagement of all stakeholders in the innovation process [5]. Such an approach accelerates knowledge transfer, improves the quality of graduate education, and fosters the development of competencies required in the knowledge economy.

For Ukraine, science–business integration has acquired particular strategic importance in the context of post-war recovery and European integration. Strengthening cooperation among universities, businesses, public authorities, and international partners will contribute to the modernization of educational programmes, the advancement of applied research, the enhancement of innovation capacity, and the development of human capital capable of supporting the technological modernization of the national economy [2]. Under these circumstances, science–business integration should be regarded not merely as a separate area of university activity but as a strategic mechanism for enhancing the competitiveness of

the higher education system, ensuring its responsiveness to contemporary challenges, and promoting sustainable socio-economic development.

At the same time, the practical implementation of integration models within Ukraine's higher education and research system requires a transition from fragmented cooperation to systematic partnerships among higher education institutions, businesses, public authorities, and civil society organizations. Such partnerships should be based on the joint identification of research priorities, the involvement of employers in curriculum design, the establishment of joint research laboratories, the implementation of collaborative applied research projects, and the engagement of students in addressing real-world industrial and managerial challenges. Equally important is the development of transparent mechanisms for intellectual property rights management, the financing of innovative research, and the evaluation of partnership performance.

In conclusion, science–business integration should be viewed not as an isolated area of activity but as a systemic prerequisite for the innovative development of higher education institutions. It enables the alignment of scientific research with the practical needs of the economy, supports curriculum modernization, promotes academic entrepreneurship, diversifies funding sources, and enhances the competitiveness of universities. For Ukraine, strategic priorities include strengthening institutional partnerships among universities, businesses, and government; expanding science parks, technology transfer offices, business incubators, and dual education initiatives; and fostering regional education and innovation ecosystems. The implementation of these priorities will enable higher education institutions to become active contributors to technological advancement, economic recovery, and the country's sustainable development.

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