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Klimczuk-Kochańska, Magdalena

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**Magdalena Klimczuk-Kochańska** | [mklimczuk@wz.uw.edu.pl](mailto:mklimczuk@wz.uw.edu.pl)

Uniwersytet Warszawski, Wydział Zarządzania

## The Role of Universities in the Knowledge Triangle Model on the Example of EIT Activities

**Abstract: Background.** For universities, it is essential to develop in the direction of market expectations. It is necessary to enter into cooperation with entrepreneurs which allows technology transfer to create innovations. The knowledge triangle model is a concept that involves creating relationships between universities, research institutions and enterprises. This idea is very important for European policy and is implemented by the European Institute of Innovation and Technology (EIT). However, it is worth checking whether it is actually being implemented.

**Research Aims.** To check if the approach of the knowledge triangle is used in practice by entities set up under the EIT. Another research aim is an exploration of the current directions in which the university's cooperation with other bodies is heading, and if this has an impact on raising the level of innovation in Europe.

**Methodology.** A look at the model of cooperation between universities and the environment and search for an appropriate framework of benefit from this kind of collaboration on scientific literature review. Moreover, the desk research regarding the EIT Food – one of the European initiatives in the food sector.

**Key findings.** The analyses carried out allow us to state that the concept of the knowledge triangle is not just a theoretical idea. The concept has its application in practice. It was also identified that universities are the main engine of all undertaken activities in the field of education, research and innovation.

**Key words:** cooperation, entrepreneurial university, knowledge triangle, third mission, triple helix, quadruple helix

### Introduction

In Europe, as well as the rest of the world, the idea of “reinventing innovation” [Smith, Sutherland & Gibert 2017] is more and more popular. In the search for new ways forward,

a knowledge triangle model is adopted which consists of research, education and business activities. As a result, cooperating organisations implement joint programs that integrate research, development, training, and commercialisation.

Innovation is regarded as the most critical competitive advantage that enables a company to act in the dynamic business environment. Innovations can be defined as “the implementation of a new or significantly improved product or process, a new marketing, or organisational method in business practices” [OECD 2005, p. 46]. Moreover, J. Tidd, J. Bessant and K. Pavitt [1997] indicate that innovation is a process of turning opportunity into new ideas and putting these into widely used practice. Innovation has continued to be a subject of interest to scholars from various disciplines, including economics, business, engineering, science, and sociology. Similarly, companies from both low-tech and high-tech sectors are interested in developing innovative solutions in their organisations [Klimczuk-Kochańska, Klimczuk, 2018].

By innovation, firms can, for example, generate positive outcomes, improve product quality, create of new markets, or reduce the environmental impact of the production [Aminreza, Maryam, Mah Lagha 2011, p. 80]. On the other hand, introducing innovations is not an easy task. The reasons are different, especially the limited financial resources of entities, which prevents them from conducting such activities. The problem is also access to other resources, including knowledge. At the same time, it is increasingly emphasised in the subject literature that one way is to undertake innovative activities and cooperation with external partners and exchange knowledge with them. Many authors point out the importance of partnership and networking in an innovation process as a requirement for success, and how constant dialogue and interaction might foster innovation processes, thanks to that partners acquire capabilities from an external source. At the same time, the decision to cooperate is as an equilibrium between achieving a high knowledge flow and protecting internal knowledge from leaking out [Schmidt 2005].

One of the crucial groups of entities to cooperate are universities. Despite their undoubted advantages, there are also many barriers that can be found in the transfer of innovation between universities and businesses. Among them are procedural obstacles related to the cultural features or motivation of both sides of the cooperation [Fowler 1984]. On the other hand, collaboration raises various types of challenges that must be addressed by entities interested in undertaking it, but what is very important the industry significantly defines the research topics in relation to their needs, which allows searching for solutions in which the universities can participate. However, the overall institutional environment has not favoured the exploitation of academic inventions, just because both types of institutions are not administratively structured to cooperate [van Dierdonck, Debackere, Engelen 1990].

The limits of cooperations are related to traditions, governance rules and mechanisms of internal and external links that universities have. However, this may be supported by various sources of external stimuli and support such as the European Institute of Innovation and Technology (EIT).

In this paper, the directions of changes in the approaches of universities' development and relations with the environment are analysed. Another part is focused on the analysis of the knowledge triangle. At the same time, an attempt was taken to answer the following questions: (1) where a knowledge triangle is a practical approach and (2) how important the idea of the knowledge triangle is for universities. The paper is based on a literature review and desk research on activities carried out by the EIT.

## **Broadening the role of the university: Characteristics of various approaches**

The primary goal of the university is to educate people. It is essential for professions that require sophisticated knowledge and skills to think critically. Universities focused on teaching are often referred to as the first-generation universities. Another core function of universities is to conduct research. In the early 19th century Wilhelm von Humboldt pointed to the need to develop a university into this direction [Scott 1960]. It has come to be the central value of top-tier universities in all countries and academic rewards. Research activities also give institutional and individual members prestige. Research can take many forms such as pure and applied research. The first is focused on the purpose of discovering a new knowledge while the applied research gives the opportunity for scientific discoveries to intervene in problems, commercial products or related practical goals. This second type of university activity is essential because it may generate the income from research output. Universities focusing on education and research are referred to as the second-generation universities [Wisseem 2009].

The above view on universities, due to the new challenges, had to undergo significant changes. Hence, in the literature, there are different concepts of research, knowledge creation and innovation. These concepts consider individual actors and dimensions. There are models such as the "third mission", the "entrepreneurial university", and the "triple or quadruple helix".

At the time of the establishment of higher schools, the third mission was not the core academic mission. However, the current model of the university, based on education and scientific research, is extended to include preparation for entrepreneurship, understood as shaping dynamic behaviours that enable independent action on the market. The third mission means broadening the university's mission through the societal and

cultural relevance [OECD 2015]. The third mission is the cooperation of the university with business and the external environment. There can be presented a set of activities contributing to innovation and social and economic development of the country or region. The cooperation of the university with the external environment and in particular the industry and authorities are essential. In the narrow approach, the third mission is the commercialisation of scientific research and technology transfer to the economy [George, Jain, Maltarich 2005]. A practical example of the reference to the concept of the third mission is the call launched in 2018 by the Polish National Center for Research and Development. The call was titled "Third University Mission" with an aim to conduct educational activities of universities jointly with local government units or non-governmental organisations.

Thus, there are five challenges for scientific and educational institutions. According to Matusiak [2010] these are (1) shaping creativity and proactive attitudes open to entrepreneurship among employees and students; (2) cooperation with business, developing knowledge and technological and organizational solutions for the needs of the market as well as small and medium-sized enterprises; (3) management of intellectual property created at universities; (4) entrepreneurial management of a university; and (5) initiating partnership and network relations with local business, administration and the social sector. The implementation of the above activities translates into, for example, the application of activities such as: commercialization of research results; participation in regional initiatives aimed at increasing the economic competitiveness and attractiveness of regions; cooperation between universities and employers to adopt educational programs to the requirements of the labor market; and participation of practitioners from outside the university educational process and scientific research [Ernst & Young 2009].

In general, the third mission of the university means summarising term for an expansion of university core mission. The next concept is an entrepreneurial university that describes the fact that the university is taking the entrepreneurial activities relying on their research activities and new management paradigm. Universities actively involved in a partnership with the environment and dissemination and commercialisation of research results are often also described as the third generation, creative, proactive, innovative or hybrid universities.

The entrepreneurial university uses trans-disciplinary research and is open to cooperation with many partners. Such entities engage in activities on a competitive international market and treat the use of knowledge outside the organisation as a basis for their operation. According to J.G. Wissema [2009], the majority of currently existing universities are in the transition phase between the university of the second generation and the third generation.

L. Foss and D.V. Gibson [2015] identify two major types of “entrepreneurial” areas of the broader concept of high education institutions. These are entrepreneurial education and entrepreneurial activities. The first focus is at fostering an entrepreneurial spirit in students and graduates as part of the university’s academic programs. There are examples such as the offer of specific courses, joint labs and platforms for co-creation with industry actors and the implementation of inter-sectoral exchange programs. These activities are to some extent complementary to entrepreneurial activities, which, among other things, rely on the involvement of the creation of spin-offs and academic start-ups, the production of intellectual property rights and engage in collaborative research [Foss, Gibson 2015]. Also, it should be mentioned here involvement of the development of support structures for commercialisation such as technology transfer offices or industrial liaison offices.

It can be concluded that the directions of operation of a modern entrepreneurial university mentioned above can bring a positive change regarding the image and competitive position of the university itself and in a broader context, in the economy. Looking at the improvement of the efficiency and effectiveness of innovation processes in the economy, it is necessary to emphasise the issue of combining activities and interests at the interfaces between researcher and laboratory, inventor and patent as well as between entrepreneur and a new company. This approach leads to the removal of the knowing-doing gap [Pfeffer, Sutton 2000]. The entrepreneurial university allows very effective commercialisation of new ideas and transferring them from science to the economy.

The last model that is presented in this paper is the triple helix. It is organised by the intersection principles of the three spheres of innovative economic relations elaborated in the concept of H. Etzkowitz and L. Leydesdorff [1995]. This model has reflected a university-government-industry relationship. In this model universities and industries are fundamentally part of the state and have direct bi-lateral and tri-lateral relations. In the recently updated version of this model (quadruple helix), there is also a fourth element which is a civil society.

Thus, this model also indicates that universities are modifying the traditional roles of higher education and research. Especially in economies where university policy depends on the regional government the public support for promoting firm innovation and cooperative projects with universities and public research centres has increased considerably in recent years.

Summarising the above considerations, it is worth noting that the analysed models point to an academic transformation aimed at the idea of the university in W. von Humboldt’s approach towards the idea of creative destruction promoted by J.A. Schumpeter [1960]. In a new approach, marketisation of research results becomes at least as necessary as education

and research activities. The role of entrepreneurship and creativity in university activity depends on several institutional factors [Unger, Polt 2017, p. 13] such as institutional autonomy, the allocation of funding streams, governance mechanisms and the surrounding entrepreneurial climate. However, it must be underlined that to some extent the university has to take on new challenges and approach to the economy as well as not to lose control over the fulfilment of its traditional functions and the academic tradition developed over the centuries. The university cannot be only a "commercial enterprise" that guarantees a profit. Each model of the university's operation must take into account the specificity of education and research that will never adapt to market rules. Such criticism has to be kept in mind because marketisation trends are often in conflict with higher education's goal of providing equity and the chance to obtain skills and better employment to underserved populations. This, of course, goes hand in hand with the work in the second part of the study that universities are linked as never before to the practical needs of business and society as dictated by governments for public institutions and by the market for both public and private institutions [Altbach 2008, p. 11].

## **The knowledge triangle concept on the example of the EIT and the EIT Food activities**

The knowledge triangle is a practical policy concept that is integrative umbrella framework for the variety of ideas discussed so far in this paper. All these concepts need some policy or strategy that will focus on their application in practice. Especially for universities, many policy instruments are necessary because most of them still do not use clearly structured management approaches to research, education and innovation.

The knowledge triangle approach should serve somewhat as a guiding principle, directing the attention of actors to create productive relations between them. It relates to the need to improve the impact of investments on the three activities (education, research and innovation) by systemic and continuous interaction [Council of the European Union 2009]. This idea is essential for the European Commission, and it was presented in policy strategies, according to the targets formulated in the European Union's 2020 Strategy for Smart, Sustainable and Inclusive Growth [European Commission 2010]. According to this strategy, useful links between these three elements are considered as a crucial prerequisite for tackling societal challenges.

Between the elements of the knowledge triangle, there are specific relations. On the line between education and research, there is a platform and processes for learning by research, development and innovation. There are different interactions which reflect, for example, in the sectoral mobility of graduates, or postgraduate training programs. Relations

between research and innovation can be described as the platform and processes for foresight and knowledge co-creation solutions. In order to support the transfer of knowledge various instruments can be used, for example, university spin-offs, academic start-ups, and knowledge and technology transfer offices. At least in relations between innovation and education, the important is new solutions within the employment and work communities. Collaboration between actors is evaluated by studying the support for the development of an entrepreneurial culture in the framework of training programs. The knowledge transfer can cover, for example, dedicated education programs for companies personnel or recruitment of PhDs students. Between companies and universities can also be technology transfer that includes, for example, solving company-specific problems and licensing out particular inventions [Santoro 2000, pp. 258–260]. The most important element between these is orchestration. It helps to provide an appropriate balance between the three described types of relations [Sjoer, Norgaard, Goosens 2011].

The knowledge triangle concept covers many similarities to the triple helix concept. However, it is oriented toward linking the spheres of education, research and innovation. The triple helix only considers the actors in the respective national or regional innovation systems as a starting point. Universities are the backbone of this concept. They provide vital inputs for each of the corners of the triangle. Often knowledge triangle dimensions are institutionally incorporated in internal organisation and mission. Cooperation within the knowledge triangle is conducive to the increase of productivity of various entities by including them into such specific network partnerships. Moreover, if there is the funding from the European Union, the cooperation may be more international, and entities are more convinced to get involved in it. It means that different kind of organisations form the knowledge triangle can follow a strategy for joining some of the European Union programs to benefit from participating in superior innovation networks, where the expectations for innovation are also higher. Such a network is precisely described in the activities carried out by the European Institute of Innovation and Technology (EIT). The development of the EIT and its international network of knowledge and innovation communities (KICs) have a considerable contribution to the dissemination of the concept of the knowledge triangle. It encourages different organisations to work along the entire research and innovation border. It supports to bring bright ideas to market and change the world by thinking outside the box.

The EIT Food is one of the KICs. It started its operations in 2016. It is a 50-institutions consortium, and its consist of leading businesses, universities and research organisations. There are thirteen universities, including three research-intensive universities, which belong to do the League of European Research Universities (LERU). There is the University of Cambridge, University of Helsinki and the Katholieke Universiteit Leuven

(KU Leuven). The structure of the EIT Food is based on five co-location centres across the EU located in Leuven, Belgium; Reading, the United Kingdom; Madrid, Spain; Munich, Germany; and Warsaw, Poland. The EIT Food mission is to boost innovation, growth and job creation and put Europe at the centre of a global evolution in food sectors. The six strategic objectives of the project are to overcome low consumer trust, to create consumer valued food for healthier nutrition, to build a consumer-centric connected food system, enhance sustainability and to educate, engage, innovate and advance and to catalyse food entrepreneurship and innovation. The idea of launching the KIC initiative around the food sector is essential because this is the low-tech sector, so there is the lagging level of innovation. Therefore, there is a vast demand for cooperation that will allow shortage reduction of the scientific, entrepreneurial and managerial skills needed for the sector.

As part of the EIT Food, two calls have been completed so far, including the first one for 2018 and the next one for 2019. Everything that the EIT Food does is organised into activities. In general, within the EIT Food projects are divided into four areas: innovation, education, business creation and communication. The calls contribute to the integration of the knowledge triangle of higher education, research and innovation, and therefore by the assumptions of the knowledge triangle. Thus, no matter which area is presented in projects each time there is the expectation that it will be linked to the real needs of the market, which is to ensure the participation of entities who are representatives of all three areas of the knowledge triangle. In projects are included solution push and market pull innovations, and the most-anticipated coordinator is a partner from the industry. There are no indications for other types of projects so innovation activities cannot relate to pure research. Consequently, there is the importance of not only finding an interesting idea but also its commercialisation possibilities. This is to be ensured by meeting the requirement of the technology readiness (TRLs) on the fourth, fifth or sixth level. The implementation of innovative projects with such characteristics is aimed at ensuring that the result of the project will be implemented, and only using it commercially will lead to a real impact on the change in the competitiveness of the food sector.

In general, 51 winning projects for 2018 are implemented in the period from January 2018 to 2019. Several projects have been classified in the so-called early bird's projects and are applied from September 2017. In addition to the 51 projects envisaged for implementation in 2018, activities related to the operation of co-location centres of the EIT Food and other general sponsorship are implemented. However, they have not been analysed in this paper. The consortium includes not only the LERU universities but also the Ecole Polytechnique Federale de Lausanne, ETH Zurich, Queen's University of Belfast, Technical University of Munich, Technion – Israel Institute of Technology, Universidad Autónoma de Madrid, University of Hohenheim, University of Reading, University of Torino, and the University of

Warsaw (UW) It is worth noting that the University of Warsaw cooperates with Technion in five projects, and in four with KU Leuven. In one project the partner is the Technical University of Munich. The UW does not cooperate with the University of Cambridge. The position of the University of Warsaw regarding the number of projects it participates in 2018 has been positively unexpected. The University of Warsaw is ranked fifth regarding the number of projects implemented from among 13 universities belonging to the consortium. The University of Reading participates in the most significant amount of projects. Within the framework of the EIT Food, it implements 15 projects in 2018. On the second place is the Technical University of Munich with 13 projects, and the third position is taken by the University of Hohenheim with 12 projects. The Queen's University of Belfast is involved in 11 projects, and the University of Warsaw in 2018 is a participant in ten projects analysed above. In the same number of projects is also engaged by the KU Leuven.

It is worth taking a look at what kind of partners cooperate with particular universities. In the consortium, there are eight research institutions and 29 industrial organisations. Entities in the category of start-ups are associated in the so-called RisingFoodStars Association. It currently consists of 42 start-ups (as at July 23, 2018). The Queen's University Belfast and the Technical University of Munich take part in projects with all university representatives from the consortium. The University of Warsaw cooperates with the majority of universities from the EIT Food consortium. Of the eight research institutions, eight universities cooperate with up to five research institutes. The University of Warsaw is in contact with projects with three research entities.

When it comes to the industry, the Technical University of Munich and Technion, which in various projects collaborate with 21 business entities, can boast of an unusually large number of projects in this area. The University of Helsinki is involved in projects with 18 companies, and the University of Hohenheim and the University of Reading are collaborating with 17 representatives of companies. The University of Warsaw cooperates in various projects with 13 firms.

As part of EIT Food in 2018, 24 educational projects are implemented. This kind of projects differs from traditional academic lectures. The educational offerings of the EIT Food consist not only of Master and PhD programmes. There are also workshops, summer schools and online educational programmes (massive open online courses, and specialised private online courses) for a wide range of audience including students, entrepreneurs and food professionals. All these courses are interdisciplinary, interactive, and practice-oriented and are jointly offered by partners from academia and business.

The educational projects are run by all 13 universities, with the most significant number of educational projects being carried out with the participation of the University of Hohenheim. This university takes part in up to 11 educational projects. The next in this

respect is the University of Torino that participates in eight educational projects. The University of Warsaw was ranked 4th regarding participation in education projects. The employees of this university take part in five projects of this type. A similar number of educational projects is conducted by the University of Cambridge, but this university does not carry out any other kind of projects. The participation of all universities in educational projects seems to stem from the fact that each of them understands the idea of education. It is the closest to what universities do on a daily basis. It is worth adding that of these 24 educational projects only four projects have a consortium representing all three areas of the knowledge triangle, that are, university, research and industry. Precisely ten projects are led by representatives of the university and industry, six by the university and research institutions. Moreover, the other four are implemented only by universities.

In the consortium, projects from the area of innovation play a unique role. In 2018, 19 projects are implemented in the innovation activity of the EIT Food. Exactly ten projects are those that include all entities in the field of the knowledge triangle. Moreover, seven projects are run by universities and enterprises, while universities are not involved in two projects. Also, four out of 13 universities do not participate in such projects at all. The most innovative projects are involved in the Technical University of Munich. Only in the case of this entity, more innovative projects are implemented (five projects) than educational projects (three projects). Participation in innovative projects requires more people interested in creating a given project consortium and arousing interest from the business sector even more than in the case of educational projects. As in any other group of projects, in the case of innovative activities, many entities that are recognised as the initiator of such a project should be a business representative. It seems, however, that the universities are showing that competencies in the field of innovation were not sufficient. It was crucial for the university to try to speak the language of benefits for a potential investor and “sell” the idea. Therefore, the critical role was to share information about how these projects will benefit companies and focus mainly on the problems they would like to solve, and innovative test projects are carried out.

As part of the EIT Food in 2018, there are seven projects implemented in communication activity. In two of them, all entities from the knowledge triangle are involved, while in the other five there are universities and enterprises. In communication projects, eight out of 13 universities are involved. In this case, the most projects in this area are carried out by the University of Reading (five projects). Also, four communication projects take part in the KU Leuven and Technical University of Munich. The University of Warsaw, similarly to the University of Helsinki, is involved in two projects in the area of communication. It is also worth emphasising the interest of five companies in these projects, including Dohler and Givaudan to be involved in two2 different projects.

In 2018, one project is carried out in the area of business creation titled EIT Food Accelerator Network (FAN). The instrument consists of 16 entities, the majority of which are enterprises (ten entities). Apart from them, four universities and one research and development units are involved in the project. Therefore, there are representatives of all elements of the knowledge triangle.

## Conclusion

Analysis of the above example, which is the participation of the university and other entities establishing the knowledge triangle, allows to state that although there is always a fear of artificiality and forced cooperation between countries with differing, sometimes significantly, development and innovation indicators, in this case, however, pass the exam. Admittedly, the participation of all parties to the triangle does not take place in any project. However, the weight of these relationships is indicated in the EIT Food documents.

Probably the number of projects with a more significant share of different types of entities from the three areas of the triangle will grow in next years. It is necessary for the projects to better reflect the needs of different parts of the economy. Universities proved to be an essential partner in the projects. They do not participate in only a few projects.

Types of activities in which universities can participate in the KICs, especially universities such as the University of Warsaw that have less experience in the international field, gives a chance for the significant development in many areas. Same if there is, for example, a higher level of internationalisation of students and faculties, higher involvement in cooperation with industry, and movement into “industrial doctorates”.

Our findings also suggest fields for further research. Firstly, the knowledge triangle needs to be validated by analysing cases from other EIT initiatives called KICs. In particular, the “relationship” type of interaction deserves to be investigated more closely. Also benefits from cooperation in the knowledge triangle need to be presented. The further research is necessary also in order to understand the differences in the perceptions and assessments from different sides and opinions made by representatives of companies, researchers and universities from KICs.

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