ROMANIAN-UKRAINIAN TRANS-BORDER ACADEMIC DEVELOPMENT FOR RESEARCH AND INNOVATIONS

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Abstract*: Establish a communication environment between Ukrainian and Romanian Partners - universities and NGO - with regional companies to use joint academicals research and innovation potential for real needs of companies, to improve exchange of good practice, the opportunities for cooperation over innovations. The ways of implementation of the project-oriented training principles in the technical university are presented, which will allow to actively involve students in scientific and innovative activities within the educational process and the performance of qualification work. The ways of increasing the innovative activity of engineering specialties students, which are proposed, include: Center of Innovation Development, equipped with modern technologies machine and tools, the researchers and students, who are able to create mockups and prototypes of their projects; database, which contains registration of companies needs of development and innovation, connects universities with economical actors; the information system, which provides documentary support to researchers and students' activities. This model of work allows the creation of associations, including cross-border, between different universities depending on the scope of tasks and the level of opportunities for implementation of decisions. The main results of the implementation of the international grant project RoUaTADRI "Ro-Ua Trans-border Academic Development for Reseach and Innovation" in the framework of the cross-border cooperation program Romania-Ukraine 2014-2020 are presented.*

1. INTRODUCTION

The general objective of the Romania-Ukraine Joint Operational Programme is to enhance the economic development and to improve the quality of life of the people in the programme area through joint investments in education, economic development, culture, infrastructure and health while ensuring the safety and security of the citizens in the two countries [1]. One of the underdeveloped fields in the programme area is research and development (R&D). The level of investment in this field is very low, although there is potential for its growth.

Cross-border educational collaboration can be a part of the much broader framework of cross-border collaboration for regional development. Collaboration between higher education institutions can support this endeavour by stimulating mutual research activities, boosting academic mobility and professional mobility of the graduates and fostering mutual understanding. Academic collaboration can provide a creative space for people from both sides of the borders.

The difficult task of education is to teach and encourage students to ask new questions, solve new problems and create new knowledge. Consequently, the triunity of knowledge, skills and motivation should be the basis of education in the modern century. Internal motivation, new skills, learning new material throughout life is the basis of success in innovation [2].

An important task of the system of higher technical education is the training of specialists for innovation and project activities. The analysis of pedagogical practice and theoretical research allows determining the project activity as means of developing competence, in the course of which the evolvement of professionally important qualities of a specialist, formation of his key competencies take place (The CDIO™ Initiative is an innovative educational framework for producing the next generation of engineers) [3]. The concurrence of the subject-oriented (skill-oriented) and project-oriented management of the educational process in the institution of higher education is a separate problem.

Therefore, in order to ensure the goals of sustainable development in the conditions of accelerated evolution of the industrial and economic system, higher education should be sufficiently dynamic, and the experience and achievements of the best educational systems of the world should be used as a roadmap of change [4].

In the future, the university campus will become a precinct that interfaces university and society, with start-ups, community organizations and social enterprise intermingling with the students: there will be full integration with society and industry. Universities will remain vital places for the development of global citizens; a university thinks internationally, is based in the local economy, but works for the purpose of national and regional development [5].

Europe has a solid research and industrial base and is the home of bold, creative entrepreneurs. Yet it often needs to strengthen the use of its scientific excellence and industrial prowess to accelerate innovation and turn innovative SMEs into global technology giants. By reinforcing close cross-border collaboration between multiple actors, including academia, the public sector, industry and individual entrepreneurs, Horizon Europe aims to develop radical solutions to pressing societal challenges and fostering sustainable economic growth and employment. Through its Pillar III 'Innovative Europe', the Programme will focus on supporting the development of disruptive and market-creating innovations and on enhancing European innovation ecosystems [6].

National Sustainable Development Strategy Romania 2013-2020-2030 [7] underline the necessity of building and maintaining a broad partnership for innovation. As a result of Ro Government's specific commitments, it is expected that active base of human resource involved in research-development-innovation TDI (related to population) to converge towards the European Union's average. The priorities of intelligent specialization involve defining and consolidating areas of high competence in which are real or potential comparative advantages that can contribute significantly to GDP. By concentrating resources and mobilizing a critical mass of researchers, these domains can ensure, including in their regional dimension, competitiveness on regional or global added value chains.

Ukrainian State Strategy for Regional Development for 2021-2027 [8] provides for ensuring the development of cross-border, inter-municipal and macro-regional cooperation in the development and implementation of joint sustainable development projects and creating conditions to encourage regions and local communities to cooperate and implement joint interregional projects.

Ivano-Frankivsk National Technical University of Oil and Gas (Ukraine) together with the Technical University of Cluj Napoca - North University Center of Baia Mare and Association Academic Organization for Research, Innovation and Professional Development (Romania) implement the project "Ro-Ua Trans-border Academic Development for Research and Innovations" (RoUaTADRI) aimed at creating pre-conditions for sustained cooperation in the fields of research and innovation [9].

General objective is to increase the potential of development, research and innovation in mechanic, electronic, environment protection domains in order to reduce technological differences and to contribute to economic development of trans-border region. The achievement of this goal involves accomplishment of at least the following objectives: to establish a communication environment between universities and regional companies to joint academical research and innovation potential with companies' real needs; to support researchers and students in developing new competencies in modern technologies; to create for the students new competences for innovation and involve them in research and innovation projects, increasing the quality of students projects by creating competition premises.

2. SEARCH

An important step for straightening the collaboration of regionals' researchers from universities and NGO research domain is the development of “International Society of Innovators and Researchers” (ISIR). The activities of the partnership aim at promotion of regional problems identifying suitable for common solutions, innovative way of development, facilitating the joint research development, raising the level of economic security of innovators through the history of partnership cooperation, creating conditions for proposals regulatory change (local, regional, cross-border), training youth in innovation and modern technologies.

One of the tools of ISIR's is the "open innovation model". The European strategy for innovation development involves the development of open innovation, which is realized through interaction between business, research institutions and civil society. The idea of a European open-source cloud (EOSC) was formed by the European Commission in 2015, which will become a virtual environment for all researchers in Europe to store, manipulate, analyse and reuse them for research, innovation and education. It must provide both general functions and local services for the individual community. EOSC unite existing resources through national datacenters, European e-infrastructures and research infrastructures [10]. The creation of the EOSC aims at removing the technical, political and human barriers that hinder the creation of knowledge and economic prosperity in Europe.

The information system with the WEB-interface is accepted as the technological basis of interaction. The need to develop a separate information system is predetermined by the European Strategy for Innovation Development. The strategy envisages the creation of national and regional units of the modern research infrastructure of the EU and the provision of access to open data and knowledge in the single digital European market. The proposed information system improves the interaction of existing information systems of universities. The development of the information system will help to accumulate the experience of creating a joint of modern research infrastructure. The effective operation of ISIR at Trans-border Academic Development for Research and Innovations (further in the text - RoUaTADRI) in the direction of systematization, promotion and dissemination of innovation is complicated without the development of the information system. The accumulated experience of introducing open innovation model during the operation of the ISIR informational system within the framework of the project will be used to assemble recommendations to introduction of open innovation model at universities at regional and state levels. ISIR will also contribute to the achievement of strategic common goals for the development of Europe and cooperation with Ukraine.

Effective activity of the RoUaTADRI implies the involvement of innovative activists (researchers, engineers, entrepreneurs). Support at the information and legal level, attracting researchers to cooperation is a necessary, but insufficient condition to stimulate innovation

development. To ensure the availability of modern hardware and elemental base, the development of contacts with suppliers of equipment, materials and components is a necessary element. The Centre of Innovation Development (CID) will serve as a tool to achieve this. First of all, CID is the premises on which the local ISIR center will be based. The room will be divided into two zones - the informational co-working area and the technology zone. The informational co-working zone is the space, equipped with workplaces with a network connection. The technology zone is a space equipped with modern digital equipment, automated tooling for prototypes production [11].

Fig.1. Center of Innovation Development, Ivano-Frankivsk, Ukraine

Fig.2. Open Center of Innovation Development, Ivano-Frankivsk, Ukraine

The technological experience of the Romanian partners and the greater experience of Romania's integration into the EU is a valuable advantage of this partnership for Ukraine, while the high level of penetration of higher education on the Ukrainian side is its advantage in finding partners for the mutual implementation of projects with Romania. But the introduction of the proposed instruments will enable not only bilateral cooperation. After all, similar problems are also present in any cooperation with European countries.

The implementation of the CID on both sides of the border (*figures 1-3*) will enable the work on joint projects, realizing them on the same technological basis. The need to create technology zones within the framework of the project is due to the lack of investment in JOP areas of R&D, and, accordingly, the lack of a modern technological innovation base. One of the main areas of the Canter's activities will be training about the use of modern technologies, providing and improving the skills of working with CNC machines. Researchers will be able to create prototypes for the development of know-how and the establishment of a reasonable price in a non-specialized unit production. The available technological base and innovative expertise of participants in the ISIR will provide a stimulus for innovation, a fundamental opportunity to implement the internal innovation potential of JOP areas of action.

Fig. 3. Center of Innovation Development, Baia Mare, Romania

Scientists from the two countries have prepared joint textbooks based on the use of equipment from two established centers of innovation development, in particular:

- Handbook on CNC machines programming.
- Handbook on Design &3D prototyping.
- Guide on innovation in mechanical domain.
- Guide on innovation in electrical domain.
- Training material for Course: Basics of innovative activity for high school students.

The proposed project makes possible further academic development for research and innovation of actual project implementation for the relevant regional production plants. The

created Innovation Development Canters (CIDs) will increase the competence of researchers and students in modern equipment usage; will make possible producing the real prototypes of innovative products. The project achievement and distinguished feature will be the preparation of human potential able to solve the actual challenges of society, production to strengthen innovation development.

DIY ideology is taken as the basis for promoting innovative development. There has been proposed special laboratory with equipment, which would be a center of innovation development for students. As a result of the implemented project the student will acquire knowledge, skills and possibly equipment suitable for immediate use in the labour market or to implement their own projects. The proposal for the implementation of projects, proposed by potential employers or through own challenges/problems of potential students, the availability of infrastructure for the projects, the availability of supplies, spare parts, contacts with suppliers, the executed projects (portfolio) is the basis for the increase of the interest in technical education. The modern university has to be a sort of business incubator and the "first job" for its graduates.

Realization of innovative projects also can act as a catalyst for investment in innovation by local population, the results of projects will be a clear reflection of the benefits of innovation development, their impact on improving the living standards of users and improving their economic ability.

In general, the implementation of the above mentioned tools will provide the achievement of the following results: improved collaboration between researchers of the two regions involved in common research ideas and in development of companies' projects; increased amount of information about companies' development, research & innovation needs in Ivano-Frankivsk and Maramures Counties; improved researchers and students' competencies in modern technologies, such as 3D printing - scanning, virtual reality for modelling, robots manipulation, CNC machines, renewable energies; developed infrastructure enabling researchers to create the experimental model in minimum time after registration and selection of ideas; increased number of joint research activities, researchers and students from the two countries involved in development of innovative projects; increased number of students' projects involving new technologies determining improved students' projects quality.

CID's equipment (f*igures 4-5*) may also be based on existing technological equipment. Even outdated or unassembled machine equipment (if its massive and precise parts are available) in modern conditions can easily be modified by adding modern electronic and mechanical components. It is clear that each case is individual, but the development of such projects is possible for modern technical HEI even within the educational process (for example, in the form of complex qualification works).

Fig.4. Equipments of Center of Innovation Development, Baia Mare

Fig.5. Equipment of Center of Innovation Development, Ivano-Frankivsk, Ukraine

The possibility of the realization of such projects appeared as a result of progress in the production of engines, systems of numerical data processing and CNC in particular. The globalization of markets, the possibility of direct cooperation between manufacturers and potential buyers, the development of common education and the broad usage of numerical devices in everyday life played an important role in providing such a possibility.

The CID will provide the functioning of the information and reference system. The system includes the following modules: registration of tasks; formation of project groups; organization of the distribution of time and material resources during the implementation of a specific project and between projects; an electronic directory of implemented projects and a database of documents for the verification of project results.

The module of the formation of project groups provides the implementation of several role functions: a student who joins the task performance; a teacher who assesses the task for compliance with a particular discipline and offers the number of points a student can gain upon completion of the assignment; a representative of the stakeholders, who proposes tasks and evaluates their solutions.

The Database will contain registration of companies' needs of development and innovation and connect universities with economic actors, growing the involvement of researchers and students in regional companies' future development and the responsibilities of highly qualified human resources in regional development. Joint projects that insure the learning through projects are developed. The tutor for company-end coordinator for university is conducting the project development ensuring the quality of the results. Along with theoretical development of the project, the main component is the practical result obtained using CID's equipment.

3.CONCLUSIONS

The ways of increasing the innovative activity of engineering specialties students, researchers, local entrepreneurs which are proposed, include: Center of Innovation Development, equipped with modern technologies machine and tools, the researchers and students, who are able to create mockups and prototypes of their projects; database, which contains registration of companies needs of development and innovation, connects universities with economical actors; the information system, which provides documentary support to researchers and students' activities. This will help achieve the following results: increased amount of information about companies' development, research & innovation needs; improved researchers and students' competencies in modern technologies; developed infrastructure enabling researchers to create the experimental model in minimum time after registration and selection of ideas; increased number of joint research activities, researchers and students involved in development of innovative projects; increased number of students' projects involving new technologies determining improved students' projects quality.

The main function of CID in the context of cross-border cooperation is similar to one of the functions of the FabLab network - ensuring equal access to modern technologies on both sides of the border. Although in FabLab this feature contributes to a simple transfer of technical

developments, in the context of CID it is a function of promoting joint development of innovation through the equalization of technological capabilities.

REFERENCES

[1] Joint Operational Programme Romania – Ukraine 2014-2020. https://www.ro-ua.net/en/joint-operational-programme.html

[2] T. Wagner, T. Dintersmith, *Most Likely to Succeed: Preparing Our Kids for the Innovation Era*, Scribner, 2016.

[3] The CDIO™ Initiative is an innovative educational framework for producing the next generation of engineers, Available at http://www.cdio.org/about

[4] V. Volchik, A. Oganesyan, & T. Olejarz, *Higher education as a factor of socio-economic performance and development.* Journal of International Studies, 11(4), pp. 326-340. 2018.

[5] L. Halloran, & C. Friday, *Can the universities of today lead learning for tomorrow? The University of the Future*. Retrieved from https://cdn.ey.com/echannel/au/en/industries/government---public-sector/ey-university-of-the-future-2030/EY-university-of-the-future-2030.pdf, 2018.

[6] *Horizon Europe, pillar III - Innovative Europe*, https://op.europa.eu/en/publication-detail/-/publication/377dbf20-b91d-11eb-8aca-01aa75ed71a1, 2021.

[7] *National Sustainable Development Strategy Romania 2013 – 2020 - 2030* https://sustainabledevelopment.un.org/index.php?page=view&nr=623&type=504&menu=139

[8] *State Strategy for Regional Development for 2021 - 2027* https://zakon.rada.gov.ua/laws/show/695-2020-%D0%BF#Text.

[9] L. Shkitsa, V. Kornuta, A. Dascalescu, C. Barz, *Pre-conditions for sustained cooperations in the fields of reseach and innovation*, II-nd International Scientific and Technical Conference "Machines, equipment and materials for oil and gas production increase PGE – 2018", Ivano-Frankivsk, Ukraine, Aprile 24-27, pp 25-27, 2018.

[10] The European Open Science Cloud (EOSC) https://eosc-portal.eu/about/eosc

[11] L. Shkitsa, V. Kornuta, O. Kornuta, V. Bui, I. Bekish, *In-campus Way of the Insight Transfer Technology*. Proceedings of the 4th International Conference on Design, Simulation, Manufacturing: The Innovation Exchange, DSMIE-2021, June 8–11, Lviv, Ukraine – Volume 1: Manufacturing and Materials Engineering. Advances in Design, Simulation and Manufacturing IV. pp 322-331, 2021.