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Technology transfer as a foundation for starting a business in Ukraine

Svitlana Zaika*
PhD in Economic Sciences, Professor
State Biotechnological University
61002, 44 Alchevskikh Str., Kharkiv, Ukraine
https://orcid.org/0000-0001-8132-7643

Kateryna Bohomolova
PhD in Economic Sciences, Associate Professor
State Biotechnological University
61002, 44 Alchevskikh Str., Kharkiv, Ukraine
https://orcid.org/0000-0002-1042-825X

Tetiana Slipukha
Assistant
National University of Life Resources and Environmental Sciences of Ukraine
03041, 15 Heroiv Oborony Str., Kyiv, Ukraine
https://orcid.org/0009-0000-3921-5517

Abstract. The relevance of innovation development activation in Ukraine is combined with the limited use of scientific results in entrepreneurial activities, which hinders the formation of a knowledge economy. The existing gap between academic research and commercial application determines the necessity to improve technology transfer mechanisms and create conditions for efficient implementation of university initiatives. In this context, study of technology transfer as a foundation for starting a business becomes relevant. The study aimed to identify mechanisms through which technology transfer can be used as a practical basis for starting a business, as well as to develop an applied model of interaction between scientific institutions, technology transfer offices, and the entrepreneurial sector. The methodology was based on analytical, comparative, and systemic research. A logical and content analysis of scientific sources from international databases such as Scopus, Web of Science, and university repositories was conducted. Generalisation of empirical data identified three directions of influence of technology transfer on business creation: scientific-technological, organisational-managerial, and socio-economic. The study addressed technology transfer as a factor in shaping entrepreneurial activity and developing innovation economy in Ukraine. The study determined that modern universities are becoming hubs for dissemination of scientific results, combining research, education, and entrepreneurial initiatives. The results showed that the effectiveness of technology transfer in Ukraine is lower than in developed countries, due to insufficient integration of science, education, and business. A model for the development of university entrepreneurship has been proposed, which combines the activities of technology transfer offices, incubators, start-up schools, and government support programs. Its implementation would contribute to increasing the commercialisation of research results, fostering an entrepreneurial culture among students and researchers, and attracting investment in the innovation sector. The practical value of this work lies in forming the analytical foundation for modernising the policy to support university-based start-ups and improving the commercialisation mechanisms for scientific developments

Keywords: start-up management; technology transfer; academic entrepreneurship; university start-ups; business planning; knowledge commercialisation; human capital development

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*Corresponding author

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Introduction

In 2020-2025, Ukraine has prioritised commercial use of scientific research results, but the transition from technology creation to practical application remains fragmented and uneven. A significant portion of scientific developments does not reach the implementation stage due to insufficient coordination between scientific, innovative, and entrepreneurial activities of universities. This situation creates a gap between generation of new knowledge, economic implementation and slows formation of innovation market as well as development of academic entrepreneurship. University teams often face a lack of advisory, organisational, and financial support, which complicates the transition from idea to product development stage. Under such conditions, technology transfer represents a process that links scientific results with opportunities for commercial application; however, potential remains limited by organisational and legal constraints. Such issues caused further scientific research in analysis of technology transfer as a basis for university start-up implementation in Ukraine.

Conceptual foundations of academic entrepreneurship have evolved alongside development of entrepreneurship research. According to T.D. Barth & W. Schlegelmilch (2020), academic entrepreneurship refers to entrepreneurial activity emerging within universities and research institutions, where scientific knowledge becomes a source of economic value creation through technology transfer, spin-offs, and cooperation with external partners. H. Landström (2020) demonstrated that entrepreneurship has developed into an independent scholarly field, extending from individual business activity to institutional and ecosystem-level processes, including the role of universities in knowledge commercialisation and innovation development. These theoretical considerations create a framework for analysis of technology transfer as a mechanism embedded in the wider development of academic entrepreneurship.

Subsequent studies addressed institutional and organisational conditions influencing the functioning of technology transfer. S. El-Ferik & M. Al-Naser (2021), in analysis of trilateral interaction between universities, business, and the state, highlighted the role of knowledge and technology transfer in coordinating interests of participants involved in cooperation. Within this context, D. Prokop (2021) demonstrated that the nature of institutional support at universities affects both the number and the duration of spin-off entities based on research results.

Empirical research further underlines significance of organisational arrangements in supporting university-based entrepreneurial activity. A.I. Gaspar Pacheco *et al.* (2024) demonstrated that mentoring programmes, educational courses, and administrative support create favourable conditions for initiation of university start-ups. Furthermore, Y. Nikitin (2023) presented a model of an innovation ecosystem in which technology transfer processes arise from interaction between science, education, the economic sphere, government structures, society, and digital platforms. At the level of applied outcomes, H. Martínez-Ardila *et al.* (2023) confirmed the presence of a relationship between university-industry cooperation and the creation of spin-off projects based on joint patenting.

In Ukrainian academic literature, institutional and regulatory issues related to technology transfer were prioritised. D. Tymchenko *et al.* (2020) examined the establishment of technology transfer offices in higher education institutions, describing their structural organisation and forms of interaction with participants in innovative activity. T. Yaroshevska (2022) analysed institutional factors of uneven economic use of scientific research results across sectors of Ukrainian economy, while I. Zrybnieva *et al.* (2023) addressed legal issues and difficulties arising during the implementation of technology transfer legislation in scientific institutions.

Related research demonstrated persistent gaps between implementation of research and subsequent economic use. L.V. Rozhkova (2024) examined commercial use of research results created with state funds, whereas V.V. Pyroh (2025) explored technology transfer as a source of funding for start-up projects in scientific sphere, highlighting investment mechanisms supporting entrepreneurial initiatives at universities. From a broader macroeconomic perspective, T. Zarkua *et al.* (2025) demonstrated that entrepreneurial initiatives are central in countries undergoing transformational processes in economic and scientific domains.

Despite extensive body of literature devoted to technology transfer offices, innovation ecosystems, and entrepreneurial activity, there remains a lack of studies explaining how technology transfer functions as a practical basis for the creation of university start-ups in Ukraine. Therefore, the study aimed to examine how technology transfer may serve as a foundation for starting a business in Ukraine and to develop an applied model of interaction between university teams, technology transfer offices, and innovation support structures.

Materials and Methods

The study was conducted using a combination of general scientific and special methods to analyse technology transfer in the launch of university start-ups. Methodology addressed reproducibility of research through description of data sources, analytical procedures, and sequence of research operations.

The study covered 2019 to 2024 including available comparable and complete statistics from open sources and analytical reports. Data for 2025 were excluded due to absence of verified and summarised metrics, which hindered comparison. To examine quantitative indicators on activity of technology transfer offices, statistical summarisation was applied. This procedure included aggregation of indicators reported in analytical publications, their conversion into comparable measurement units, and calculation of average values. The resulting data formed the basis for Table 1, which presents indicators for the United States (US), The United Kingdom (UK), Germany, Poland, and Ukraine.

The dynamics of university start-up creation in the European Union (EU), North America, Asia, Latin America, and Ukraine were analysed using generalisation of data reported in systematic reviews and analytical studies (Padilla Bejarano *et al.*, 2023; Ríos Yovera *et al.*, 2025). Analysis incorporated average annual number of newly created start-ups, share of projects that reached the stage of commercial use, and main sources of funding. Summarised quantitative data were structured in tabular form to support comparison between regions.

Furthermore, systematic and comparative analysis supported generalisation of theoretical findings and formation of integrated concept of technology transfer as a research process. Content analysis of publications by international and Ukrainian authors identified major research directions related to university entrepreneurship and use of scientific results. Combination of methods ensures scientific soundness of the study, adequate coverage of research topic, and possibility of repeating the procedure using similar information sources and analytical sequences.

Results and Discussion

Technology transfer as a mechanism for shaping entrepreneurial initiatives

When analysing the role of technology transfer in launching entrepreneurial initiatives, it is useful to refer to quantitative metrics of the performance of technology transfer offices in different countries. Such metrics can be used to trace the transfer of scientific research results to the stage of practical application and to identify the institutional conditions that contributed to this process. For a comparative analysis of universities' capabilities in technology transfer, Table 1 presents indicators characterising average annual number of patents transferred, share of developments developed for use, and number of spin-off projects created in selected countries.

Table 1. Performance indicators of technology transfer offices in selected countries worldwide (2019-2024)

Country	Average number of patents transferred annually	Share of commercialised developments, %	Number of spin-offs created	Main forms of support
US	520	38.6	210	Grants, venture capital funds, business incubators
UK	310	35.2	175	University development funds, partnerships with businesses
Germany	285	33.1	160	Government programs, EXIST, innovation clusters
Poland	95	27.4	68	Regional hubs and technology parks
Ukraine	22	10.5	9	Academic laboratories, start-up schools at universities

Source: based on M. Guerrero & M. Menter (2024)

Metrics presented in Table 1 are analytically significant for assessment of functioning of technology transfer offices. The average annual number of patents transferred reflects intensity of research results transfer outside universities. Share of developments that have reached the stage of use indicates the ability of institutions to accompany these results at legal formalisation and implementation stages. Number of spin-off projects, in turn, characterises entrepreneurial activity based on scientific achievements. A comparison of indicators between countries reveals a significant difference in activities of technology transfer offices. European Union and North American countries had higher values for patent activity, share of developments used, and number of spin-off projects. Ukraine had significantly lower indicators, which could be caused by limited financial resources, less developed forms of interaction between scientific community and users of developments, as well as a lack of specialists in research transfer.

Similar observations are present in analysis by M. Guerrero & M. Menter (2024), noting that management capabilities of universities have a decisive influence on the development of academic entrepreneurship. C. Olvera *et al.* (2021) also demonstrated that organisational conditions of institutions involved in technology transfer influenced nature of cooperation between universities and external partners.

Scientific publications showed that technology transfer was considered by researchers to be an important component in transforming research results into developments suitable for practical use. The analysed studies demonstrated a tendency towards strengthening role of technology transfer offices in supporting entrepreneurial activities of scientists and students, in particular through participation in commercial support of developments and establishment of interaction between academic community and potential users of technologies. This approach was reflected in studies by C.S. Hayter *et al.* (2023), N. Halilem *et al.* (2024), as well as Z. Chen *et al.* (2025). A summary of comparative analysis results suggested that technology transfer was substantial in shaping entrepreneurial initiatives both at support for individual researchers and students and at institutional development of universities. A comparison of the activities of technology transfer offices in different countries reveals a pattern whereby more structured interaction between the academic sector and users of developments was accompanied by higher rates of conversion of scientific ideas into applied solutions. These generalisations provide a basis for

further analysis of possibilities for developing technology transfer in Ukrainian universities in the context of launching start-ups based on scientific results.

University start-ups as a result of the commercialisation of scientific knowledge

A substantial aspect of entrepreneurial ecosystem is university spin-offs, which emerge based on research projects and represent a specific form of transferring scientific knowledge into economic activity. According to A. Civera *et al.* (2020), such entities arise when research outcomes are combined with organisational conditions for further development outside academic context.

E.E. Lehmann *et al.* (2021) emphasised that academic entrepreneurship is formed at intersection of innovation processes, institutional settings and individual initiative within universities. In this context, university spin-offs function as organisational arrangements through which research results acquire an applied dimension. B.H. Jevnaker & B.A. Misganaw (2022) demonstrated that formation of spin-off projects is related to structure and coordination of entrepreneurial teams, as well as role of technology transfer offices in supporting researchers at early stages. From perspective of developing economies, M.M. Musleh *et al.* (2025) highlighted that university spin-offs often operate under conditions of limited resources, which increases the importance of coordinated institutional support and access to external networks.

To analyse dynamics of university start-up creation across different regions, data from international analytical studies were summarised. Results of comparative assessment are presented in Table 2, which reflects average indicators of start-up creation and progression to commercial application stage in selected regions between 2019 and 2024.

Table 2. Estimated dynamics of university start-up creation (2019-2024)

Region	Average number of new start-ups per year	Percentage of start-ups that have passed the commercialisation stage, %	Main source of funding
European Union	420	42.1	EU grants, venture capital
North America	510	47.3	Private investors, corporate partners
Asia	375	39.8	University funds, government programs
Latin America	165	24.7	International technical assistance
Ukraine	35	12.6	Donor support programs, government grants

Note: The figures shown reflect the average number of university start-ups that have passed the initial commercialisation stage, i.e. received initial funding (grant or investment) or brought a minimum viable product (MVP) to market between 2019 and 2024
Source: summary based on J.B. Padilla Bejarano *et al.* (2023), V.R. Ríos Yovera *et al.* (2025)

The data presented in Table 2 indicate notable differences in scale and progression of university start-up creation across regions. Higher average numbers of newly established projects and larger shares of initiatives reaching commercial application stage were noted in North America and the European Union, which reflects presence of more developed organisational arrangements supporting research-based projects. Lower indicators recorded for Ukraine suggest a more limited number of start-up initiatives and a smaller proportion of projects progressing outside early stages. Similar observations were reported by C.S. Hayter *et al.* (2023), emphasising that formation of academic entrepreneurship is associated with availability of educational programs, access to incubation infrastructure and institutional support for intellectual property. A summary of the analysis results shows that university start-ups had significant potential for developing scientific results, while emergence pace depended on available resources, institutional support and quality of interaction between participants in innovation system. For Ukraine, these conclusions determine the need to expand opportunities for teams working on scientific developments and to create conditions that facilitate the transition from research to commercial application.

Development of financial and organisational mechanisms to support start-ups

The analysis showed that creation of university start-ups correlated with availability of financial and organisational support, ensuring transfer of research results to business sector. In European Union countries, such support was based on a combination of public funding, venture capital investments and participation of private funds. As noted by M. Guerrero & M. Menter (2024), government grants and programmes, particularly within European Commission initiatives, were directed toward initial costs related to development, prototyping, and early stages of research application.

In Ukraine, government grants dominated, prioritising support of research and development projects. Participation of private investors and venture capital funds was sporadic. N. Halilem *et al.* (2024) confirmed that the main source of funding for start-ups remained government support through national programmes for young scientists and a start-up fund. For comparison, in 2024, the average amount of funding for start-ups in European Union countries was approximately 7.4 billion EUR, while in Ukraine it was 32 million EUR, which indicated a significant reserve for expanding investment field by integrating university projects into international support programmes. Structure of university start-up funding by source is presented in Table 3.

Table 3. Structure of university start-up funding by source, %

Source of funding	EU	US	Asia	Ukraine
Grants from governments and international organisations	42.3	28.7	33.5	61.0
Venture capital	31.5	47.8	29.4	12.4
Crowdfunding and private investors	8.6	12.2	18.1	7.8
University funding	10.4	6.1	11.3	9.6
Other sources (donations, corporate participation, etc.)	7.2	5.2	7.7	9.2

Source: summarised based on analytical data from international and national studies A. Civera *et al.* (2020), N. Halilem et al. (2024)

The indicators presented in Table 3 are central for analysis of effectiveness of financial mechanisms supporting university start-ups, as they can be used for an assessment of ratio between budgetary and extra-budgetary sources of funding. High share of grants from state and international organisations reflects the dependence of start-ups on budgetary support, while volume of venture financing and private investor participation characterises the level of interest of capital market in university projects.

Presented data show that financing of university start-ups in Ukraine was predominantly based on state programmes, as more than 60% of support was provided from budgetary sources. This funding structure limited opportunities for broader private capital involvement and distinguished Ukraine from European Union and United States, where venture capital funds and private investors were more influential, supporting faster project development and wider prospects for further expansion.

Predominance of budget-based support constrained development potential of university projects and highlighted the need for diversification of funding sources. In this context, reference to international experience in academic entrepreneurship provides a basis for analysis of alternative formats for combining financial and organisational support in development of university start-ups.

International practices in the development of academic entrepreneurship

A study of international experience showed that mechanisms supporting academic entrepreneurship in different countries share a common foundation, while specifics are shaped by economic opportunities and organisational characteristics of national systems. Despite these differences, researchers identified recurring patterns in university practices, including use of financial support, consulting assistance, interaction with investors, and creation of organisational arrangements aimed at supporting start-ups at early stages.

A distinct organisational configuration has been formed in Singapore. According to J. Hong *et al.* (2023), university accelerators in Singapore accompany projects until they reach market stage and create conditions for attracting private investors. This configuration relies on long-term mentoring and stable partnerships between research groups and economic structures, which supports continuity of assistance throughout entire development cycle.

European Union countries demonstrate a different format, prioritising integration of university developments into regional development policy. J.A. Cunningham *et al.* (2022) showed that universities in Italy, Spain, and Finland receive tax incentives, grant support, and advisory assistance, which support project development at early stages and contributes to cooperation between academic institutions and regional partners. Scandinavian practice should also be mentioned. Y. Cai & A. Lattu (2022) emphasised that universities in these countries involve external partners in management of technology transfer offices, which supports trust among participants and facilitates assessment and further use of innovations.

Ukrainian commercialisation system remains at an early stage of formation. Most influential support mechanisms include international technical assistance programmes, particularly Horizon Europe (n.d.), as well as initiatives of the European Bank for Reconstruction and Development. Activities of state institutions, including the Ukrainian Start-up Fund and National Research Fund of Ukraine, support communication between scientists and investors, although scale of such support remains lower than that observed in European practice. Effects of interaction between universities, public authorities, and economic partners are also reflected in employment outcomes. M. Guerrero & M. Menter (2024) reported that a single university start-up in the United States creates, on average, between 6 and 12 jobs during first years of operation, which confirms role of academic entrepreneurship as a source of economic activity.

A summary of international experience indicates that several typical formats of support organisation for entrepreneurial activity based on technology transfer can be identified. One such format involves early selection of innovations, with specialised funds concentrating resources on promising developments at initial stages. In Singapore, a system of long-term support for start-up projects has been formed, with prioritising developments throughout entire cycle, from idea to market entry.

European Union countries are characterised by a regional format for development of entrepreneurial initiatives, which relies on combination of educational, financial, and organisational resources within territorial partnerships that include universities and other institutions. In Scandinavian countries, a system of partnership-based management of technology transfer offices prevails, in which coordination between participant's supports the use of scientific results and facilitates their further application.

These formats remain relevant for Ukraine; however, their efficient use requires gradual improvement in

funding availability, expansion of accelerator networks, and conditions that support private investment. A comparison of foreign experience indicates that Ukraine may move toward a configuration that combines state support with the development of independent institutions operating alongside universities. Such a configuration supports the transformation of university developments into projects capable of entering the market and underscores the growing role of digital solutions in coordinating technology transfer processes and start-up management.

Digitisation of technology transfer and use of data analytics in start-up management

Continuing analysis of technology transfer mechanisms in formation of entrepreneurial initiatives, this subsection considers the role of digital solutions in compilation of information on scientific results and coordination of interaction between participants involved in the further use. Digital tools support systematisation of data on research outputs and facilitate communication between universities, investors, and users of developments. P. Karanikic *et al.* (2021) noted that use of digital knowledge management tools reduced time required to assess potential of scientific developments and supported faster establishment of professional contacts.

Further development of electronic technology transfer platforms has expanded these possibilities. Z. Chen *et al.* (2025) demonstrated that such platforms accumulate, systematise, and disseminate information on inventions, patents, and research results suitable for further use. These platforms supported remote submission of applications, execution of licence agreements, and partner search, which facilitated coordinated interaction between participants involved in transfer of scientific results. A generalised representation of this form of interaction is presented in Figure 1.

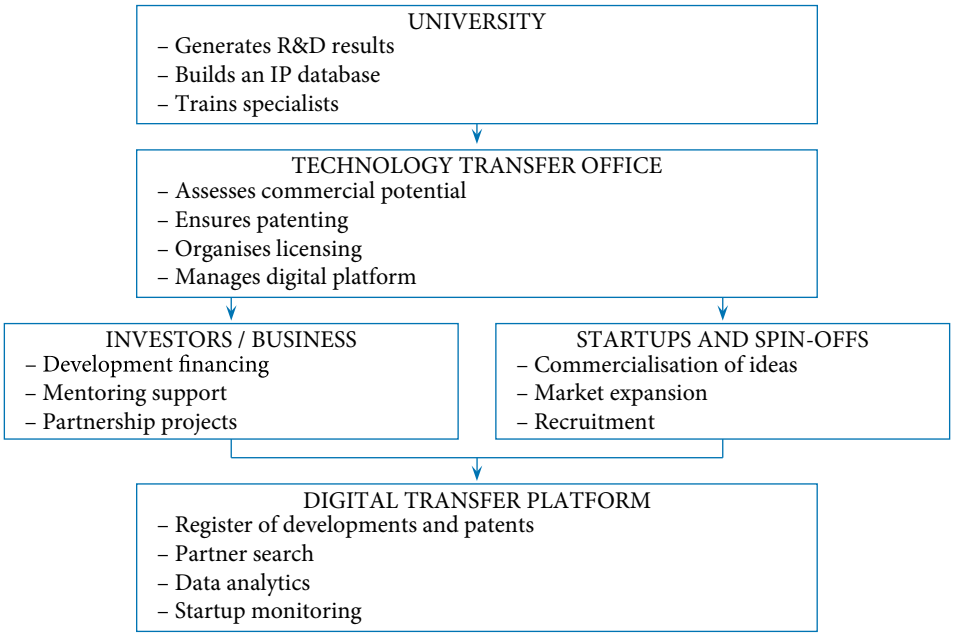

Figure 1. Model of digital interaction between participants in the technology transfer system
Source: compiled by the authors based on P. Karanikic *et al.* (2021), J.B. Padilla Bejarano *et al.* (2023), Z. Chen *et al.* (2025)

Figure 1 illustrates information exchange between universities, investors, users of developments, and organisational structures involved in transfer of research results. This interaction creates a basis for monitoring start-up projects and evaluation of their progress using analytical methods. Within this digital environment, analytical methods have become relevant in supporting start-up projects. According to M.F. Arroyabe *et al.* (2022), use of data analysis can be used to assess potential of developments more accurately, evaluate demand for innovative products, and allocate available resources more rationally during the selection of projects for funding.

A separate direction of digital development in technology transfer is associated with creation of national electronic systems for intellectual property registration. Such systems simplify application procedures, reduce processing time, and expand interaction between universities and users of research results. Estonia is an illustrative example, where the e-IP electronic service introduced by national patent office can be used for remote submission and support of intellectual property applications (E-services: Electronic channels…, n.d.).

Ukraine has also introduced digital services in this field. According to official materials of the Ukrainian National Office of Intellectual Property and Innovation, online tools for submitting applications and managing rights have been gradually implemented, expanding opportunities for scientific institutions to register and transfer

research results (Ukrainian National Office for…, 2025). The main directions of digital development related to technology transfer and academic entrepreneurship are summarised in Table 4.

Table 4. Main directions of digitalisation in the field of technology transfer and academic entrepreneurship

Digitalisation direction	Main functions	Expected effect
Electronic technology transfer platforms	Publication of information about patents, agreements, start-ups	Expansion of the circle of potential investors
Data analytics and artificial intelligence	Assessing innovation potential, forecasting demand	Improving the accuracy of management decisions
Blockchain technologies	Accounting for license agreements and copyright protection	Reducing the risks of intellectual property infringement
Digital education platforms	Training specialists in the commercialisation of innovations	Developing entrepreneurial skills among scientists
Cloud services for joint development	Collaborative work on projects between universities and businesses	Accelerating the creation of prototypes and the launch of start-ups

Source: compiled based on P. Karanikic *et al.* (2021), M.F. Arroyabe *et al.* (2022), S. Proença (2025)

The directions presented in Table 4 reflect different areas of application of digital solutions in technology transfer and start-up project support. Their use supports structured handling of information on patents and developments, increases accuracy of analytical evaluation, and facilitates collaboration coordination. Digital solutions have also influenced organisational practices within technology transfer offices. Z. Chen *et al.* (2025) emphasised that digitalisation supported a transition from intermediary functions toward forms of organisation based on shared access to information and coordinated activity. In this context, digital tools strengthened correlation between scientific research and entrepreneurial initiatives and supported informed decision-making in start-up project management.

Fostering entrepreneurial culture in universities and developing human capital through technology transfer

Z. Chen *et al.* (2025) considered digitalisation as a factor in formation of innovative culture in universities, ensuring transition from forms of technology transfer organisation in which transfer office performed mainly intermediary functions to integrated interaction between participants in the process. Under these conditions, researchers, students, and investors gained access to shared digital services, which created opportunities for collaboration on data, accelerated information exchange, and coordination of decisions on further development of projects.

Digital platforms that support technology transfer are already widely used in international practice and significantly influence organisation of interaction between universities and external partners. For example, the AUTM Innovation Marketplace (AIM) (n.d.) platform in United States can be used to publish developments for licensing, search for investors, and monitor status of commercialisation. Stanford University operates the Sophia system, through which descriptions of inventions are submitted and patent applications are managed. In Europe, similar functions are performed by digital platforms of the Technical University of Munich (TUM Patent and License Portal) and KU Leuven, which provide access to technology databases and support online communication with potential users of developments. These examples demonstrated how digital infrastructure supports practical implementation of technology transfer and creates conditions for its integration into the academic environment.

Role of digital solutions is not limited to facilitating technology transfer procedures. Their implementation also influences broader processes related to development of entrepreneurial activity in universities, as digital services increasingly become part of educational space and support preparation of students for implementation of personal projects. This connection between digital infrastructure and education defines the growing attention to entrepreneurial culture as an element of university development.

Academic entrepreneurship is not limited to establishment of start-ups. It includes teaching innovative thinking, development of competencies related to technology management, and encouraging initiative among students and early-career researchers. Scientific and pedagogical staff involved in entrepreneurial activity performs a substantial educational role by demonstrating practical applications of research results in real economic conditions. Comparative characteristics of the implementation of entrepreneurial education and its influence on human capital development in different university models are presented in Table 5.

Table 5. Comparing the role of academic entrepreneurship in the educational process in different university models

Country/university model	Characteristics of entrepreneurial education	Forms of interaction with business	Key effects on human capital
US (entrepreneurial university)	Entrepreneurship is integrated into curricula at all levels, and incubators operate at faculties	Mentoring, joint programs with venture capital funds, start-up competitions	Risk management skills development, team building, leadership
UK (innovative model)	Universities actively involve students in research projects with commercialisation potential	Partnerships with local businesses, technology hubs	Development of creative thinking and independent business planning skills
Germany (research and applied model)	Dual education programs that combine research and practice	Cooperation with industrial enterprises, joint laboratories	Deepening technical competencies, involving applicants in technology transfer
Ukraine (model in development)	Courses in innovation management and start-up education are being introduced, support centres are being created	Participation in international programs, grant projects, cooperation with start-up funds	Increasing the level of entrepreneurial activity among applicants and young scientists

Source: summarised based on S. Taskin *et al.* (2023), S. Proença (2025)

Formation of an entrepreneurial culture in universities is also related to changes in educational methods. R.A. Rahmatika & S.E. Rachma (2025) noted that universities in the United States, the Netherlands, and Sweden promote a model of learning by venturing, in which educational process is combined with implementation of research and entrepreneurial projects. Such learning formats familiarise students with technology transfer mechanisms through direct participation in project activities.

Similar conclusions were reached by E. Aromaa *et al.* (2024), demonstrating the value of combining educational and project-based activities for development of socially oriented entrepreneurship in cooperation between universities and external partners. M.A. Davila *et al.* (2024) also demonstrated that involving students in entrepreneurial initiatives during the educational process contributes to development of practical skills related to commercial use of research results.

From an institutional perspective, M.S. Loyola & C.J. Selby (2025) emphasised that expansion of access to entrepreneurial education in universities creates conditions for a more even distribution of academic entrepreneurship among different groups of students. At the same time, O. Maliarchuk & V. Vostriakova (2024) highlighted that efficiency of such educational formats largely depends on coordinated interaction between technology transfer offices, educational units, and other participants in innovation-related activities.

Furthermore, M. Passarelli & G. Bongiorno (2025) showed that efficiency of start-up education is closely connected with interdisciplinarity of learning. The combination of engineering, economic, and social disciplines contribute to a comprehensive concept of innovation processes and trains specialists capable of operating under conditions of market uncertainty. Relationship between education, technology transfer, and human capital development is illustrated in Figure 2.

Thus, development of an entrepreneurial culture in universities represents one of the main directions for implementation of technology transfer in Ukraine. Formation of educational programmes that combine theoretical foundations of innovation management with project-based learning contributes to improved human capital of scientific sphere and supports new generations of entrepreneurs capable of implementing research results in production and economic activity.

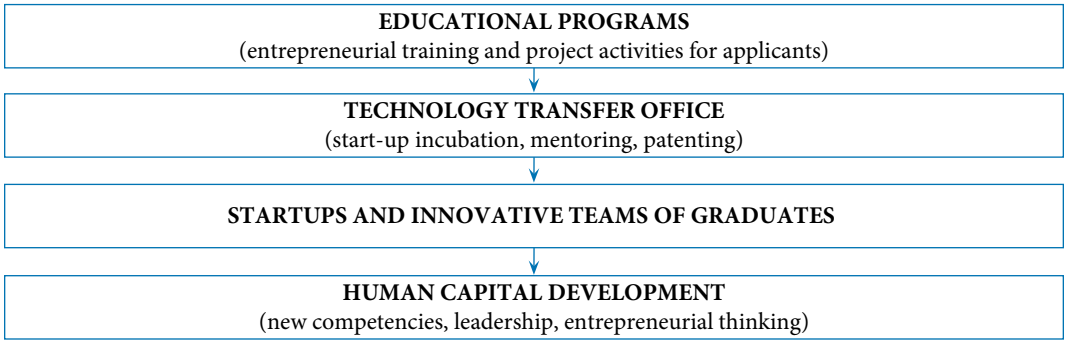

Figure 2. Schematic representation of the relationship between education, technology transfer, and human capital development

Source: summarised by the authors based on A.I. Gaspar Pacheco *et al.* (2024), M. Passarelli & G. Bongiorno (2025)

Problems and directions for improving the technology transfer system in Ukraine

The technology transfer system in Ukraine is still in early stages of development, and despite existence of a regulatory framework and state programmes to support innovation, a number of issues remain unresolved, including coordination between universities, technology transfer offices and institutions responsible for practical utilisation of scientific results. Scientific research showed that the effectiveness of interaction depends on the ability of universities to create conditions for the development of innovative initiatives, in particular by streamlining commercialisation processes and strengthening institutional capacity (Guerrero & Menter, 2024).

Ukraine has developed tools to support scientific developments and start-ups. These include programmes of the Ukrainian Start-up Fund aimed at financing early stages of project development, and grant competitions of the National Research Fund of Ukraine, which support scientific research with potential for practical application. However, scale of such support is still significantly inferior to European practices, which limits ability of universities to expand circle of partners and accelerate commercialisation of research results.

Development of institutional infrastructure remains a separate problem. There are a range of technology transfer offices operating in Ukraine, but most of them have limited financial and human resources, as well as insufficient experience in interaction with international partners. There is also no unified digital system that would integrate databases of intellectual property, patents and promising developments on a single platform, which complicates access to information and coordination between participants in innovation activities.

In this context, issue of low commercialisation of research results in state universities requires further consideration. Studies show that even in economically developed countries, only a fraction of academic developments reach market, and effective management of technology transfer process is a determining factor in innovative development (Halilem *et al.*, 2024). In Ukrainian context, the situation is complicated by lack of motivation among researchers, absence of specialised educational programmes in patent management, and limited opportunities for attraction of private capital. Table 6 summarises the main problems of technology transfer in Ukraine identified through analysis of academic literature and regulatory documents.

Table 6. Main problems of technology transfer in Ukraine and possible ways to solve them

Problem	Characteristics	Possible solutions
Insufficient digitisation of technology transfer	Lack of a unified national database of patents and scientific developments	Creation of a centralised electronic platform based on open data
Weak interaction between universities and business	Limited number of joint innovation projects	Introduction of joint incubation programs and regional clusters
Low motivation of scientists to commercialise	Lack of financial incentives and appropriate training	Improvement of the system of incentives, grants, and educational programs
Uncertainty of rights to research results	Complexity in the distribution of rights between the institution and the author	Harmonisation of legislation with EU standards and updating of licensing procedures
Lack of specialists in the field of technology transfer	Limited opportunities for training and professional development	Development of master's and postgraduate programs in the field of innovation management

Source: developed by the authors based on analysis of scientific and regulatory sources

Experience of European countries shows that efficiency of technology transfer system directly depends on state's participation in creating favourable conditions for interaction between scientific institutions and investors. Germany, Finland, and Spain have special government programs that support university start-ups by providing grants at prototyping stage.

In Ukraine, institutions were also gradually formed to support innovative initiatives at universities. In particular, at Lviv Polytechnic National University (n.d.), innovative projects were implemented through Tech Start-Up School, which functioned as a university platform for start-up development and included acceleration programmes, prototyping laboratories, and mentoring support, as evidenced by official university materials. The National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" operated the Sikorsky Challenge Ukraine innovation ecosystem, which combined incubation and acceleration formats, as well as a network of investors prioritising support of technology projects at various stages of their development, as confirmed by information published on project's official website (Sikorsky Challenge Ukraine, n.d.). Similar initiatives were implemented in other higher education institutions. For example, the Kyiv School of Economics (n.d.) introduced the Start-up Booster Program, aimed at supporting technology-oriented projects in cooperation with international partners, as reflected in institution's official materials. Odesa Polytechnic National University (n.d.) operated the Polytechnic Start centre, which was aimed at supporting student and scientific initiatives within university, as evidenced by information published on university's official website. These examples confirm gradual development of university support structures in Ukraine and convergence of their organisational capabilities with practices characteristic of leading European institutions.

These developments make it possible to draw broader conclusions regarding factors that influence efficiency of technology transfer systems across different countries. As shown by studies by J. Hong *et al.* (2023) and N. Halilem *et al.* (2024), improvement of efficiency of the system is possible if that network interaction is established between all participants – universities, research institutes, venture capital funds, business associations, and regional authorities. This format of cooperation ensures sustainable circulation of knowledge and contributes to formation of a national innovation system in which technology transfer is a central element of entrepreneurship development. Therefore, creation of a national technology transfer ecosystem should be based on integration of three levels: educational (competence building), scientific (knowledge generation), and entrepreneurial (commercialisation of innovations). A generalised scheme of interaction between these levels is presented in Figure 3, which reflects proposed model for improving technology transfer system in Ukraine.

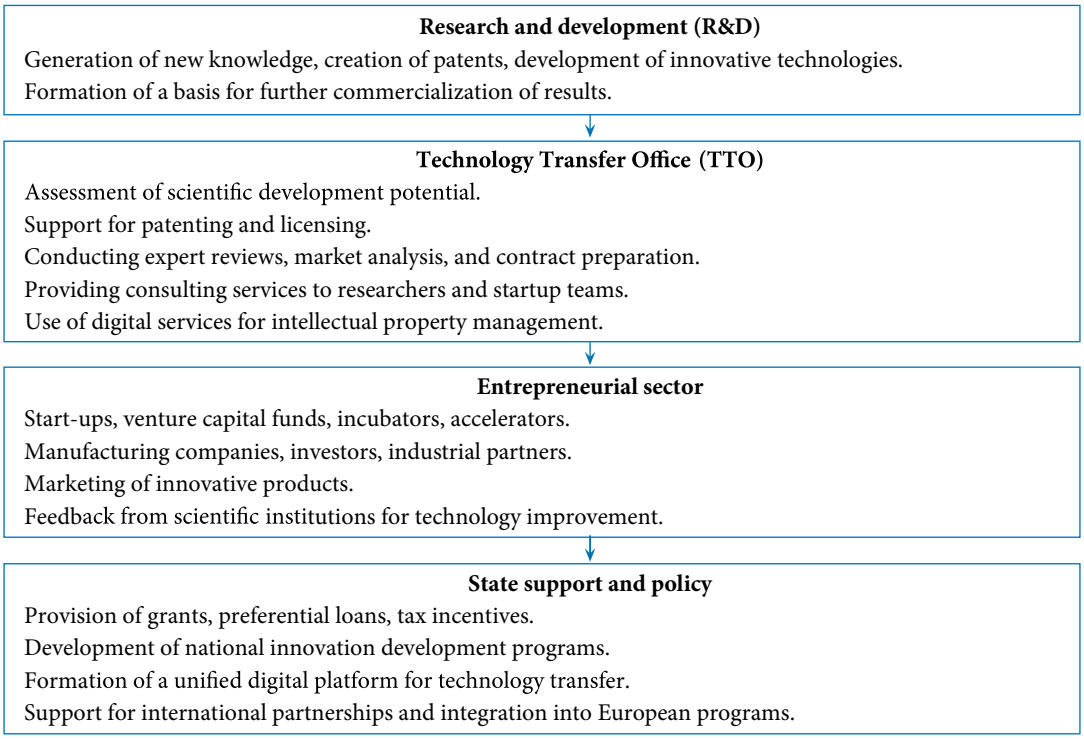

Figure 3. Generalised model for improving the technology transfer system in Ukraine
Source: developed by the authors based on J.A. Cunningham *et al.* (2022), M. Guerrero & M. Menter (2024)

As M. Guerrero & M. Menter (2024) noted, creation of an integrated technology transfer system can combine academic initiatives with market needs, promoting development of innovative entrepreneurship and formation of a competitive economy. Presented model reflects an interconnected system of participants in technology transfer process in Ukraine, combining scientific, organisational, entrepreneurial, and governmental levels. At the centre of this system is scientific research (R&D), which provides new knowledge, developments, and patents that form the basis for commercialisation. Next link is technology transfer office (TTO), which acts as an intermediary between universities, businesses, and government institutions. Activities of TTO include assessment of innovation potential, supporting patenting and licensing, analysing market opportunities, and supporting start-ups in early stages.

Interaction with business sector ensures implementation of developments in production, creation of new start-ups, and attraction of investments. At the final level, state support and policy are aimed at stimulating the process through grant programs, tax incentives, development of digital infrastructure, and integration into the European innovation space. Thus, proposed model demonstrates consistent movement of technologies from laboratory research to market, where each level contributes to efficiency of national innovative development.

Conclusions

The study assessed state of technology transfer system in Ukraine and identified main development trends. The summary indicators show that Ukrainian universities lag significantly behind leading countries in terms of technology transfer and creation of innovative projects. Average number of patents transferred in Ukrainian institutions is only 22 per year, while in the United States this figure exceeds 520, and in Germany it is approximately 285. Only 10.5% of Ukrainian developments are commercialised, which is several times lower than in EU

countries. An analysis of university start-ups confirmed that around 35 projects are created in Ukraine each year, of which only 12.6% pass initial commercialisation stage, i.e., receive initial funding or receive enough development to become a minimally viable product. This demonstrated limited opportunities for transforming research results into ready-made technological solutions and highlights the need to strengthen support in early stages of innovation development.

A study of the structure of start-up financing showed that more than 61% of funds come from public sources, which creates significant dependence on budget and does not stimulate activity of private investors. For comparison, in European Union countries, share of venture capital exceeds 30%, and in the United States, it is approximately 48%, which creates much broader opportunities for intensive innovation development. Obtained results substantiated a model for improving technology transfer system, which is based on coordinated interaction of three interrelated levels: educational, which forms competencies in field of innovation; scientific, where new knowledge is generated; and entrepreneurial, which ensures commercial implementation of developments. Systematic integration of these levels will contribute to an increase in the number of innovative projects, improve quality of scientific results assessment, and develop human resources capable of transforming scientific ideas into applied technologies. Prospects for further research include development of mechanisms for evaluation of effectiveness of technology transfer offices, modelling of relationships between universities and innovative enterprises, and determination of socio-economic impact of introducing scientific developments into entrepreneurial activity.

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Трансфер технологій як підґрунтя відкриття власної справи в Україні

Світлана Заїка
Кандидат економічних наук, професор
Державний біотехнологічний університет
61002, вул. Алчевських, 44, м. Харків, Україна
https://orcid.org/0000-0001-8132-7643

Катерина Богомолова
Кандидат економічних наук, доцент
Державний біотехнологічний університет
61002, вул. Алчевських, 44, м. Харків, Україна
https://orcid.org/0000-0002-1042-825X

Тетяна Сліпуха
Асистент
Національний університет біоресурсів і природокористування України
03041, вул. Героїв Оборони, 15, м. Київ, Україна
https://orcid.org/0009-0000-3921-5517

Анотація. Потреба в активізації інноваційного розвитку в Україні поєднується з обмеженим рівнем використання наукових результатів в підприємницькій діяльності, що стримує формування економіки знань. Наявний розрив між академічними розробками та їх комерційним застосуванням засвідчує необхідність удосконалення механізмів передачі технологій і створення умов для ефективної реалізації університетських ініціатив. За таких умов особливої актуальності набуває дослідження трансферу технологій як основи започаткування власної справи. Метою дослідження було визначення механізмів, за допомогою яких трансфер технологій може стати практичною основою для започаткування власної справи, а також сформувати прикладну модель взаємодії між науковими установами, офісами трансферу технологій і підприємницьким сектором. Методологія ґрунтувалася на аналітичному, порівняльному та системному дослідженні. Проведено логіко-змістовний аналіз наукових джерел з міжнародних баз Scopus, Web of Science та університетських репозиторіїв. На основі узагальнення емпіричних даних визначено три напрями впливу трансферу технологій на створення бізнесу: науково-технологічний, організаційно-управлінський та соціально-економічний. У статті розглянуто роль трансферу технологій як фактора формування підприємницької активності та розвитку інноваційної економіки в Україні. Визначено, що сучасні університети перетворюються на осередки поширення наукових результатів, де поєднуються дослідження, освітній процес і підприємницькі ініціативи. Результати засвідчили, що ефективність трансферу технологій в Україні є нижчою, ніж у розвинених державах, що зумовлено недостатньою інтеграцією науки, освіти й бізнесу. Запропоновано модель розвитку університетського підприємництва, яка поєднує діяльність офісів трансферу технологій, інкубаторів, стартап-шкіл та державних програм підтримки, реалізація якої сприятиме підвищенню рівня комерціалізації результатів досліджень, формуванню підприємницької культури серед здобувачів і науковців, а також залученню інвестицій у сферу інновацій. Практична цінність роботи полягає у формуванні аналітичної основи для модернізації політики підтримки стартапів при університетах та вдосконалення механізмів комерціалізації наукових розробок

Ключові слова: стартап-менеджмент; трансфер технологій; академічне підприємництво; університетські стартапи; бізнес-планування; комерціалізація знань; розвиток людського капіталу