



S

USTAINABILITY OF KNOWLEDGE & TECHNOLOGY TRANSFER CENTER AT KHMELNITSKY NATIONAL UNIVERSITY (UKRAINE)

¹ Tetiana Hovorushchenko

² Andriy Nicheporuk

³ Dmytro Medzatyj



ABSTRACT

The need of the search for new sources of funding due to the decrease in the level of state financing of higher education institutions of Ukraine testifies to the actuality and importance of the development of cooperation between academic institutions and industrial partners. The Knowledge & Technology Transfer Center (KTTC) was established at Khmelnytsky National University (KhNU) with the purpose of such cooperation. The main areas of activity of the KTTC are: organization of effective communication interface of the University; in-university consulting on implementation and commercialization of innovations; intellectual property management and research of the market requirements. The main target groups of the KTTC at KhNU are researchers, students and industrial partners. This paper highlights the ways of achieving sustainable development by the KTTC at KhNU. The tasks, which were solved to ensure sustainable development of the KTTC, are presented. Among these tasks, the main attention is paid to the analysis of the innovation branch, financial support of the KTTC and involvement of as many partners as possible in the activities of the KTTC.

Keywords: Knowledge & Technology Transfer Center (KTTC). Khmelnytsky National University (KhNU). Sustainability. Innovations. Information Field of KTTC.

Cite it like this:

Hovorushchenko, T., Nicheporuk, A., & Medzatyj, D. (2019). Sustainability of Knowledge & Technology Transfer Center at Khmelnytsky National University (Ukraine). *International Journal of Innovation*, 7(2), 210-226. <https://doi.org/10.5585/iji.v7i2.357>

¹ Head of Computer Engineering & System Programming, Khmelnytsky National University (KhNU), (Ukraine).
Orcid: < <https://orcid.org/0000-0002-7942-1857> >. Email: < tat_yana@ukr.net >

² Senior Lecturer of Computer Engineering & System, Khmelnytsky National University (KhNU), (Ukraine).
Orcid: < <https://orcid.org/0000-0002-7230-9475> >. Email: < andrey.nicheporuk@gmail.com >

³ Associate Professor of Computer Engineering & System, Khmelnytsky National University (KhNU), (Ukraine).
Orcid: < <https://orcid.org/0000-0002-1879-2945> >. Email: < d.medzatyj@gmail.com >

S

OSTENIBILIDAD DEL CENTRO DE TRANSFERENCIA DE CONOCIMIENTOS Y TECNOLOGÍA EN LA UNIVERSIDAD NACIONAL KHMELNITSKY (UCRAINA)

RESUMÉN

La necesidad de buscar nuevas fuentes de financiamiento debido a la disminución en el nivel de financiamiento estatal de las instituciones de educación superior de Ucrania demuestra la actualidad y la importancia del desarrollo de la cooperación entre instituciones académicas y socios industriales. El Centro de Transferencia de Conocimiento y Tecnología (CTCT) se estableció en la Universidad Nacional de Khmelnytsky (KhNU) con el propósito de dicha cooperación. Las principales áreas de actividad del CTCT son: organización de una interfaz de comunicación efectiva de la Universidad; consultoría universitaria en implementación y comercialización de innovaciones; gestión de la propiedad intelectual e investigación de los requisitos del mercado. Los principales grupos objetivo de CTCT en KhNU son investigadores, estudiantes y socios industriales. Este documento destaca las formas de lograr un desarrollo sostenible del CTCT en KhNU. Se presentan las tareas, que se resolvieron para asegurar el desarrollo sostenible del CTCT. Entre estas tareas, se presta la mayor atención al análisis de la rama de innovación, el apoyo financiero de CTCT y la participación de tantos socios como sea posible en las actividades de CTCT.

Palabras Clave: Centro de Transferencia de Conocimiento y Tecnología (CTCT). Universidad Nacional de Khmelnytsky (KhNU). Sostenibilidad. Innovaciones. Campo De Información de CTCT.

INTRODUCTION

At present, the development of higher education institutions is not possible without close cooperation with industrial enterprises (Shegelman, Shchukin and Vasilev, 2015; Melink and Pavlin, 2014; Kromydas, 2017). Among the important areas of development of such cooperation: (1) improving the quality of training the specialists in accordance with the requirements of the labour market (Cesnyiene, Diskiene and Stakeviciene, 2013; The Labour Market Story, 2014; Global Agenda Council on Employment, 2014); (2) attracting the scientific and technical potential of higher education institutions to the decision of production tasks of real industrial enterprises (Kromydas, 2017; Halloran and Friday, 2018; Making industry-university partnerships work, 2012); (3) creating the commercial structures, subsidiaries in the higher educational institutions for the

commercialization of their own scientific and practical developments (Halloran and Friday, 2018; Making industry-university partnerships work, 2012; Gachie and Govender, 2017; Novikova, Martyniuk, Bediukh and Kharina, 2018; Ministry of Education and Science of Ukraine, 2017).

The need of the search for new sources of funding due to the decrease in the level of state financing of higher education institutions of Ukraine testifies to the actuality and importance of the development of the above areas of cooperation between Ukrainian academic institutions and industrial partners (Novikova, Martyniuk, Bediukh and Kharina, 2018; Ministry of Education and Science of Ukraine, 2017; Repko and Ruda, 2017).

With the purpose of activating the knowledge and technology transfer, the

Knowledge & Technology Transfer Center was created at the Faculty of Programming, Computer and Telecommunication Systems of the Khmelnytsky National University within the framework of the TEMPUS KTU International Project (No. 544031-TEMPUS-1-2013-1-AT-TEMPUS-JPHES). Within the framework of the TEMPUS KTU project, 6 Knowledge & Technology Transfer Centers have been created in Ukrainian partner universities, the path of formation and development of some of them is described by Karpenko & Iashyna (2015).

The main areas of activity of KTTC at KhNU are (Tempus KTU Strategy, 2013): (1) organization of the effective communication interface of the university (contact point for companies and other external partners with a special emphasis on transfer of knowledge); (2) in-university consulting on the issues of introduction and commercialization of innovations; (3) intellectual property management and market requirements research.

The main target groups of the KTTC at KhNU are researchers, students and industrial partners.

The processing of the issues of realization of industrial-academic interaction requires taking into account the features of the region, the state of innovation development, and analyzing and identifying the most promising sectors in which the effect from attracting the potential of educational institutions will be the highest. For Khmelnytsky region, the domain of information technologies (IT) is such sector. This industry doesn't require the involvement of costly and high-tech resources. Student and researcher groups can quickly start and bring their own IT business to a sufficient level of profitability. Therefore, precisely domain of information technologies should become a priority for higher education institutions in the Khmelnytsky region when implementing the strategy of interaction between academic institutions and enterprises.

The KTTC at KhNU works as a centre for helping groups of researchers in creating profitable enterprises. In the new Ukrainian reality, this is a very timely and actual problem. The main task of the KTTC as a university unit is to organize an efficient transfer of technologies and knowledge and to support innovation activity with a strong communication network for the

development of cooperation with industry. The KTTC at KhNU is able to provide the support all the requests related to the transfer of knowledge at the university and its ecosystem, but the main focus is focused on areas related to information technology.

One of the challenges by the KTTC is ensuring of its sustainable development. For solving this task, the analysis of the internal (staff & management, finance, industry, innovations) and external (customers & society, investors, providers, competitors) environments will be conducted. The main problem for this unit is the self-sustainability and self-sufficiency after completing the proceeds from the TEMPUS KTU project in support of the Center's activities. During the implementation of the TEMPUS KTU project, the KTTC was at a level of stable activity thanks to continued EU funding. After termination of EU funding, the KTTC must achieve the level of sustainability or as a minimum stay at the level of stable activity. For solving this problem, the identification of KTTC funding sources, the identification of the ways of improving the KTTC competitiveness, the identification of effective paid services, the search of the ways of investments will be conducted. Therefore, this paper is devoted to the actual and important issue of ensuring the sustainable development of the KTTC at KhNU. The advantage of solving this issue will be the development of the unified mechanism on ensuring the sustainable development of the university's units, which have the financial support during the certain period, but after this period these units should become self-sustainability and self-sufficiency.

Literature Review & Research Model

Transfer of knowledge and technology. The interaction between universities and companies arises from the need of the productive sector to develop a new technology, product or process, or even when there is an adequately mature invention to be transferred from the university to the company, which is one of the ways interaction may occur (Sankat, Pun and Motilal, 2007).

The technology transfer is defined as the transmission of knowledge in a continuous, frequent, and strategic manner, which is applied

to researching in government technological agencies, laboratories, universities, and any institution capable of generating knowledge (Urbano, 2013; Mauricio and Lopez, 2018).

Suppliers of technology and knowledge: universities, agencies' research, technology centres, companies. Recipients of technology and knowledge: companies, corporations consulting, consulting, law, intellectual property, etc. Public or parastatal intermediaries: foundations, science and technology parks, etc. The most commonly used transfer mechanisms are: licensing and patent commercialisation, followed by units of research, development and business incubators, finding parks and technological cities as mechanisms least used, which should be promoted more (Mauricio and Lopez, 2018).

The "stakeholder" groups of the university-industry technology transfer: companies, universities, researchers and state government. Companies partner with universities for a variety of reasons, including intellectual property acquisition, access to potential new hires, and access to cutting-edge ideas and expertise. Universities partner with industry for reasons of mission and resource acquisition, and for opportunities for strategic partnerships and application settings. Researchers in the university seek partnerships for resources, personal entrepreneurial opportunities, and a venue for doing paradigm-shifting research. State government is significantly motivated by aspirations regarding economic development and state or institutional prestige, and the economic geography of technology transfer outcomes (Tornatzky, Waugaman and Gray, 2002).

The institutions that have extensive research grants and do best in the delivery of research results, generally have the best potential for collaboration with industry. Long-term strategic partnerships between universities and industry that run for 5 to 10 years are the most productive at driving innovation (Earnshaw, 2017).

The main results of the research how technology transfer occurs showed the need of companies and universities to understand that working in collaborative technology research contributes to the transformation of applied research into technological innovations that can transform society (Chais, Ganzer and Olea, 2018).

The wealth flows from university-industry partnerships is repeatedly reinforced (for example, the transformation of the U.S. economy from one reliant on agriculture and manufacturing to one opening up new industrial sectors, like information technology and biotechnology, in the places, where major research universities have spawned new companies and industries and created new wealth for the local citizenry) – foster new business, create new jobs, promote innovation, enhance the work force, and improve the quality of life, transformation of academic research findings (and inventions) into commercially viable technological innovations (Koehn, 1998). Because the broader measures encompass the traditional missions of universities – education and research – they will align more closely with the activities desired by industry and economic developers. The university income from academic engagement outranks income derived from selling intellectual property and is valued higher by industry. Researchers are also motivated to see their research transferred out from the university to society (Vries, Dolfsma, Windt and Gerkema, 2018).

Modes of interaction between the academy and industry include: consultancy (university's researcher does external work for a company for which they are paid directly, though some institutions require a proportion to be given to the institution); collaboration on an R&D project of mutual interest (where industry funds the R&D costs); contract, or subcontract, from industry as part of an R&D project funded by industry, or by an external funding agency; personnel exchange between the academy and industry; Setting up spin-off company (to generate product or service based on academy-owned Intellectual Property Rights); licensing of academy-owned patents to industry (Earnshaw, 2017).

Collaboration in research and development (R&D) between academia and industry has been the main driver for the development of innovative technologies for many years. Since industry and university are the two most powerful engines that can generate innovation, it would be obvious that if the two entities can work in conjunction, the resulting outcome would be enormous and could push the frontiers of innovation in a major way. The benefits to a university include – increased

opportunities for research funding; being a potential source for receiving monetary rewards that may go back to unrestricted R&D; providing an industrial connection leading to sponsored research funds; opportunities for consulting; assistance in student success via internships and employment opportunities; and provision of prestige to its affiliated university. As for industry benefits from a relationship with a university – receipt of federal funding through governmental collaborative funding initiatives; cost savings via student hires as interns and faculty consultants; commercialization of university-based technologies for commercial and financial gain; subcontracting R&D project to university (due to lack of in-house infrastructure or expertise in the industry; enhancement of corporate image (Spiewak, 2016).

There are base models of technology transfer that have their own peculiarities. Triple helix innovation model (Leydesdorff and Etzkowitz, 1998; Leydesdorff, 2012) is model that includes as many stages of technology transfer; and as many transfer factors are recorded. It focuses on university-industry-government relations. The Quadruple Helix innovation model (Carayannis, Barth and Campbell, 2012) embeds the Triple Helix by adding as a fourth helix the “media-based and culture-based public” and “civil society”. The Quintuple Helix innovation model (Carayannis, Barth and Campbell, 2012) is even broader and more comprehensive by contextualizing the Quadruple Helix and by additionally adding the helix (and perspective) of the “natural environments of society”. The other models of university-industry technology transfer are: Mayer and Blass model (2002), Rubiralts model (2004), Gorschek, Garre, Larsson and Wohlin model (2006), Hoffmann, Amal and Mais model (2009), Kalnins and Jarohnovich model (2015) (Arenas and Gonzalez, 2018).

Considering the actuality and necessity of establishing the university-industry partnerships, the Knowledge & Technology Transfer Center was created at the Faculty of Programming, Computer and Telecommunication Systems of the Khmelnytsky National University within the framework of the TEMPUS KTU International Project. This KTTC is the technology bridge between the two parties, which provides the legal

and business services, and provides the breakthrough innovation through the generation of new knowledge. This Center is created on the basis of the Quintuple Helix innovation model. So, the important task for KhNU KTTC is ensuring the sustainable development of it.

Sustainability. Sustainable development is a general concept regarding the need to strike a balance between satisfying the current needs of the organization and protecting its future interests (Goniadis, 2015; Department of Economic and Social Affairs, 2008; The New Sustainable Frontier, 2009; Jorna and Hadders, 2010).

One key aspect of sustainability science, therefore, is the involvement of actors from outside academia into the research process in order to integrate the best available knowledge, reconcile values and preferences, as well as create ownership for problems and solution options (Lang, Wiek, Bergmann, Stauffacher, Martens, Moll, Swilling, and Thomas, 2012).

Sustainable development is prompting a re-assessment of innovation and technological change (Smith, Voss and Grin, 2010). Sustainability oriented innovation and technology studies have received increasing attention over the past 10-15 years (Markard, Raven and Truffer, 2012). When companies pursue sustainability, it's usually to demonstrate that they are socially responsible (Nidumolu, Prahalad and Rangaswami, 2009).

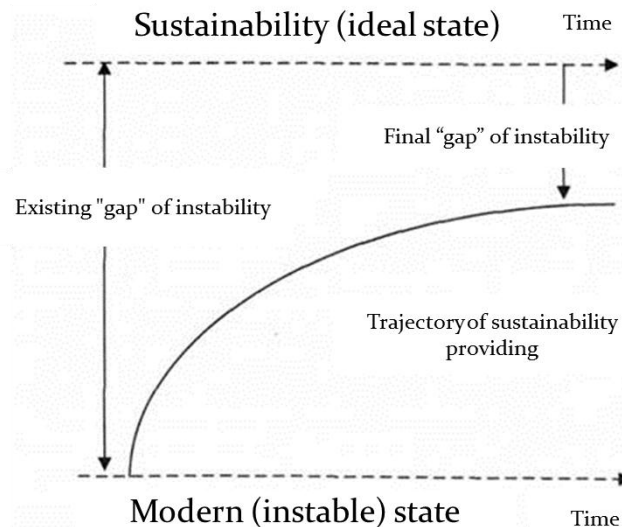
The main indicators of sustainability are (Singh, Murty, Gupta and Dikshit, 2009): the existence of a legislative framework (the existing and necessary laws are specified in the Project Strategy (Tempus KTU Strategy, 2013)) and the participation of stakeholders in decision-making (Ayuso, Rodriguez, Garcia-Castro and Arino, 2011). Ayuso et al. (2011) performed a logistic regression analysis in order to test the hypothesized relationships between stakeholder interaction, knowledge management and sustainable innovation orientation.

Empirical results showed that knowledge sourced from engagement with internal and external stakeholders contributes to a firm's sustainable innovation orientation, but that this knowledge has to be managed by the firm

internally in order to be converted into new ideas for innovation.

The trajectory of motion to the sustainability is presented on Figure 1.

Figure 1. The trajectory of motion to the sustainability (Smirnov, 2009; Nascimento, 2012).



Nidumolu et al. (2009) have found that companies on the journey to sustainability go through five distinct stages of change: (1) viewing compliance as opportunity; (2) making value chains sustainable; (3) designing sustainable products and services; (4) developing new business models; (5) creating next-practice platforms.

For created during TEMPUS KTU project KTTC, the sustainability is the capacity of the Center to continue its existence and functioning beyond its end. The KTTC should be used and exploited continuously. Sustainability of results implies use and exploitation of results in the long term. The Center can be considered as sustainable if its outcomes or parts of these continue after the end of the funded project duration (Tempus KTU Strategy, 2013).

Therefore, further achievement of the sustainability of KhNU KTTC will be considered from this position – from the position of achieving the self-sustainability and self-sufficiency after completing the proceeds from the TEMPUS KTU project in support of the Center's activities.

Achieving this sustainable development requires the following tasks solutions (Pope, Annandale and Morrison-Saunders, 2004; Ness, Urbel-Piirsalu, Anderberg and Olsson, 2007): (1) identification of opportunities for sustainability based on analysis of the internal environment:

staff & management, finance, industry, innovations; (2) identification of opportunities for sustainability based on analysis of the external environment: customers & society, investors, providers, competitors; (3) development and implementation of the strategy of sustainability: management of relations with stakeholders, systemic motivation towards sustainability, system of balanced indexes and goals.

Research Method

Before beginning and during functioning the KTTC at KhNU, the SWOT-analysis is conducted. During SWOT-analysis the strengths and weaknesses of the internal (staff & management, finance, industry, innovations) and external (customers & society, investors, providers, competitors) environments are determined.

During the analysis of staff & management for the KTTC at KhNU the following tasks are solved: (1) the harmonization of the use of labour resources with a focus on the stable growth of efficiency; (2) the effectiveness of using the optimal organizational structure and rational management methods; (3) the concordance of the KTTC staff and their competences with the existing needs of the region's economy and Khmelnytsky National University; (4) the increase

of the value of employees through study visits to European universities, professional advance.

The staff of the KTTC at KhNU successfully coped with such tasks. In particular, the optimal organizational structure was chosen. Because the KTTC staff is well-known IT specialists and the IT industry is a priority for higher education institutions in the Khmelnytsky region when implementing the strategy of interaction between academic institutions and industrial enterprises, the IT industry was chosen for the work of the KTTC at KhNU. The KTTC staff repeatedly visited such leading European universities as: the Royal Institute of Technology in Stockholm (Sweden), the University of Girona (Spain), the University of Technology and Economics in Budapest (Hungary), the University of Applied Sciences FH JOANNEUM in Graz (Austria), Tallinn Technical University in Tallinn (Estonia).

The main purpose of the analysis of industry was the maximization of the expansion of external financing, so during this analysis, the staff of the KTTC at KhNU provided the answers on the following questions: (1) what needs are in the university community, organizations, enterprises and entrepreneurs in the region? – such an analysis was carried out in order to form the demanded services in the KTTC. For example, an analysis of the needs of the western region, which represents the KhNU, provided the following basic and additional services for the KTTC at KhNU: support for preparation of application; technical, legal and consulting support for student's IT developments; support for public events, public awareness and student engagement; 3D-modeling and technical consulting, analysis of engineering applications, its implementation in the educational process; work with innovations; development of advanced training programs for KhNU lecturers and for industry representatives; (2) what types of activities are available in KhNU? – such an analysis was carried out with the purpose of further integration of types of activities and expansion of their in the services of the KTTC.

Effective innovations are one of the key conditions for sustainable development. In the analysis of innovations, the following tasks were solved: (1) identification of opportunities for conducting special research and engineering works on the basis of the University for the implementation of innovative products, services, processes, methods and production technologies; (2) selection of tools for innovative management – methods for finding ideas, analytical methods, estimation methods, methods for generating ideas, forecasting methods, decision-making methods, visual representation methods, argumentation methods; (3) formation of research groups for work on external innovations from different knowledge domain ("top-down" strategy) and evaluation of the success of these innovations; (4) identification of the internal innovative ideas ("down-top" strategy) that can receive support and funding from the outside; (5) establishment of criteria and methods for evaluating the external innovative ideas (development of templates for the description of the idea, analysis of novelty).

The analysis of Ukraine's innovation field showed that the smallest amount of innovation is allocated in the Khmelnytsky region (within 0.6%), but during building the strategy of sustainability the staff of the KTTC at KhNU relied on the hidden innovative potential.

Evaluation of innovations and groups of researchers is carried out using the experience gained in the scientific platform KTH Innovative of the Royal Institute of Technology in Stockholm (Sweden) – during a study visit of the KTTC staff to the KTH Innovative and the meeting with Lisa Ericsson, the director of KTH Innovative platform. In particular, the KTTC staff use the method for describing and evaluating the idea developed, which is borrowed from the KTH Innovative platform. This method is called NABC (Need; Approach; Benefits; Competition) – Figure 2,3 (Ericsson, 2017).

Figure 2. Technology Readiness Level (Ericsson, 2017)

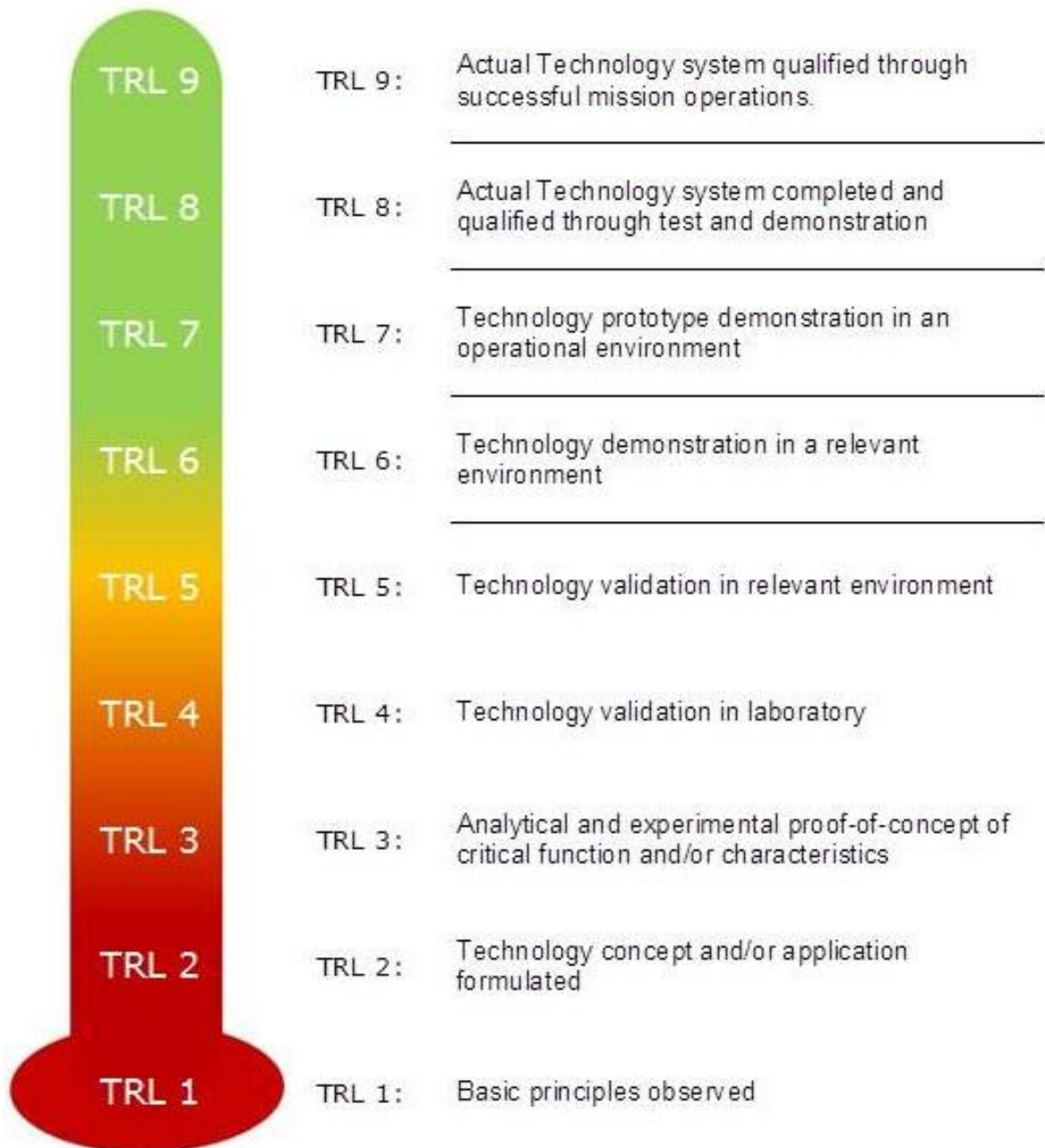


Figure 3. Market Opportunity Readiness Level (Ericsson, 2017).



By the NABC approach, the KTTC staff evaluated more 50 innovative propositions from both students and researchers at the KhNU (Pomorova, Hovorushchenko, Poberejnyi, Mahdin, 2016), among which 7 more interesting and prospective project were selected. The example is the student startup "Outsourcing "superfluous" affairs or Let's exchange time for money!" – a social IT project that allows one people to save time, and allows others people to earn money by doing the well-known work. This

startup received high scores by the NABC approach. KTTC staff recommended this startup to participate in the All-Ukrainian 1-st student competition of IT projects, where this student startup received due recognition (1-st place in the category "Social IT projects").

The experience of working on this startup has shown that: (1) innovative ideas appear, including in the student environment; (2) it is quite realistic to organize and support the process of transforming the idea into a product; (3) lecturers

and students, who once went from idea to creation of the successful product, have thus acquired skills and abilities, have confidence in their strengths and capabilities, and will continue this process producing new ideas, implementing quality products, i.e. creating successful startups.

Finance is the most important category of the internal environment. In analyzing this category, the following tasks were solved: (1) identification of funding sources - for example, for the KTTC at KhNU the following sources of funding

are possible (Figure 4). KhNU provides only auditoriums and costs, which associated with ensuring the operation of the KTTC. The external financing is also difficult to find. So paid services are currently the only source of funding for the KTTC, therefore, the actuality and demand in the region of the proposed services are very important; (2) continuous improvement, increase of competitiveness, optimization and effectiveness of the offered paid services; (3) intensification of investment activity.

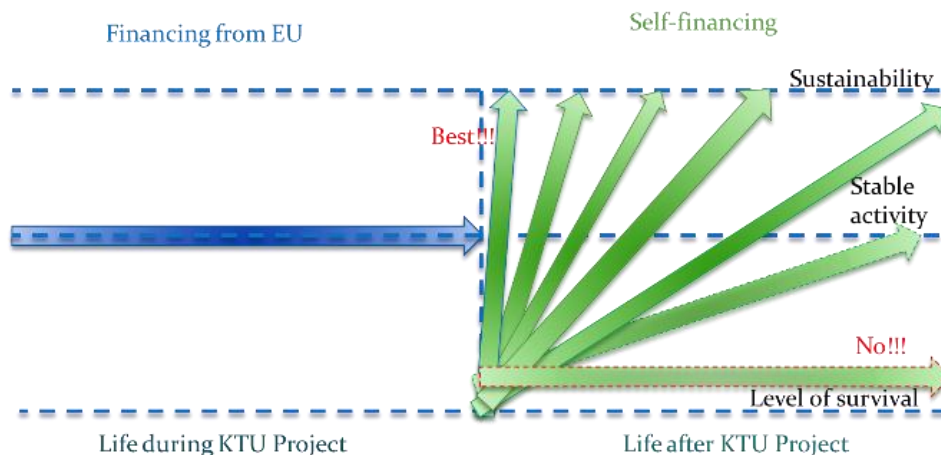
Figure 4. Sources of financing of the KTTC at KhNU



In general, from the point of view of ensuring the sustainable development of the KTTC at KhNU, two stages of its existence can be identified: during the TEMPUS KTU project (EU funding) and after the end of the TEMPUS KTU

project (self-financing). The staff of the KTTC prognosticated three levels of financial development of the KTTC: level of survival, level of stable activity, level of sustainability (Figure 5).

Figure 5. Levels of the financial development of the KTTC at KhNU



During the implementation of the TEMPUS KTU project, the KTTC was at a level of stable activity thanks to continued EU funding. After completion of the TEMPUS KTU project on March

2017, the KTTC could: achieve the level of sustainability, stay at the level of stable activity (this task was a minimum for the KTTC staff) or stabilize at the level of survival (the staff of the

KTTC considered this scenario to be inappropriate for the KTTC at KhNU). As a result, the KTTC at KhNU stayed at the level of stable activity in 2017 and the KTTC has achieved the level of sustainability in 2018.

The time of achieving sustainability by the KTTC was important. In order to move quickly to a level of sustainability, the KTTC successfully began

to provide paid services before the end of the project and before the start of full self-financing – Figure 6. It is thanks to such a decision, the KTTC at KhNU has reached the level of financial sustainability rather quickly – less than 1 year after the termination of funding it from the Project funds (Figure 7).

Figure 6. Financing the activity of the KTTC at KhNU

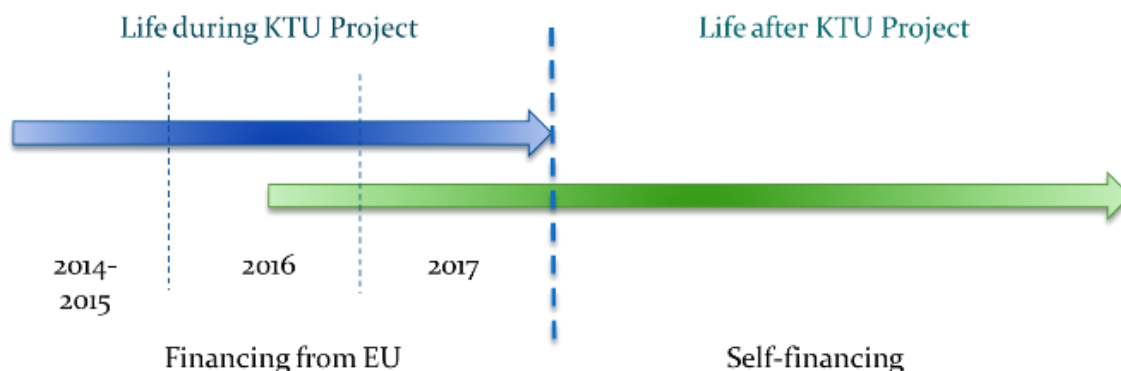
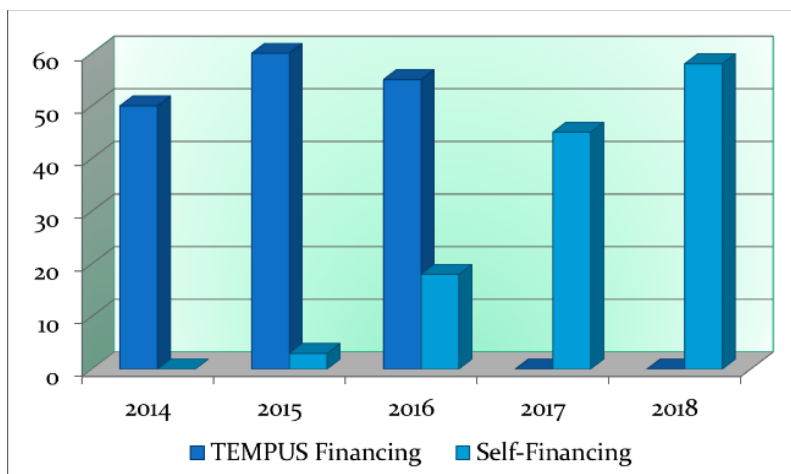


Figure 7. Financing of the KTTC at KhNU



In the analysis of customers & society, it was necessary: (1) to inform society and customers about available services in the KTTC; (2) to determine the ability and willingness of customers to pay for the services provided by the KTTC; (3) to identify the needs of the society of the region in new innovative types of products or in improving the customer characteristics of existing

products, in creating new processes, services that can improve "the quality of life"; (4) to determine the needs of the region's industry in implementing new methods and technologies of production; (5) to identify and to analyze the groups of customers, who are capable and willing to purchase the innovative products, processes, services, methods and technologies.

The KTTC staff identified the needs of the society and the industry of the region in the innovative IT products (web services, software, mobile applications). After this, the KTTC staff focused all efforts on the evaluation and work on these products, and on the development of programs of improving the qualification for lecturers of the KhNU (for example, at the expense of real internships at the IT firms of Khmelnytsky) – for further transfer of the acquired knowledge from the lecturers to the students. In addition, the KTTC staff is very active in informing the society and customers about the services of the KTTC, which ensures an ever-increasing number of requests to KTTC for various services. These requests ensure financial stability and independence of the KTTC at KhNU.

During the analysis of investors it was necessary: (1) to inform about the creation of the KTTC (as the Center for establishing the cooperation between science and production and for transforming the University's resources into profitable business ideas) the maximum number of potential investors in the region; (2) to conduct the analysis of enterprises in the region with the purpose of finding the organizations, who are capable and ready to financially support the internal innovative ideas of university scientists ("down-top" strategy); (3) to conduct the analysis of enterprises in the region with the purpose of finding the organizations that have their own innovative ideas and can order their research, evaluation and development ("top-down" strategy); (4) to analyze the interests of the university and potential investors with the purpose of establishing the "points of contact".

The conducted analysis of investors showed the 10 IT enterprises in Khmelnytsky are capable and ready to invest funds for the development of innovative ideas of university researchers, which are working in the IT domain (10 enterprises – this is a lot, given that the number of such IT researchers at the university is about 50 people). The purpose of funds contracts is: the work on external innovations (from enterprises) by university's research groups; the identification and development of the internal (in-university) innovative ideas. The results of the work of KTTC at KhNU on cooperation with investors are: signing of 8 agreements on cooperation between the Department of Computer Engineering and

System Programming of the KhNU with IT enterprises in Khmelnytsky, including the Khmelnytsky IT cluster; scientific advising of 6 enterprises of Khmelnytsky by researchers of the Department of Computer Engineering and System Programming of the KhNU due to the work of KTTC at KhNU; organization of internship of the lecturers of IT specialties in real IT companies, which provides the improvement of the quality of training of IT specialists in accordance with the requirements of the labor market.

An analysis of existing competitors implies: (1) analysis of enterprises in the region for identifying the organizations that are already successfully providing services that KTTC plans to provide; (2) benchmarking, analysis of the activity and sales market of the above organizations (if any); (3) improvement of the competitiveness through mutually beneficial partnerships.

The analysis of competitors showed that there are currently no higher education institutions in the Khmelnytsky region that have KTTC and can provide similar services.

For management of relations with interested groups (stakeholders) should be: (1) to explore the environment with the purpose of identifying the stakeholders; (2) to use the communicative methods: meetings, events, conferences; (3) to use the comparative methods; (4) to provide the communication with industry representatives of the region and with potential customers of KTTC services.

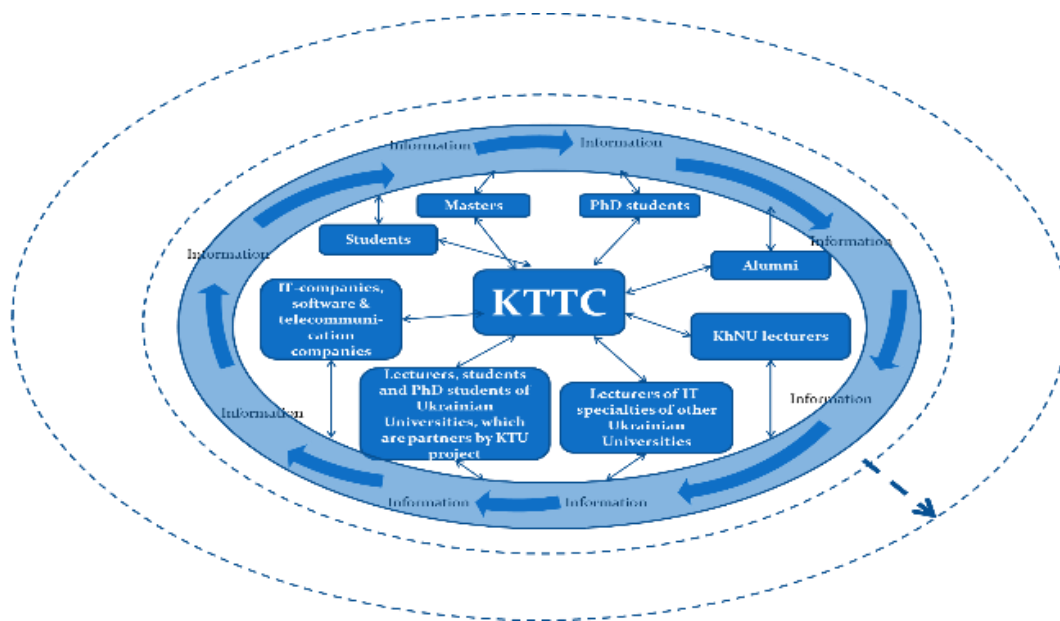
The following types of activities are required for systemic motivation towards sustainability: (1) support of the information field of KTTC in the active state; (2) support of long-term relations with customers; (3) material and non-material incentives for employees; (4) improving qualification and training employees.

For achieving the level of sustainability of the Knowledge & Technology Transfer Center at KhNU the necessary and compulsory condition was the involvement of as many partners as possible in the operation of the KTTC (minimu 100 persons). Effective involvement of potential consumers of services and potential investors implies: (1) effective informing of potential consumers and investors – is a top priority, the urgent task; (2) quality provision of the ordered services to consumers; (3) qualitative execution of research, which were ordered by investors.

In the partnership, the next stakeholders are involved: Students; Masters; Alumni; PhD students; KhNU lecturers; Teachers of IT specialties of other Ukrainian Universities; lecturers, students and PhD students of Ukrainian Universities, which were partners in the TEMPUS KTU project; IT companies, software & telecommunication companies of Khmelnytsky and Khmelnytsky region.

As a result of informing all stakeholders about the activities of the KTTC and their involvement in the partnership, there is the formation and constant support in the actual state of the information field of the KTTC at KhNU (Figure 8). After receiving information, the stakeholders are turning to the KTTC for services. It should strive to expand the information field of the KTTC, since the more powerful it will be, the more services will be ordered by stakeholders.

Figure 8. Information field of the KTTC at KhNU



At the current stage, the web-pages of Computer Engineering & System Programming Department (<http://ki.khnu.km.ua>) and the Khmelnytsky National University (<http://www.khnu.km.ua>) are used to highlight the results of the KTTC.

For the additional involvement of students and masters in the partnership and the implementation of scientific research the KTTC staff creates the permanent student scientific groups (sections). Students- participators of student scientific groups conduct the scientific research and implement the projects for selected (by KTTC) external and internal innovative ideas. In particular they conduct the analysis and modeling of data from potential customers (from software companies of Khmelnytsky region).

Under the auspices of the KTTC, the organization and implementation of student projects under the leadership of representatives of Khmelnytsky software companies began. So, with the assistance of KTTC, the lecturers of Computer Engineering & System Programming department of the KhNU are the only ones in the Khmelnytsky region, who provide the unique opportunity of the dual education and CASE-training - the study of several educational courses by the programs of IT companies of Khmelnytsky, during which students solve the real tasks (cases) of IT companies of Khmelnytsky. Upon completion of the study of such courses, the employment in the IT companies is carried out based on the results of the competition for projects developed during the study of such business-oriented academic courses. Since the purpose of modern IT

education is not only the provision of knowledge, but, first of all, the development of professional skills and a creative approach to task solving, with the particular emphasis on teaching students through research and own experience, this cooperation can improve the quality of practical training of students in accordance with the requirements of the labor market, motivates them to implement real and useful projects and provides to employers more closely work with potential employees, and increases the chances of successful employment of students of IT specialties of KhNU.

KhNU KTTC staff selected the most effective strategy for achieving sustainable development among the 6 Knowledge & Technology Transfer Centers in Ukrainian partner universities. Strategies and results of achieving the sustainable development of the 6 Ukrainian KTTCs were discussed in 1 year after the completion of the project at the post-project meeting of Ukrainian partners in 2018. So, KTTC of Dniprodzerzhynsk State Technical University, KTTC of Kyiv State Maritime Academy, KTTC of National Aerospace University "Kharkiv Aviation Institute", KTTC of International Science and Technical University (Kyiv), KTTC of State Higher Educational Institution "Banking University" (Kyiv) have not reached the level of financial sustainability (after the termination of funding it from the Project funds) at the time of the meeting (March 2018), while KhNU KTTC has already reached that level at that moment.

Conclusions

The KTTC at KhNU was created to organize the interaction of the University with the industrial enterprises with the purpose of: improving the quality of training the specialists in accordance with the modern requirements of the labor market; attraction of the scientific and technical potential of the KNU to the solution of the production tasks of the industrial enterprises.

The development of issues of the realization of industrial-academic interaction requires taking into account the features of the region, the state of innovation development, the identification of the most promising domain of industry, in which the effect of attracting the Higher Education Institution's potential will be the highest. For

Khmelnytsky region, such domain is the information technologies.

This paper highlights the ways to achievement of sustainability by the Knowledge & Technology Transfer Center at the Khmelnytsky National University - in particular, the tasks solved for achievement of sustainability are highlighted, the main attention is paid to the analysis of the innovation domain, of the financial provision of the KTTC and of the involvement of as many partners as possible in the operation of the KTTC at KhNU.

It is proved that the KTTC is the successful structural unit of the KhNU that has achieved sustainability, has quickly come out on full self-financing (less than a year after the completion of the TEMPUS project), successfully operates, has established a close cooperation of the IT specialties of the KhNU with the IT industry of Khmelnytsky and already has a number of interesting, successfully implemented projects.

The limitations of Ukrainian KTTC are: the lack of clear and established processes within universities; the variety of mismatches with university practices and policies; the lack of access to technology contracts (they are considered confidential).

The analysis of financial sustainability of only 6 created Ukrainian KTTC is considered a limitation of this study, as it is not possible to generalize the conclusions pointed out by the study.

So, the university-industry interaction process has been improving, but it still needs to advance in organizational aspects, in particular the adjustments for the institutions' internal policies, the existing negotiations, the researchers' behaviour regarding the dissemination of the innovation culture and the performance of the technological innovation centres, which gradually are being trained to work in the market as well as in the university. Now the structural or management changes in universities that will promote innovation and/or expedite the licensing of new ideas are necessary. It is necessary that primarily companies and universities understand that they must join efforts in collaborative technological research, that all investment must return as new products, services and technologies. The future research of authors (as employees of KhNU KTTC too) will be directed

on the solving the above problems, and for support of achieved financial sustainability and for development of KTTC at KhNU.

References

Arenas, J. J., & Gonzalez, D. (2018). Technology transfer models and elements in the university-industry collaboration. *Administrative sciences*, 8 (2): 19.

Ayuso, S., Rodriguez, M. A., Garcia-Castro, R., & Arino, M. A. (2011). Does stakeholder engagement promote sustainable innovation orientation? *Industrial Management & Data Systems*, 111: 8-9: 1399-1417.

Carayannis, E. G., Barth, T. D., & Campbell, D. F. J. (2012). The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of Innovation and Entrepreneurship*, 1: 1: 1-12.

Cesnyiene, R., Diskiene, D. & Stakeviciene, A. (2013). Labour market trends and their impact on human resource management in Lithuanian companies. *Ekonomika*, 92: 3: 123-140.

Chais, C., Ganzer, P. P., Olea, P. M. (2018). Technology transfer between universities and companies: Two cases of Brazilian universities. *Innovation & Management Review*, 15: 1: 20-40.

Department of Economic and Social Affairs (2008): *Achieving Sustainable Development and Promoting Development Cooperation: Dialogues at the Economic and Social Council*. Available on: http://www.un.org/en/ecosoc/docs/pdfs/fina_08-45773.pdf

Earnshaw, R. (2017). *Models of Interaction Between the Academy and Industry*. Research and Development in the Academy, Creative Industries and Applications, 11-26.

Ericsson, L. (2017). *Introduction to KTH Innovation*. Available on: [https://gidec.abe.kth.se/InnoCENS/2017_06_kth/Lisa Ericsson. Introduction to KTH Innovation.pdf](https://gidec.abe.kth.se/InnoCENS/2017_06_kth/Lisa%20Ericsson.Introduction%20to%20KTH%20Innovation.pdf)

Gachie, W. & Govender, D. W. (2017). Commercialization of higher education institutions' research within the National System of Innovation. *African Journal of Science, Technology, Innovation and Development*, 9: 4: 387-397.

Global Agenda Council on Employment (2014): *Matching skills and labour market needs building social partnerships for better skills and better jobs*. Available on: http://www3.weforum.org/docs/GAC/2014/WEF_GAC_Employment_MatchingSkillsLabourMarket_Report_2014.pdf

Goniadis, G. (2015). *Introduction to sustainable development*. Available on: <https://www.ihu.edu.gr/icsd/docs/introduction-to-sustainable-development.pdf>

Halloran, L. & Friday, C. (2018). *Can the universities of today lead learning for tomorrow? The University of the Future*. Available on: <https://cdn.ey.com/echannel/au/en/industries/government---public-sector/ey-university-of-the-future-2030/EY-university-of-the-future-2030.pdf>

Jorna, R. J. & Hadders, H (2010). *The many faces of sustainability*. Available on: https://www.waddenacademie.nl/fileadmin/inhoud/pdf/03-Thema_s/Economie/2010-02_Many_faces_of_Sustainability.pdf

Karpenko, O.O., & Iashyna, K.V. (2015). Formation of knowledge transfer system in Ukrainian higher education institutions. *Actual Problems of Economics*, 7: 157-165.

Koehn, R. K. (1998). *Assessing the value of research in the chemical sciences: report of a workshop*. Available on: <https://www.ncbi.nlm.nih.gov/books/NBK45351/>

Kromydas, T. (2017). *Rethinking higher education and its relationship with social inequalities: past knowledge, present state and future potential*. Palgrave Communications, 3: 1-12.

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., & Thomas, C. J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability Science*, 7: 25-43.

Leydesdorff, L. (2012). The Triple Helix of university-industry-government relations. Available on: <https://www.leydesdorff.net/th12/th12.pdf>.

Leydesdorff, L., & Etzkowitz, H. (1998). Triple Helix of innovation: Introduction. *Science and Public Policy*, 25(6): 358-364.

Making industry-university partnerships work (2012): Lessons from successful collaborations. Available on: <https://www.sciencebusiness.net/sites/default/files/archive/Assets/94fe6d15-5432-4cf9-a656-633248e63541.pdf>

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41: 6: 955-967.

Mauricio, D., & Lopez, X. (2018). A systematic literature review on technology transfer from university to industry. *International Journal of Business and Systems Research*, 12: 2: 197-225.

Melink, M. & Pavlin, S. (2014). Emerging modes of cooperation between private enterprises and universities – insights of european enterprises and employers organisations. Available on: https://www.camara.es/sites/default/files/publicaciones/cooperacion_universidad-empresa_resultados_europa.pdf

Ministry of Education and Science of Ukraine (2017): Innovative development of universities and scientific institutions of the Ministry of Education and Science of Ukraine. Available on: <https://mon.gov.ua/storage/app/media/news/Новини/2018/07/04/Innovative-development-of-universities-and-scientific-institutions-of-the-Ministry-of-Education-and-Science-of-Ukraine.pdf>

Nascimento, E. P. (2012). The trajectory of sustainability: From environmental to social, from social to economic. *Estudos Avançados*, 26: 74: 51-64.

Ness, B., Urbel-Piirsalu, E., Anderberg, S., & Olsson, L. (2007). Categorising tools for sustainability assessment. *Ecological Economics*, 60: 3: 498-508.

Nidumolu, R., Prahalad, C. K., & Rangaswami, M. R. (2009). Why sustainability is now the key driver of innovation. *Harvard Business Review*, 87: 9: 56-64.

Novikova, I., Martyniuk, V., Bediukh, A. & Kharina, O. (2018). Academic capitalism: development trends in Ukraine and European practice. *Marketing and management of innovations*, 1: 27-44.

Pomorova, O. V., Hovorushchenko, T. O., Poberejniy, S. Y., & Mahdin, V. V. (2016). Transfer of knowledge and technologies on the example of support for the implementation of student start-ups. *Journal Electrotechnic and Computer Systems*, 22(98): 384-391.

Pope, J., Annandale, D., & Morrison-Saunders, A. (2004). Conceptualising sustainability assessment. *Environmental Impact Assessment Review*, 24: 6: 595-616.

Repko, M. & Ruda, Yu. (2017). Ukrainian-style education: 129 billions hryvnya – a waste or an investment in the next generation? Available on: <https://voxukraine.org/en/osvita-po-ukrayinski-en/>

Sankat, C., Pun, K. P., & Motilal, C. B. (2007). Technology transfer for agro-industries in developing nations: a Caribbean perspective. *International Journal of Agricultural Resources, Governance and Ecology*, 6: 6: 642-665.

Shegelman, I., Shchukin, P. & Vasilev, A. (2015). Integration of universities and industrial enterprises as a factor of higher vocational education development. *Procedia - Social and Behavioral Sciences*, 214: 112-118.

Singh, R. K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. (2009). An overview of sustainability assessment methodologies. *Ecological Indicators*, 9: 2: 189-212.

Smirnov, I. (2009). Logistics of tourism (in Ukrainian). Available on: https://pidruchniki.com/1584072041415/logistika/logistika_turizmu

Smith, A., Voss, J. P., & Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy*, 39: 4: 435-448.

Spiewak, A. (2016). Bridging the university-industry divide in R&D collaborations. Available on: <https://www.rdmag.com/2016/12/bridging-university-industry-divide-r-d-collaborations>.

Tempus KTU Strategy (2013): Strategy document for Knowledge Transfer Units: 544031-TEMPUS-1-2013-1-AT-TEMPUS-JPHES Grant.

The Labour Market Story (2014): Skills for the Future. Available on: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/fi

[le/344441/The_Labour_Market_Story_-_Skills_for_the_Future.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/344441/The_Labour_Market_Story_-_Skills_for_the_Future.pdf)

The New Sustainable Frontier (2009): Principles of sustainable development. Available on: <https://www.wbdg.org/FFC/GSA/newsustainablefrontier.pdf>

Tornatzky, L. G., Waugaman, P. G., & Gray, D. O. (2002). Industry-University Technology Transfer: Models of alternative practice, policy and program. A benchmarking report. Available on: <https://projects.ncsu.edu/iucrc/PDFs/IUCRC%20Pubs/Tornatzky%20Waugaman%20and%20Gray%201999.pdf>

Urbano, D.A. (2013). Entrepreneurial universities socioeconomic impacts of academic entrepreneurship in a European region. *Economic Development Quarterly*, 27: 1: 40-55.

Vries, E. W., Dolfsma, W. A., Windt, H. J., & Gerkema, M. P. (2018). Knowledge transfer in university-industry research partnerships: a review. *The Journal of Technology Transfer*, 1-20.