

DOI: [10.55643/fcapter.4.45.2022.3808](https://doi.org/10.55643/fcapter.4.45.2022.3808)
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Received: 07/07/2022

Accepted: 21/07/2022

Published: 31/08/2022

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TECHNOLOGY TRANSFER RISK MANAGEMENT IN THE CONDITIONS OF SCIENTIFIC INTERNATIONALISATION

ABSTRACT

In times of globalisation and post-pandemic, it is the availability of advanced technologies, their effective use is a determining factor in economic growth. The process of transferring innovative technologies is associated with a significant level of risk, which negatively affects the economic, social and technical, and technological development of the economy of any country in the world. Thus, the study aims to develop an algorithm for managing key risks that arise in the exchange of technology in the scientific and educational environment in the context of the internationalisation of science. In turn, the risk analysis became the basis for developing proposals to eliminate probabilistic barriers, such as limited information, shortage of qualified personnel, low government activity, lack of business interest in high-cost and high-risk science-intensive projects, and the uncertainty of potential demand for new technology among consumers. The hypotheses proposed by the authors proved that educational collaborations, marketing intelligence, and the use of professional networking platforms are both sources of potential risks for technology transfer in scientific circles and the driver of its development. The theoretical and practical value of the research results is that they allow forming a theoretical and practical basis for the formation of the methodological paradigm of risk management of internationalisation of technology transfer, taking into account the peculiarities of the domestic economy and global challenges.

Keywords: innovation, technology, transfer, strategy, risk, intellectual property, diffusion of innovations, management

JEL Classification: D81, F29, O32, O33

INTRODUCTION

Uncertainty and non-standard threats prevailing in international innovation markets are increasingly encouraging the search for optimal ways to minimise the risks of diffusion of innovations of commercial interest. So, if a few years ago, the international community actively promoted the philosophy of "open innovation", which is based on so-called "network knowledge", ie access to intellectual capital at minimal cost, today the rhetoric about the practice of international use of joint technologies and global technology cooperation has received a new personified vector.

Although crises and global shocks increase the degree of entrepreneurial risk, a balanced strategic approach to technology transfer can minimise risks to an acceptable level. Innovative technologies are a product that can have a unique set of risk management solutions in each case. At the same time, it is already possible to identify certain clear signs of established strategic approaches used in proven sustainable combinations. However, these combinations require flexibility in application, which is directly proportional to the extent of the potential spectrum of risks. In itself, the need to form a risk management strategy can raise many controversial issues, as this is a long-term period where the impact of the external environment is unpredictable and extremely risky. However, these are new opportunities and, consequently, competitiveness in domestic and foreign markets.

LITERATURE REVIEW

Prange C., Verdier S. (2011) argue that the analysis of internationalisation strategy in research has been the focus of international innovation business for a long time. Although the main theories (process theory and new venture theory) have significantly influenced the general understanding of internationalisation processes, they have not yet fully explained the algorithm of growth and survival rates of innovative companies and research institutions. Cannice, M., Chen, R., and Daniels, J. (2004) consider how to protect technologies when transferring them to companies operating outside their country of origin. Their work forms a theoretical basis for risk management in international technology transfer from the perspective of the recipient. Well-known theorist and practitioner Wissema, J.G. (2009) notes that the production of new technologies has become the locomotive of the development of one of the types of innovative academic business. According to him, this trajectory of modern universities is unalterable in competition at the international level. But because academic entrepreneurship is a high-risk area of activity, much depends on the university's management skills and willingness to take risks for success.

International technology transfer regimes involve risks when transferring to a host country within a multinational company when selling or licensing technology. This is how Uusitalo, O. (2013) explores the issue of possible risks in his work, where he emphasises the presence of possible risks in the method of transfer, the existing state trade policy, and the influence of industry associations. Working on a practical model of technology transfer, T., Gorschek, P., Garre, S., Larsson, and C., Wohlin (2006) consider it a priority to minimise the risks of technology transfer and insist that the risks should be as acceptable as possible compared to potential benefits. Herlandí de Souza Andrade, Messias Borges Silva & other authors (2017) in the study of the main risk factors for technology transfer between participants in this process concluded on critical success factors in technology transfer, such as stage of technology development, investment time by all participants, training, and qualification of researchers and technicians involved in the process, the technical ability of the organisation to absorb technology, ability to shake technology, financial opportunities for continuity of development, among others. It is through the prism of success factors that the risk of technology transfer should be considered. After all, technology transfer affects the country's competitiveness.

A group of researchers consisting of Kozyk, V., et al. (2021) proposed an author's methodology that allows you to predict the behaviour of R & D products to the market of its commercialization, which allows you to build strategies for this commercialization. In addition, the universality of the application of the method of technological forecasting to the research product of any type of economic activity, the method of transfer, etc. is important. The importance of technology protection is extremely important in the context of globalisation. And, it is the leakage of knowledge is considered by such researchers as Coadour, D., Droff, J. and Bellais, R. (2019) through the prism of risks that arise in the learning process in the field of technology, where coaches are considered a vulnerable link. Therefore, it is extremely important to implement preventive measures that would prevent the leakage of knowledge from the direct carriers of this knowledge.

In general, the bibliometric analysis makes it possible to draw a number of conclusions. Firstly, the analysis of publications in the Scopus database, devoted to the researched issues, is given in Figure 1.

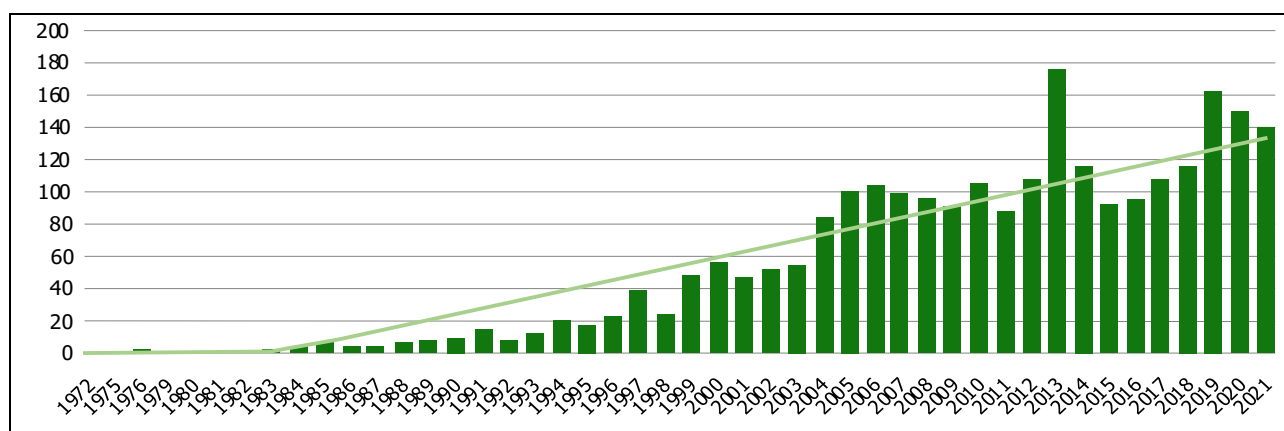


Figure 1. The dynamics of research activities on the base of the Scopus database analysis on technology transfer risk management.
 (Source: compiled by the authors using the Scopus database toolkit)

The results show that the first indexed article is dated by 1972, however, the greatest interest in this issue was observed in 2010-2021, as evidenced by 59% of publications from the sample of 2485 document results for the 46 years from 1972

to 2021 by a search “technology transfer risk management” in keywords, abstracts, and titles. The trend of research action is positive.

Secondly, the bibliometric analysis of the above sample using the VosViewer toolkit shows 4 clusters of research connected with technology transfer risk management (Figure 2).

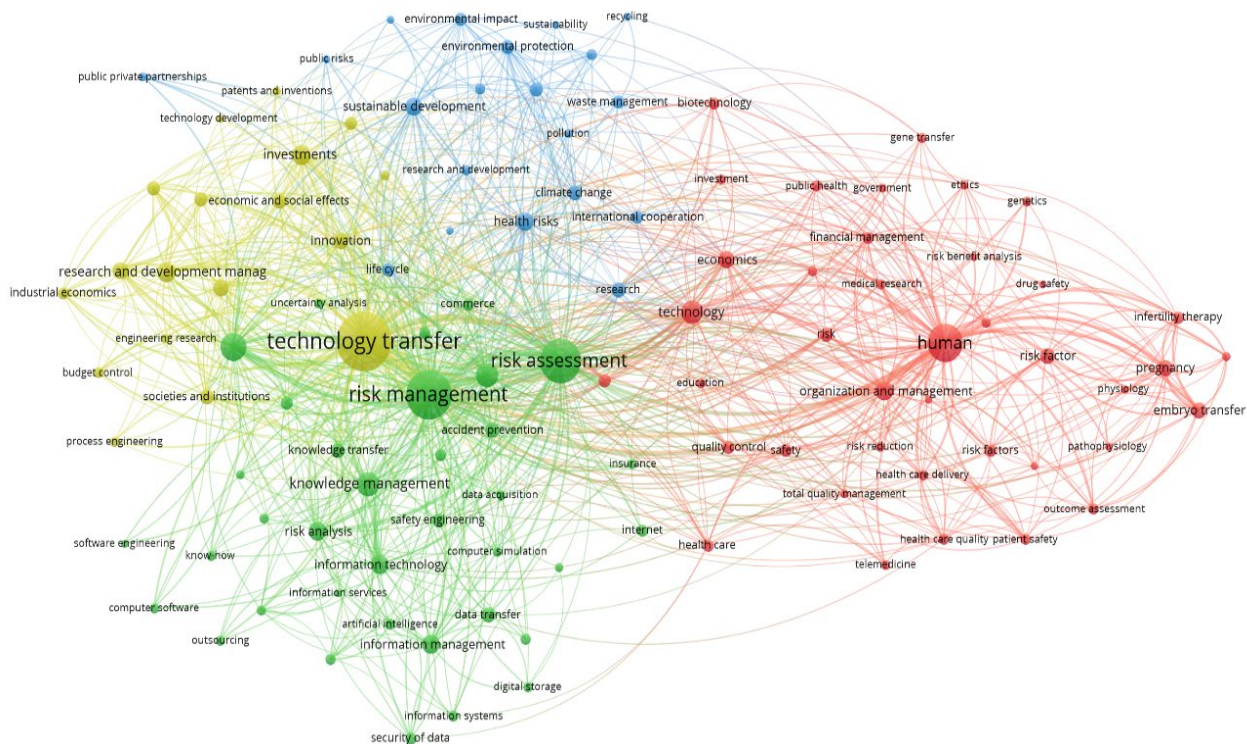


Figure 2. The results of bibliometric analysis of research connected with technology transfer risk management. (Source: compiled by the authors using VosViewer toolkit)

The above sample of 2485 documents indexed in the Scopus database for the 46 years were analysed on co-occurrence. In general, there were 20204 keywords, then the minimum number of occurrences of a keyword was set at 20, and 231 keywords met this condition. That is why the identified 4 clusters of research connected with technology transfer risk management are the following:

- 1) human and medical research (red cluster): gene transfer; medical technology; biotechnology; genetics; embryo transfer; pregnancy and infertility therapy; telemedicine; public health; drug industry; health care; drug safety; physiology; pathophysiology; patient safety, etc.;
- 2) risk, innovation and informational technologies research (green cluster): artificial intelligence; data transfer and its security; blockchain; computer simulation; information systems, technologies and services; know-how; knowledge transfer; software engineering; outsourcing; accident prevention; uncertainty analysis; risk assessment; safety engineering, etc.;
- 3) sustainable development research (blue cluster): environmental protection technologies; climate change; energy efficiency; recycling; waste management; international cooperation; public-private partnership, etc.;
- 4) economic and social research (yellow cluster): industrial economics; industrial management; investments; finance; budget control; marketing; product development; strategic planning; economic and social effects; societies and institutions, etc.

Thirdly, the geographical map of research about technology transfer risk management is presented in Figure 3. From 226 countries according to the formed sample 28 countries were selected through a minimum number of documents of a country is 20. The most attention for this scientific direction is paid in the United States of America (684 documents and 16339 citations), United Kingdom(241 documents and 8290 citations), Germany (132 documents and 3911 citations), Italy (111 documents and 1822 citations), China(208 documents and 3197 citations), Netherlands (60 documents and 2801

citations), France (99 documents and 1537 citation), Switzerland (40 documents and 1776 citations), Australia (97 documents and 2739 citations), Canada (131 documents and 3972 citations), Spain (47 documents and 1931 citations), Denmark (23 documents and 1574 citations), Norway (23 documents and 1180 citations), Belgium (34 documents and 1054 citations), Finland (25 documents and 960 citations), Sweden (35 documents and 991 citations), Singapore (22 documents and 424 citations) and others (Figure 3).



Figure 3. The geographical map of research about technology transfer risk management. (Source: compiled by the authors using VosViewer toolkit)

And fourthly, the results of bibliometric analysis on co-authorship include 6893 authors. If the minimum number of documents of an author is 5, so only 21 authors meet the threshold. They are Chen, J., Liu, X., Wang, I., Wang, X., Wang Y., Li, J., Li, Y., Zhang, I, Zhang, Y., and others.

AIMS AND OBJECTIVES

The work aims to consider the trends of key risks in international technology transfer and existing strategies for their management with further development of the algorithm of response taking into account Ukrainian characteristics and intensification of internationalisation of knowledge and technology in transnational space.

Although our topic is relevant, the current publications in the research space do not reflect the strategic nature and causes of risks in international technology transfer in the context of internationalisation of knowledge and development of the knowledge economy under the influence of global challenges. However, based on the above research of other scientists, we have formulated the following hypotheses:

H1. Among other things, the risks in international technology transfer processes are caused by changes in functional priorities of research universities (research has become primary, education - secondary) and other research organisations, as well as the consequences of the COVID-19 pandemic.

H2. In the new environment, the main trend is the internationalisation of knowledge, which on the one hand stimulates the formation of international team collaborations in research, and on the other encourages the maintenance of a balance between the paradigm of "open innovation" and the paradigm of "closed innovation".

H3. The rapid pace of internationalisation in technology transfer has given impetus to the emergence of new forms of academic entrepreneurship: remote - through the use of specialised international platforms and social networks. However, the use of these business forms creates additional risks of cyber-attacks.

RESULTS

1.1. Substantiation of H1.

Risk is an integral part of human life. At the same time, it is one of the least studied concepts in modern science. In economic activity, the riskiest is the academic business in the field of creation and transfer of innovative technologies. At the same time, it is so highly profitable that modern universities are actively changing the functional priorities of their activities from educational to research. For example, the income of Oxford University for 2019/20 is 2371.6 million pounds, where 8% - are government research grants, 25% of research funding from various funds, including the public, 51% of income from the commercialization of research products, and donations and only 16% tuition fees. That is, the educational income of a modern university is only 1/6. As a result, the basic goals of the world university system are currently changing. Their focus is increasingly on research. Wissema J.G. (2009), who is an honorary professor of innovation and entrepreneurship at Delft University of Technology (Netherlands) and managing director of Wissema Consulting EOOD (Sofia, Bulgaria, since 2007), describes research as a modern, lucrative business and new technologies as a profit tool. This trajectory of modern universities is unalterable in competition at the international level. However, producing technologies to commercialize them is a risky business. The main source of risk for such a business is the uncertainty caused by numerous unforeseen or accidental circumstances. These may include uncertainty about the potential demand for newly developed technology among consumers; variability of their preferences; unstable competitive advantages. Today, the university has to devote a lot of time to marketing research, promotional activities, presentation of "goods" at exhibitions, as well as communication with potential client-investors. Therefore, Lina Landinez, T. Kliewe, Habtamu Dirib (2019) in their work draw public attention to the fact that the academic aspect of the development of the innovative entrepreneurial activity of universities and the results of their "third mission" are still insufficiently reflected in the methodology of global rankings. After all, at present, there is only the practice of measuring the effective entrepreneurial achievements of universities, at the same time little attention is paid to evaluating their work in the direction of educating public attitudes toward academic entrepreneurship. Most universities in the world continue to ignore the "rules of the game" in the new reality, which is why their activities are characterized as insufficiently strategic, overly egalitarian, prone to risk, short-term planning, and so on.

1.2. Substantiation of H2.

In international expert assessments, the degree of risk in the innovation environment can be influenced by various factors of economic, political, and social nature, which are inherent in science-intensive innovation business (probability of new potential mega-opportunities for development, the possibility of expatriate profits). This led to the emergence and spread of the paradigm of "open innovation" by American theorist G. Chesbro, where to save time launching new products, companies can and should use in their innovation processes not only their own but also borrowing ideas and ways to innovate. (Chesbrough HW, 2003). Thus, thanks to the technologies acquired in Brazil, Angola was able to enter the sugar and alcohol sector, which significantly increased the number of jobs in rural areas of this country, expand the diversification of the energy sector and increase exports of relevant products. (Rafael Vaisman, 2013) Angola is one of the countries that has taken a clear strategic approach to international technology transfer to increase its share of the world market while reducing its dependence on imports. However, although the process of ethanol and sugar production has obvious advantages, technology transfer in this area is not without risks. Strategic principles in the transfer of such technologies need to be developed, improved, and carefully protected. Yes, Lewis, J.A. (2019) noted that the theory of "open innovation" is more beneficial to individual countries that have the opportunity to purchase relatively inexpensive technologies to increase their competitiveness in the global environment. First of all, he meant China, which built its high-tech base by buying technology from more developed countries. However, it is known that China is actively using not quite legal ways to obtain information about promising know-how. This has complicated China's relations with the civilized world. Currently, the United States has imposed certain restrictions on innovation and technology transfer, aimed at mitigating the risks of harm to the US economy in the event of excessive disclosure of new American technologies. The COVID 2019 pandemic has initiated restrictive measures for the free movement of people between countries, which has hampered the international mobility of students, most of whom come from China. In 2021, as part of the World Economic Forum, it was clearly stated that "technology transfer in exchange for market access has become a controversial part of trade negotiations." The acute problem of minimising the risks of the modern world (pandemics, cyberattacks, energy security, etc.) was the impetus for the US government to create and launch a global American platform for emergency management.

However, the leading universities of the Asian region, Europe and Latin America are continuing to form international project research collaborations. After all, the expansion of the range of research areas with a commercial connotation and the establishment of closer cooperation with the business sector, against the background of a significant reduction in the number of foreign students, allow universities to maintain the scale of their functional operations. Thus, according to the

Leiden University ranking, the methodology of which evaluates the effectiveness of research activities of universities around the world and is based on bibliometric indicators (Web of Science database) and shows the dynamics of international publishing collaborations in 2021 among the top 100 in this ranking, 34 positions US universities, the rest are universities in China (26), Great Britain (6), Canada (4), Japan (4), South Korea (4), Australia (4), Austria (2), Singapore (2), France (2), the Netherlands (2), Brazil (1), Germany (1), Israel (1), Italy (1), Sweden (1), Mexico (1). Harvard University is the most active in the field of effective collaborations with the manufacturing sector in terms of purely international publishing collaborations, with Aalborg University in Denmark leading the way. The need for international academic collaborations has given impetus to the formation of several international research networks. Thus, with the support of the Commission of the European Communities (now the European Commission), the European Association for the Transfer of Technology, Innovation and Industrial Information (TII) was established on 4 May 1984 in Luxembourg. TII is an independent association of technology transfer and innovation support professionals. The main goal of TII is to develop a knowledge-based economy and promote social welfare. On 31 December 1999, the Association of European Professionals in Science and Technology Transfer (ASTP) was set up in the Netherlands on the initiative of a multinational group of technology transfer professionals. ASTP's mission is to conceptually develop the transfer of technology and knowledge between Europe's science base and industry. However, the growing competition for knowledge and technology in universities has led to the emergence of other international networks, which primarily contribute to the establishment of global collaborations in science. In particular, the European University Association was founded in Belgium in 2001, and today represents more than 800 universities in 48 European countries. 2016 marked the beginning of the development of the Open Data Research Network, a joint project coordinated by the Web Foundation and the International Development Research Center (IDRC). In 2019, at the initiative of the famous London expert in international law, Dr. Yoriko Otomo, to establish close international cooperation in academia, the Global Research Network (GRN) was launched. In 2020, with the support of the European Union of Social Sciences and Humanities, the World Pandemic Research Network launched a platform for knowledge exchange in the framework of overcoming COVID-19. Investigating the impact of inter-organisational networking platforms on the creation and development of knowledge through the transfer or exchange of certain innovative components, Marchioria, D. & Franco, M. (2020) demonstrate increasing productivity of knowledge-intensive organisations that are more prone to research collaborations. After all, their analysis of the international scientometric database Web of Science showed that bibliometric indicators of joint achievements, such as citing documents or authors, in conditions of fierce competition, are gaining momentum because it seriously affects the growth of personal research ratings and ratings of universities where they work. However, there is always a risk of losing the reliability of data on the real contribution of a particular author, and therefore the university to which the author belongs, in the development of a study. Therefore, this topic is increasingly attracting the attention of researchers around the world.

1.3. Substantiation of H3.

Today, almost 60% of the world's population is online and about one million people connect to the Internet every day, demonstrating the importance and relevance of technologies related to the development of digital innovation. The COVID-19 pandemic has led to an unprecedented situation, where the social, economic, and geopolitical consequences for humanity are still invaluable. It has also strengthened the role of social networks such as Facebook, Instagram, LinkedIn or Twitter, and other professional Enterprise Europe Network (EEN) platforms, which are actively used by young companies to promote their innovative products to the market in competition with well-known brands (Novikova I. & etc. (2020)). After all, in such networks, it is possible to establish more successful promotion of innovative products at the low cost of advertising. In recent years, the functional load of innovation has gained new practical perspectives, and, accordingly, marketing tools to find answers to current challenges have changed. Currently, the conditions for the formation of innovation networks and clusters are key aspects of global innovation policy (Recker, J., Malsbender, A., Kohlborn T. (2016)). However, the success of the perception of innovative ideas depends on how clear to the community is the idea posted on the network platform. In this regard, scientists Prónay, S., Buzás, N. (2015) in their arguments agree that the main engine of the modern knowledge economy is not in itself the process of knowledge creation, but the way they diffuse and apply. Attempts to assess the real commercial prospects of an innovative product encourage entrepreneurs, before or in the process of science-intensive business, to conduct primary marketing research using the capabilities of the same network resources (social networks, blogs, etc.) to identify managerial, reputational and other types of risks. In addition, the legislative field in the fields of science, innovation, and technology transfer is monitored, databases of risks inherent in the relevant area of innovation are developed, and psychological diagnostic methods are used to identify individual risk propensity, honesty/fraud, and short-term implementation. long-term risk forecasts. The lack of cybersecurity recommendations makes internationalisation a major challenge for innovative companies. The digital nature of 4IR technologies makes them too vulnerable to cyberattacks, which can be very damaging. In the context of this statement, scholars such as Orero-Blat, M., Palacios-Marqués, D., and Garzón, D. (2020) draw public attention to the problem of trust in information,

which involves the commercial nature of the transfer. This is the reason why new companies that carry out innovation management choose the philosophy of "Lean Start-up" of economical innovative entrepreneurship as a basis.

The risk transfer process in technology transfer aims to help innovative companies anticipate and minimise potential risks. After all, risk management is an important part of the concept of security and financial integrity of modern companies, and risk assessment is an integral part of their strategic development. The organisation's risk management strategy should be that all risks it faces should be identified, assessed, monitored, and managed in such a way that they are maintained within the limits set by the entity's management (Vasile, E. and Croitoru, I. (2012)). Currently, the identification of risks in the field of the science-intensive business depends on the nature or circumstances that determine the nature of their occurrence, the extent of coverage (expropriation, nationalization, total or partial loss of property due to civil war, external economic sanctions, terrorism, quarantine, raiding, corruption, inflation, strikes, rallies). To determine which technology transfer risk management strategy to choose, it is necessary to first understand the nature of the risk. The internal and external environment has already been discussed above. As for the internal environment, this is the quality of management that the company has as the owner-developer (in one person) of an innovative product and the development and implementation of risk management strategies at the internal level. You should also consider the purpose and choice of optimal solutions. This should be a long-term program of specific actions aimed at protecting against adverse external environments and optimising the internal environment. Accordingly, the program is based on the following principles: systematic (risk analysis, risk assessment, choice of risk management method), consistency (development of algorithms for action under different probabilistic states), feasibility, feasibility, the balance of costs and benefits associated with probabilistic risk management), flexibility (adjusting input and output data according to the current situation) (Table 1).

Table 1. Strategic approaches to the formation of risk management program.

Strategy		Characteristics of actions				
		Risk management goals	Strategic focus of risk management	Features of risk management	Approaches to risk analysis and assessment	Risk dominance environment
Cautious	Conservative	Total loss control and complete security	Not prone to risk. Stabilisation of results	Hard limits and restrictions.	Stress testing. Sensitivity analysis. Scenario analysis.	Collapse
Risky	Maximiser	Reward for accepted risks	Risk propensity. Maximise profits at maximum risk.	Flexibility.	Pricing models. Methods of rating agencies.	Lift
Balanced	Manager	Risk minimisation	Neutral to risk. The main message is to increase the value of the company.	Formal policies and standards.	The risk-reward. Budgeting.	Restraint
	Pragmatist	Diversification and avoidance of high risks	Making profits not only from risky transactions.	Flexibility, high level of communication, and competence.	Simplified economic capital.	Uncertainty

A prudent strategy, which is typical of a conservative method of management, involves avoiding risks, and, consequently, avoiding losses, however, makes it impossible to make a profit. This is the case when it comes to the high probability of taking risks and losses (unreliable contacts, high risk of the country). Therefore, the "conservative" is characterized by control and the presence of "airbags". The "maximizer" strategy is aimed at accepting risks and in case of adverse situations to compensate for losses from its sources, so this strategy means working at the stage of rising and active growth of market trends. However, this does not mean that it is worth going all-in, but it is worth correctly assessing the benefits and risks. When global risk management standards are used and appropriate risk management policies are developed, then the "manager" strategy is adopted. And the strategy of "pragmatist", which provides for situational behavior, where actions take place by the current situation and choose not the best solution, but a good and profitable one. This is achieved through the diversification of risks.

And given internationalization and global challenges in the current and future periods, the focus should be on analyzing the external environment and, consequently, on the strategies for managing the risks that arise from this external environment (Figure 4).

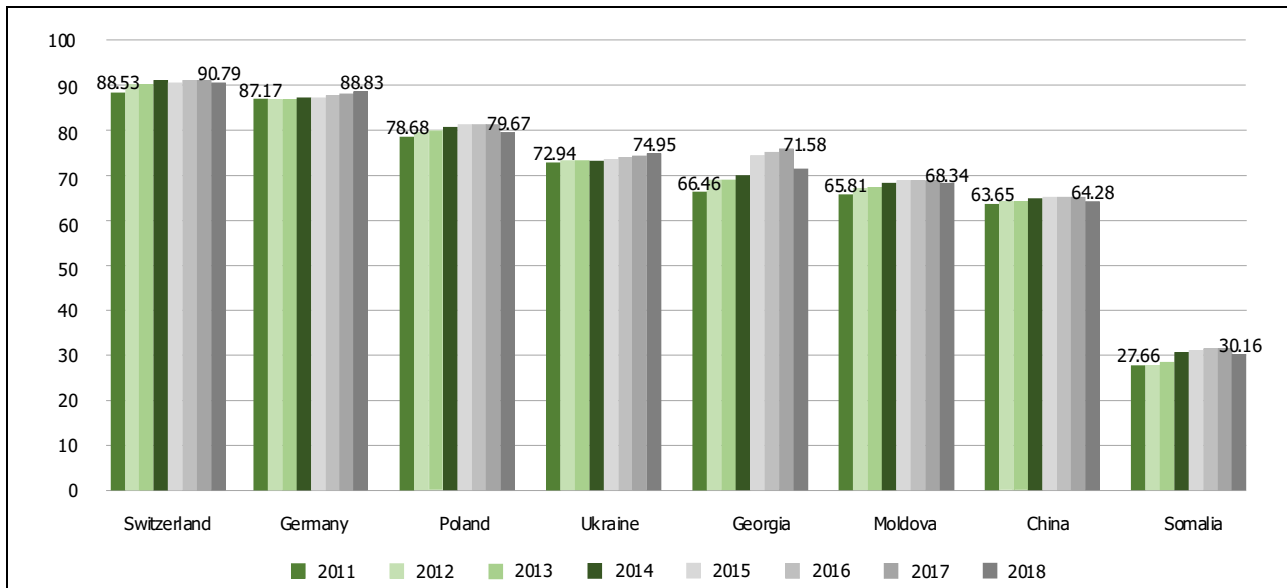


Figure 4. Ukraine's position in the world ranking of globalization.

Again, we can approach this problem from different angles, but we will choose the institutional approach because in recent decades the formation of national innovation systems is designed to spread new technologies through the development of institutions (K. Freeman). An innovative type of economy involves the interaction of elements such as market, innovation, institution, and investment. Based on this, we can consider possible existing risks, such as market, innovation, institutional, and investment. In developing countries (Ukraine), technology transfer has specific corporate, institutional and organisational risks (Table 2).

Table 2. Risks that may arise in the academic environment of Ukraine in the transition to an innovative business model.

Stage	Type of risk	Risk factors
Establishment of a specialised department for innovation and business process management	Negative result or overdue performance	Lack of qualified personnel Ignorance of the legal framework in the field of research and innovation and entrepreneurship Lack of organisational skills to create appropriate structural units
Search and employment of potential managers of science-intensive business	Negative result or overdue performance	Lack of qualified personnel Errors in the interpretation of the basic provisions of labour law and the legal field of educational, research and innovation and entrepreneurship Miscalculations in the assessment of resource provision of research projects
Activities of the specialised department for the management of scientific-innovative-entrepreneurial process	Negative result or overdue performance	Difficulties in integrating results and/or choosing ways to commercialise research results Miscalculations in the choice of institutional and/or market methods of activating the innovation and investment potential of regional development and commercialization of research results.
	Profit shortfall	

However, in recent years Ukraine has been actively involved in the internationalisation of its own higher education. Ukrainian universities currently teach 76,548 foreign students from 155 countries. They have the same ambitious goal as the Polish one - 100,000 foreign students, which they intend to achieve by 2025. At present, foreigners make up 15.6% of the total number of students in Ukraine. An interesting fact is that the largest group of foreign students (over 18,000) are Indians, Moroccans (almost 9,000), and Turkmen (more than 5,000) due to the weakening of visa policy for students from these countries. Also, the internationalisation of innovation in such countries is always associated with the risk of losing real commercial benefits. Well-known theorist D. Clark (1998) in determining the characteristics of the University of Entrepreneurship notes that he is forced to work by analogy with a company that is working to implement the idea, the result of which is not obvious. Technology transfer has a complex institutional structure, which includes intermediary institutions (professional participants in the investment market: venture funds, innovation funds, innovation companies, investment companies) and the university (laboratory, science park, technology park). All this is possible if there is an ascending development of innovation structures when new income opportunities arise when the existing environment is not able to

promote the realisation of opportunities that are on time. It is worth paying attention to the legal side of the issue: protection of property rights and technology support.

In world practice, to minimise risks and avoid potential losses that can lead to riskier investment projects, resort to various measures. Common methods of responding to risks are compensation, evasion, localization, and dissipation. The main compensatory forms of science-intensive risk management are marketing and strategic planning and forecasting. Currently, research teams are constantly forced to conduct preliminary marketing research in the direction of their research (Figure 5).

The results of the hypothesis test have shown that the changes taking place in the field of international technology transfer are accompanied by new risks.

First, these risks are related to changes in functional priorities in universities - the main producers of new technological solutions and their implementation of strategies to internationalise knowledge on a commercial basis in international innovation markets. Although new trends and conditions of academic entrepreneurship have significantly changed the approaches to the internationalisation of knowledge and technology, the trajectory of risk management in the global environment is not yet perfect. We have proposed strategic solutions for the diversification of such risks, which involve institutional changes in risk management.

In general, H1 can be considered well-founded.

Secondly, the vector of formation of international research collaborations is unalterable, as it involves the exchange of valuable experience. We introduce the concept of "opportunities for marketing the results of academic research" to balance the likely risk effects, and trade-offs and maximise the effectiveness of internationalisation in technology transfer.

In general, H2 is reasonable.

Third, the use of remote forms of academic entrepreneurship in technology transfer, involving work with specialised international platforms and social networks, creates additional risks of cyberattacks, but early identification of such risks contributes to the internationalization of technology transfer in the global environment.

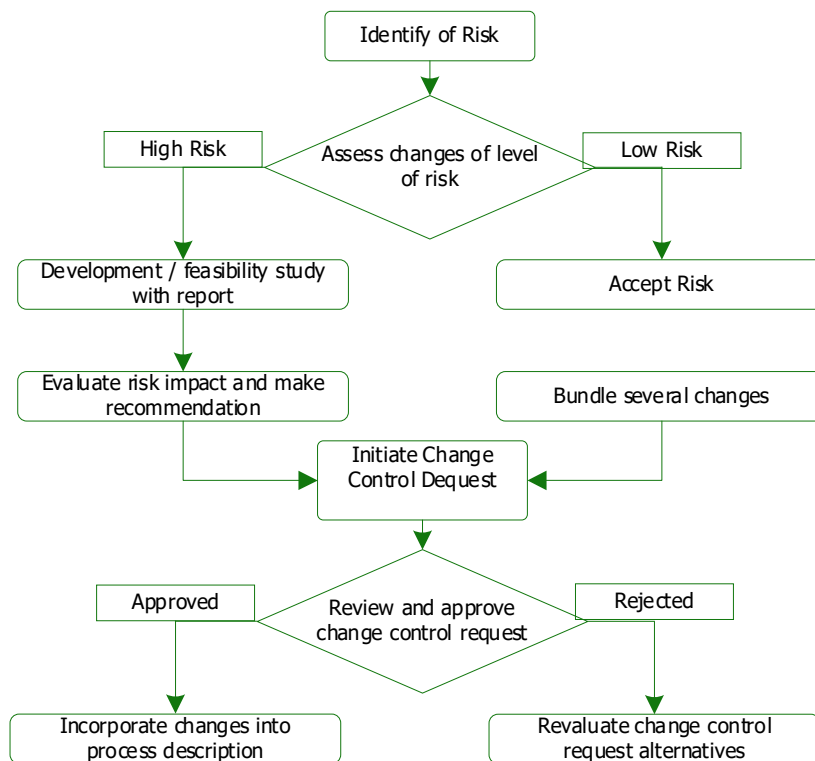


Figure 5. Algorithm of risk management actions in the process of internationalization of technological transfer.

Therefore, it can be argued that H3 is justified.

DISCUSSION

The role of the state is difficult to overestimate in this process because it is through the actions of state institutions that conditions are created for the development of high-tech business. The main customer of innovative developments with a high degree of risk is usually the state. As for business, it joins these initiatives in the final stages of testing innovative developments. In Ukraine, the risks of investing in high-tech developments are extremely high. After all, according to well-known rating publications (Heritage Foundation, Wall Street Journal, Euromoney), Ukraine holds positions (from 120 to 150) that are not attractive to foreign investors. This is also confirmed by the analysis of macroeconomic risks of the world-famous analytical platform "The Global Economy" (Figure 6).

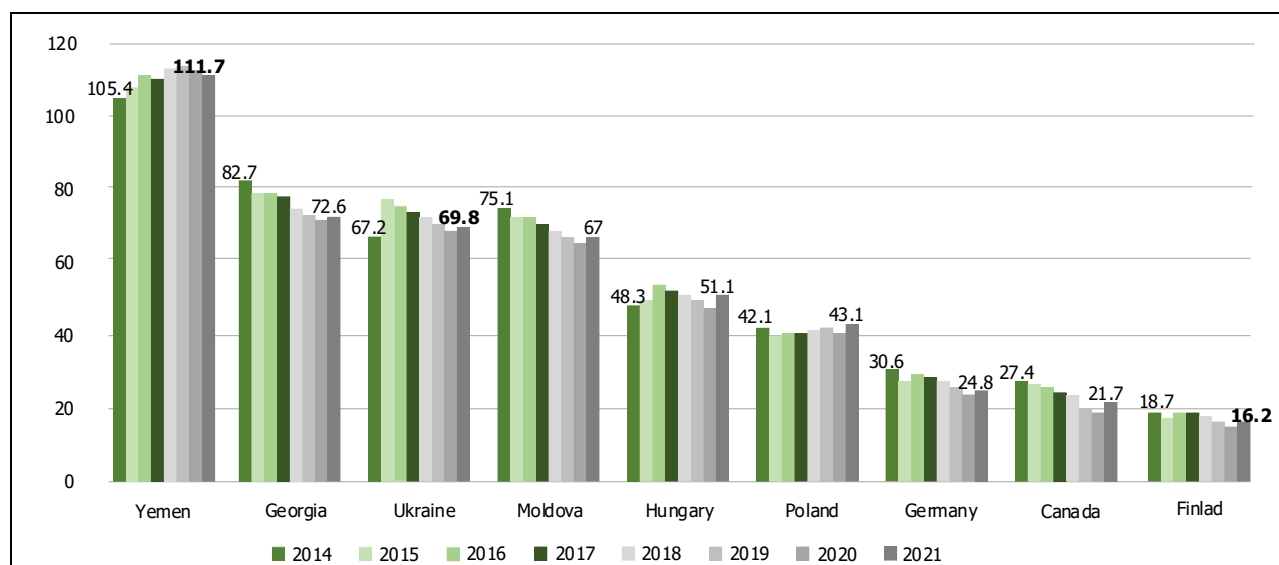


Figure 6. Ukraine's position in the ranking of fragile states. (Source: compiled by the authors)

The fragile state index is a reflection of the various problems that occur in the country. The higher its importance, the worse the situation in areas such as government management, public confidence in public institutions, economic development, the gap in society between different social groups, access to benefits for all participants, existing migration processes, and external interference in governing the country. This index varies from 0 to 120 index points. The average value in 2021, when analysing 173 countries, was 66.4 index points. Ukraine has slightly worse than average results.

Information on the protection of intellectual property rights is available on the website of the European Union, which lists the protection measures for technology transfer on the example of transfer from European countries to China. These guidelines can also be applied to European companies, namely: 1) design products for delivery to China on a modular basis so that different modules can be manufactured by different manufacturers, thus ensuring that each supplier receives only partial knowledge; study of the practice of reducing the risks of international technology transfer; 2) combine and produce the main elements of the product in your own company to prevent industrial piracy; 3) conduct a thorough inspection of the potential partner, location and local industrial policies and laws; 4) inform the buyer about the invented know-how, documents, customer relations, designs, strategies, update plans, etc. strictly only after signing the confidentiality agreement. 5) protect against unauthorised copying with patents, trademarks, designs, etc., and monitor competing companies for counterfeiting; 6) conduct regular audits with an emphasis on the verification of contractual obligations for leakage of intellectual property rights; 7) actively monitor the identified violations.

These recommendations should be implemented in the practice of Ukraine on the protection of intellectual property rights and create effective control mechanisms. This would promote the activity of technology transfer, innovation with less risk for all participants in this process, and Ukraine's representation in the international arena.

CONCLUSIONS

The paper analyses the possible causes of risks in international technology transfer, taking into account international trends in the knowledge economy. Based on the formulated hypotheses and their proof, the authors cover the risk management of technology transfer in the Ukrainian environment, taking into account the processes of internationalisation and globalisation. The key to success in international technology transfer is investing in long-term relationships at the domestic and

international levels, which allows process participants to share responsibilities and risks. And the main reasons for the low efficiency of technology transfer are ignorance of the market by scientists and developers and a lack of understanding of how their scientific results can be transformed into a particular market product. Professional intermediaries - managers, and business representatives do not have enough knowledge about the development of modern science, and its activities, and therefore it is difficult for them to calculate the probability of success in the implementation of scientific results. The state as an arbiter must establish "rules of the game" in the technology transfer market, but is very roughly oriented in real-life research and development of technology, which inhibits the development of technology and its commercialization.

Analysis of current trends and challenges in science-intensive business, allows you to describe a "portrait" of likely risks in the process of creating and transferring innovative technologies, which avoids most threats. Effective methods of minimizing risks in innovative entrepreneurship are the availability of an appropriate information base, "Financing" innovation and research projects through hybrid mechanisms (including the use of grant funds) to reduce capital costs, absorption of the risk of technological failures, assessment of the level of danger of implementation of high-risk projects and application of the mechanism of insurance against risks of science-intensive business in insurance companies.

The country's competitiveness is largely shaped by quality management between all structural units of the system, the marketing network, and the process of innovation development. Success is achieved by those countries that have developed scientific, educational, technological, financial, and institutional infrastructure.

ADDITIONAL INFORMATION

FUNDING

This research was funded by the authors (Novikova & Stepanova) and the Ministry of Education and Science of Ukraine according to the projects "Business-Education-Science" Coepetition: Institutional and Economic Models of Innovation Transfer for National Security and Sustainable Development" (№ 0122U000772) and "Cognitive Model of Innovations' Commercialization in the Conditions of Industry 4.0: Intellectual Capital Protection, Marketing and Communications" (№ 0122U000780) (Samoilkova).

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УПРАВЛІННЯ РИЗИКАМИ ТРАНСФЕРУ ТЕХНОЛОГІЙ В УМОВАХ ІНТЕРНАЦІОНАЛІЗАЦІЇ НАУКИ

У часи глобалізації та постпандемії саме доступність передових технологій, їх ефективне використання є визначальним фактором економічного зростання. Процес трансферу інноваційних технологій пов'язаний зі значним рівнем ризику, що негативно впливає на економічний, соціально-технічний і технологічний розвиток економіки будь-якої країни світу. Таким чином, дослідження спрямоване на розробку алгоритму управління ключовими ризиками, які виникають при обміні технологіями в науково-освітньому середовищі в контексті інтернаціоналізації науки. У свою

чергу, аналіз ризиків став основою для розробки пропозицій щодо усунення ймовірнісних бар'єрів, таких, як обмеженість інформації, дефіцит кваліфікованого персоналу, низька державна активність, відсутність інтересу бізнесу до високовартісних і ризикованих наукоємних проектів, невизначеність потенційного попиту на нову технологію серед споживачів. Гіпотези, запропоновані авторами, довели, що освітня співпраця, маркетингова розвідка та використання професійних мережевих платформ є водночас джерелами потенційних ризиків для передачі технологій у наукових колах і рушійною силою їхнього розвитку. Теоретична та практична цінність результатів дослідження полягає в тому, що вони дозволяють сформувати теоретико-практичне підґрунтя для формування методологічної парадигми управління ризиками інтернаціоналізації трансферу технологій з урахуванням особливостей вітчизняної економіки та світових викликів.

Ключові слова: інновація, технологія, трансфер, стратегія, ризик, інтелектуальна власність, дифузія інновацій, менеджмент

JEL Класифікація: D81, F29, O32, O33