UNIVERSITY OF ECONOMICS IN BRATISLAVA

FACULTY OF NATIONAL ECONOMY

Evidence number: 101004/D/2023/0004604297

SUPPORT FOR HYBRID RESEARCH ORGANIZATIONS AS A TOOL FOR UNIVERSITY-BUSINESS COOPERATION IN THE V4 COUNTRIES

Dissertation thesis

2023 **Mgr. Klaudia Glittová**

UNIVERSITY OF ECONOMICS IN BRATISLAVA

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Dissertation thesis

Study programme: Economics

Field of study: Economics and Management

Department: Department of Public Administration and Regional Development

Supervisor: doc. Mgr. Miroslav Šipikal, PhD.

Bratislava 2023 **Mgr. Klaudia Glittová**

THESIS ASSIGNMENT

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Study programme:	Economics (Single degree study, Ph.D. III. deg., full time form)
Field of Study:	8. - Economics and Management
Type of Thesis:	Dissertation
Language of Thesis:	English
Secondary language:	Slovak

Thesis's title: Support for hybrid research organizations as a tool for university-business cooperation in the V4 countries

Goal: The aim of this thesis is to analyze the support for the creation and functioning of hybrid research organizations in the V4 countries.

Annotation: A particular issue of universities' involvement in innovation systems is government support for this involvement. National, regional and local governments are trying to exploit the potential of universities for their development, which corresponds to the many different programs and tools that are used in this direction (EUA, 2015). In Central European countries, education has long been the dominant task (Kwiek, 2012), but in recent years more and more attention has been paid to the involvement of universities in research and other tasks (regional development, business university). Hybrid organizations as a tool for overcoming barriers to university involvement are based on the triple helix model. (Champenois and Etzkowitz, 2018). While the research of the Triple helix model is generally focused on its individual structures and dynamics between spheres, the authors have so far paid much less attention to the results of overlapping spheres or the creation of autonomous organizations supporting innovation. Hybrid organizations can be built within a consensus space (Etzkowitz 2002b, Etzkowitz 2008, Ranga and Etzkowitz 2013), which is defined as a set of activities linking the components of the Triple helix model. Qualitative methods such as case studies, surveys or interviews should be used in the research within this dissertation. They should be able to examine hybrid organizations as a tool for overcoming barriers to universities' involvement in innovation systems, as well as to identify the strengths and weaknesses of their real involvement in the V4 countries. The work should also include a proposal for measures to improve support for the functioning of these types of institutions.

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ACKNOWLEDGMENT

I would like to thank the following people and institutions, without whom I would not have been able to complete my dissertation research. First, I would like to express my gratitude to my dissertation supervisor doc. Mgr. Miroslav Šipikal, PhD. for providing invaluable advisory, guidance, feedback, and thoughtful recommendations throughout this dissertation thesis and during my PhD studies. Thanks also to my other colleagues from the Department of Public Administration and Regional Development at the University of Economics who helped me with the dissertation research.

I am also grateful to colleagues from Faculty of Economics and Administration, Masaryk University in Brno (Czech Republic) who actively involved me during my research mobility, especially doc. Ing. Viktorie Klímová, Ph.D. for her support, professional advices and encouragement throughout the process of questionairre survey conduction, planning interviews in the Czech Republic and cooperation on joint publications and projects.

I had the pleasure of collaborating with all respondets (directors, managers and others) of questionnaire who took the time to complete my questionnaire surveys, provide interviews and who contributed so carefully through their further comments and emails.

To conclude, I cannot forget to thank my dear family and friends for all the unconditional support in these very challenging and intensive three years.

ABSTRACT

GLITTOVÁ, Klaudia: Support for Hybrid Research Organizations as a Tool for University-Business Cooperation in the V4 Countries. – University of Economics in Bratislava. Faculty of National Economy; Department of Public Administration and Regional Development. – Supervisor: doc. Mgr. Miroslav Šipikal, PhD. – Bratislava: NHF EU, 2023, 137 p.

Dissertation thesis is elaborated on the theme *Support for Hybrid Research Organizations as a Tool for University-Business Cooperation in the V4 Countries*. The aim of the dissertation is to analyse the role of university STPs as an innovative tool for improving university-business collaboration by realization of activities and services, and role of government support in the setting up and the operation of this tool. At the intersection of the actors of the Triple helix model are hybrid organisations that help to reduce innovation blockages between universities and the private sector. We chose a complex hybrid organisation – STPs which have been set up as an integral part of universities and within the framework of the Triple helix innovation model are designed to connect with practice. Based on qualitative research, we have evaluated their activities, services, barriers and the position of the government as a financial supporter of these projects. Findings from dissertation suggest that although STPs in V4 countries were set up at the same time with the EU Funds support, they are at different stages of development in the implementation of activities and services contributing to cooperation with business. The most successful STPs are in the Czech Republic, which have managed to develop into STPs of an international character thanks to continuous support from the government. We perceive a difficulty in Slovakia and Poland, where STPs are less successful in the implementation of activities, servicies and the perception of government support is more negative. In the conclusion of the discussion, we mainly present findings and recommendations based on the conclusions of the research.

Keywords: university-business cooperation, Triple helix model, support, innovation, hybrid organizations, STPs

ABSTRAKT

GLITTOVÁ, Klaudia: Podpora hybridných výskumných organizácií ako nástroja spolupráce univerzít a podnikov v krajinách V4. – Ekonomická univerzita v Bratislave. Národohospodárska fakulta; Katedra verejnej správy a regionálneho rozvoja. – Školiteľ: doc. Mgr. Miroslav Šipikal, PhD. – Bratislava: NHF EU, 2023, 137 s.

Dizertačná práca je vypracovaná na tému *Podpora hybridných výskumných organizácií ako nástroja na spoluprácu univerzít a podnikov v krajinách V4.* Cieľom dizertačnej práce je analyzovať úlohu univerzitných STPs ako inovatívneho nástroja na zlepšenie spolupráce univerzít a podnikov prostredníctvom realizácie aktivít a služieb a úlohu vládnej podpory pri zriadení a fungovaní tohto nástroja. Na priesečníku aktérov Triple helix modelu sú hybridné organizácie, ktoré pomáhajú zmierňovať inovačné blokády medzi univerzitami a súkromným sektorom. Pre náš výskum sme si vybrali komplexné hybridné organizácie - STPs, ktoré boli zriadené ako integrálna súčasť univerzít a v rámci inovačného modelu Triple helix sú určené na prepojenie s praxou. Na základe kvalitatívneho výskumu sme zhodnotili ich aktivity, služby, bariéry a postavenie vlády ako finančného manažéra týchto projektov. Zistenia z dizertačnej práce naznačujú, že hoci STPs v krajinách V4 vznikli v rovnakom čase s podporou fondov EÚ, nachádzajú sa v rôznych štádiách vývoja na základe realizácie aktivít a služieb prispievajúcich k spolupráci so súkromným sektorom. Najúspešnejšie STPs sú v Českej republike, ktorým sa vďaka kontinuálnej podpore vlády podarilo rozvinúť svoj medzinárodný charakter. Výraznejšie problémy vnímame na Slovensku a v Poľsku, kde sú STPs menej úspešné v realizácii aktivít, služieb a vo všeobecnosti vnímanjú podporu vlády negatívnejšie. V závere diskusie uvádzame hlavné zistenia a odporúčania vychádzajúce zo záverov výskumu.

Kľučové slová: spolupráca univerzít a súkromného sektora, Triple helix model, podpora, inovácie, univerzity, hybridné organizácie, STPs

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LIST OF ABBREVIATIONS

CIS – Community innovation Survey

DUI – Doing, Using and Interacting

EIB – European Investment Bank

EU – European Union

EUTOHA – Emerging Unified Theory of Helix Architectures

GDP – Gross domestic product

HEIs - Higher education institutions

IASP – International Association of Science and Technology Parks

IP – Intellectual property

MIT – Massachusetts Institute of Technology

NGO – Non-governmental organization

NIS – National innovation system

OP – Operational programme

R&D – Research and Development

RIS – Regional innovation system

SMEs - Small and mid-size enterprises

STI – Science, Technology, and Innovation

STPs – Science and Technology Parks

TTO – Transfer technology office

UBC – University-business cooperation

V4 - The Visegrad Group

INTRODUCTION

The position of universities in terms of cooperation with the private sector has changed significantly over the years. In the transition to a knowledge society, university-business collaboration (hereinafter as "UBC") is gaining increasing attention from governments, researchers, and private sector managers alike. Both the university and the business sector have undergone significant transformation processes, leading to the creation of new forms of cooperation with a focus on addressing economic challenges in countries. A primary prerequisite for understanding academic-private sector collaboration is to understand the interrelationships between the actors in the Triple helix model, which is the theoretical premise of our work. Within the Triple helix boundaries, can be created independent hybrid organizations at intersection of overlapping spheres to address innovation barriers. The process of operation of these of organisations in V4 countries that include and combine elements from the Triple helix spheres has been addressed by only a few authors. Therefore, we have decided to address this research gap in one of the forms of hybrid organizations, which we believe is the most comprehensive – the university science and technology parks.

Science and technology parks (hereinafter as "STPs") have been set up at the intersection of the actors of the Triple helix model with the strengthening of their mutual interactions, which are among the main strategic political priorities defined by EU Commission support dynamic UBC interaction for the 2007-2013 programmimg periods (and, of course, in other and current programming periods). Central and Eastern European countries were long-term moderate and emerging innovators and UBC was also very low compared to other European countries. The smaller group of countries - the V4 countries – they were in a similar situation. Except for the fast-growing and successful Czech Republic, the other three countries were mostly at the bottom of the innovation rankings. In the second programming period of EU funds 2007-2013, governments have made several calls for large-scale infrastructure STPs projects at universities. The common goal was to modernisation, improve the quality of research and innovative infrastructure and upgrade conditions for education in higher education in stitutions (hereinafter as "HEIs") with a link to results that can be implemented in practice. These projects were preceded by the earlier setting up of less complex projects of competence centres and centres of excellence. At first view, very great ideas to support national and regional R&D ended with less ambitious results. The set up STPs, especially in Slovakia and Poland, showed dissatisfaction of the governments with the conditions of support and further sustainability.

The primary prerequisite for the selection of the dissertation topic was to address the research gap in any evaluation of STPs in the V4 countries. The general view about STPs as successful support tool for universities and the private sector cooperation in the world has been confirmed by several authors (Audretsch and Link, 2012; Alegre, Berbegal-Mirabent and Guerrero, 2019; Almeida et al., 2020 and other case studies in Chapter 4.1), but with the gradual implementation of this tool in the V4 countries, we wanted to use in-depth qualitative research to find out how it is in selected post-socialist countries. Initially, in Slovakia at least, we have long observed dissatisfaction and a low level of cooperation, which appeared especially on the part of the academic sector and universities that have received support to build STPs (Jakab, 2020). The negative perception was almost always linked to the lack of financial resources for sustainability from the governments that initially supported their overall building. In its 2019 report, the Supreme Audit Office of the Slovak Republic identified a few negatives and substandard practices associated with the STP setup in Slovakia. This was also related to the newly established STPs at universities, which have been widely perceived around the world (but especially in Europe and the USA) as an important and successful means of improving the quality of the higher education environment and its linkages with the private sector. These projects were intended to significantly promote UBC, we later expanded the research to three other V4 countries (Czech Republic, Poland and Hungary) where these projects were being developed at the same time.

The main aim of the dissertation was to analyse the role of university STPs as an innovative tool for improving university-business collaboration by realization of activities and services, and role of government support in the setting up and the operation of this tool. Our purpose was to bring new insights into the formation and the operation of STPs in the V4 countries as one of the tools to connect the actors of the Triple helix model.

We have provided an overview of the dissertation's structure. To fulfil main objective, we divide dissertation into five chapters. Chapter 1 indentifies main theoretical frameworks on which our dissertation is based. We discuss the role of collaboration in innovation models, with an emphasis on the Triple helix model, which places importance on collaboration between three main actors - universities, industry and government (Etzkowitz, 1993; Etzkowitz and Leydesdorff, 1995). For our research, we chose the Triple helix model because in one line, it emphasizes primarily higher education for the emergence of innovation and is compatible with the knowledge economy. Although new studies have

defined additional actors in new models – Quadruple helix, Quintuple helix, or N-tuple helix (Carayannis and Campbell, 2012) that contributing to the creation of innovations by collaborating with each other, they have also largely confirmed that universities, industry and government are the main actors because of their most important roles in supporting innovation. Related to UBC in the Triple helix model, hybrid organisations are created at the intersection of the actors of Triple helix model, which represent a space where interactions between actors can take place. In terms of opportunities improving UBC, we describe the functions and attributes of hybrid organisations as a tool for UBC. In terms of functionality and direct links with universities, we focused on the possibilities of cooperation between these actors in common hybrid space - STPs. Our detailed literature review shows that while many authors in Western and Northern Europe have addressed this topic, research in the V4 countries is very limited. Nevertheless, we have tried to create a suitable theoretical concept of studies that correspond to the solution of the given problem and offer possible solutions.

Chapter 2 attempts to shed light on innovation performance and UBC in V4 countries based on international indicators. The research objectives were presented in Chapter 3, from which were developed three research questions to explore the research objectives.

In Chapter 4 will be explored methodological choices. Specifically, the adoption of qualitative research method – questionnaire survey and semi-structured interviews on the broader research design and conduction of questionnaire survey. We will explain the advantages, disadvantages and limitations of the research with regard to the research possibilities applied in the research area and describe the design of the pilot and final questionnaire survey.

Chapter 5 - results section presents the main findings of data collection and analysis we conducted by qualitative research. We present all relevant results in a logical order from the overall support for STPs to the individual selected STPs features that we evaluated.

Finally, a discussion combined contribution of results with comparison of literature review and other studies, propose recommendations on the main findings, suggested avenues for future research and final conclusions.

1 THEORETICAL FRAMEWORKS OF THE DISSERTATION THESIS

An innovative environment and sustainable economic development depend not only on activities of government, universities and a competitive private sector, but above all on their cooperation to achieve mutual strategic goals. The development of these interactions and their implementation is discussed in the theory of the Triple helix model, which characterizes the main roles of the actors in the model to achieve effective cooperation in a space of overlapping joint activities. For this reason, we have chosen the Triple helix model as the theoretical framework of our work, in which we emphasize just one of the three actors of the Triple helix model - universities. We will look at how the issue of collaboration is reflected in the university environment in relation to other actors in the development of innovation activities. In solving the limitations of collaboration, according to the authors Champenois and Etzkowitz (2018) we define hybrid organizations, which represent a space in which effective collaboration between the individual actors of the innovation triangle takes place. As a partial extension of the Triple helix model and the creation of new multidimensional models to eliminate the limiting factors of development, new studies identify the addition of new actors to the model - the addition of a fourth (Quadruple) and fifth (Quintuple) helix or n additional (N-tuple helix), which will be described in the next subsection.

On the intersection of Triple helix actors, hybrid organizations emerge that combine elements from all institutional spheres with the main goal of strengthening institutional cooperation between actors. As we are thematically addressing academic-private sector collaboration, in this frontier space we have focused on a selected type of hybrid organization - university STPs, which have an immediate relationship with universities because they have been created as an integral part of them. However, the process of setting up and financing these infrastructures does not only depend on an agreement between universities and businesses; the government that finances these projects has an important role to play.

1.1 The evolution of collaboration role in innovation models

Collaboration is an important part of innovation models because the overall success of innovation activities is influenced by the nature of its collaborative partners. The evolution of the changing role of university collaboration in innovation models is

illustrated by the transition from linear[1] innovation models to non-linear Triple helix model and its transformations to Quadruple and Quintuple models (Figure 1). A literature review indicates us that universities always had an important role in innovation processes (Mowery, 1983; Kline and Rosenberg, 1986; Lundvall, 1992; Edquist, 1997; Godin, 2006; Etzkowitz and Leydesdorff, 1995). Innovation models point out that innovation is an interactive process in which knowledge institutions interact with both firms and customer and suppliers (Freeman, 1987; Kline and Rosenberg, 1986; Lundvall, 1988; Vinding, 2002). Looking at linear innovation patterns from the early 1950s to the 1970s, universities are seen as the main engine of technological development. The implicit understanding of innovation processes in linear model comes from idea that innovation is generated by basic research (scientific inventions), which is gradually transformed into applied research. Arrow's (1972) view on optimal allocation to research and inventions it would be necessary for the government or other not governed agencies by profit and loss criteria to finance research. Majority of basic research was carried out at universities, in government, through the private sector, but outside industry. In this case, it is also necessary to realise the importance of non-monetary incentives that supported research organisations and universities. The complementarity between research and education can sometimes be a coincidence, especially in some of the more applied sectors (e.g., agriculture, aeronautics or medicine), which are considered to be particularly important. Eventually, knowledge development ends with production and diffusion, and innovations become commercially and technologically useful in the form of applied research and commercialization (Mowery, 1983; Godin, 2006). This is how were invented groundbreaking innovations such as the atomic bomb, radar, and penicillin. Later, in Kline's model, universities lost their dominant position as creators of technological innovations (Kline and Rosenberg, 1986) because new knowledge created in universities was not a necessary factor for success[2]. Innovation processes focus more on unfulfilled market demands and there is less emphasis on collaboration.

National Innovation Systems (NIS) and Regional Innovation Systems (RIS) represented a new generation of innovation models in the early 1980s. Based on a new line

[1] Linear understanding of innovation model claims basic university research that later converts into applied research of intermediary organisations and finally firms transform applied research to experimental development introduced as commercial market applications. Non-linear models of innovation underscore a more parallel coupling of basic research, applied research and experimental development. Universities and firms join in variable networks for creating innovation with regard to the type of R&D activities, universities, UBC related institutions at the same time (Carayannis and Campbell, 2012).

[2] Essential historical works and empirical body's demostrate that learning and innovation play an important role in most industries with different depending on context as well as strategy (von Hippel, 1976; Rothwell, 1977; Rosenberg, 1982; Pavitt 1984).

of thinking, innovation becomes the result of initiative-based collaboration between different types of knowledge actors (Lundvall, 1992; Edquist, 1997). Partnership is an "umbrella term" for interaction, cooperation and collaboration and between essential elements of a NIS. Interaction includes all types of contributions to innovation in terms of knowledge diffusion. Interactions are building blocks for collaboration, though in this context collaboration has a closer meaning in the context that collaboration refers to 'working together to achievea common goal" (Inzelt, 2004). Universities, enterprises, and other knowledge institutions are among the key actors in innovation processes, and the creation of linkages is becoming a priority for advanced economies. The approach of universities indicates progressively engage with other actors in the innovation system, especially in relation to national and regional industries, the public sector and government, in addition to their traditional educational and research roles. The Triple helix model represents a shift from the dominance of industry-government relationships to an equal triadic strengthening of relationships and cooperation with the addition of universities (Etzkowitz and Leydesdorff, 1995; Cai and Etzkowitz, 2020). In comparison to previous models, innovation in the Triple helix model is the result of mutual non-linear interactions between actors, in which institutional spheres take over each other's role in the absence or weakened function. Government intervention in innovation processes is also evolving and the model is widely accepted by innovation policy makers (Ranga, 2020). The Triple helix model provides a structure underlying an innovation system operating on different levels (national, regional, sectoral, etc.). In contrast to NIS (or RIS), the Triple helix model does not geographically delimit the space in which interactions should take place. It provides a framework of institutional processes and innovation activities between actors (Leydesdorff and Zawdie, 2010).

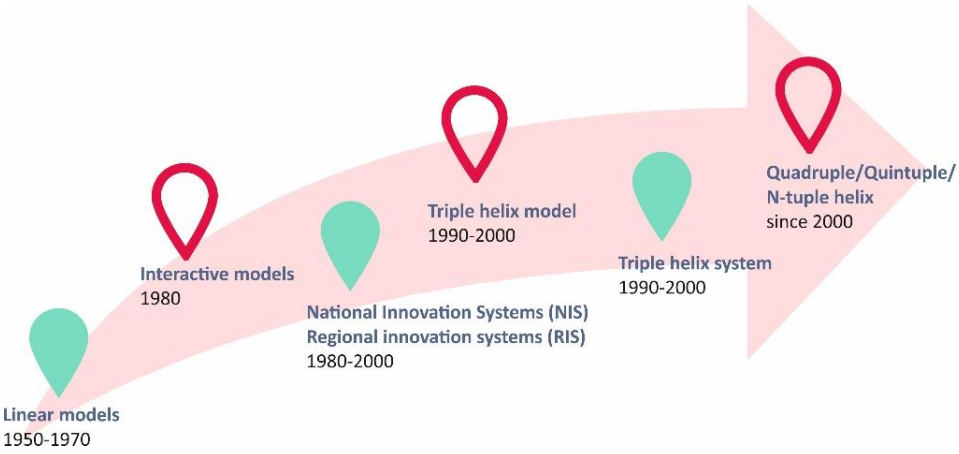


Figure 1: Evolution of innovation models from 1950 to the present
Source: own elaboration based on Ranga, 2020

In the context of innovative collaboration, we would like to mention two innovation modes – both STI mode and DUI mode represent forms of learning in promoting knowledge creation and innovation. The STI mode (Science, Technology and Innovation) is based on the production and use of scientific codified and technological knowledge. It develops an output based on high R&D expenditures that include highly skilled research human capital, investments and advanced scientific infrastructure and technologies (Jensen et al., 2007). The innovation STI mode supports intractions with new knowledce producing centres – predominantly universities and research centres, foundations for the scientific research diffusion that generate explicit knowledge which can be used by the entreprises to produce innovations (Fitjar and Rodriguez-Pose, 2013). The second, DUI mode (Doing, Using and Interacting) is an experienced based. This kind of knowledge is acquired for the most part on the job as employees face ongoing changes that confront them with new problems in which finding solutions to these problems enhances the skills and know-how of the employees and extends their repertoires (Jensen et al., 2007; Parilli and Alcalde Heras, 2016). The implications of combining these two models and their success have been further addressed by several authors (Aslesen, Isaksen and Karlsen, 2012; Gonzáles, Parilli and Peńa, 2015; Parilli and Alcalde Heras, 2016) but both innovation modes are mainly focused on business innovation procesess view, so we won't discuss it further.

1.1.1 Triple helix model

The interactive Triple helix model (also called triple spiral, triple screw) was developed in the early 1990s. The author of the model is Henry Etzkowitz, currently a professor at Stanford University in the USA and founder of the non-profit international Triple Helix Association, a non-profit institution based right here in the Sillicon Valley. Etzkowitz (1993), Etzkowitz and Leydesdorff (1995) have identified triple interactions based on knowledge support for economic development at MIT (Massachusetts Institute of Technology). In the first decade of the 21st century, the model has received attention among regional development theorists (Etzkowitz, 2002a; Cooke et al., 2006). In developed and developing economies, it has been presented as a tool to increase innovation activities and promote economic development (Etzkowitz and Leydesdorff, 1995)[3]. The evolution of the Triple helix model suggests economic growth of countries through innovative

[3] According to the authors of the Triple helix concept, it is not a completely new theory, but an analytical concept that is suitable for studying the organisational and institutional set-up of the key actors underlying regional competitiveness.

strategies with a necessary transition from a static or Laissez-faire model to a hybrid[4]. In the context of the transition from an industrial to a knowledge-based economy, this can be seen as a conscious innovation process rather than a random evolutionary process (Etzkowitz, 2011). The triple helix model describes different types of collaboration between the three main actors involved in mutual innovation cooperation: government, universities, and the private sector (mainly industry), between which a common hybrid space emerges (Figure 2).

The Triple helix model highlights the potential for innovation and economic development in a knowledge society and the more prominent roles of universities, the private sector and government in creating new institutional and social formats for knowledge production, transfer, and application (Etzkowitz et al., 2007; Champenois and Etzkowitz, 2018). Stronger linkages between universities, industry and government create collective benefits and help to improve economic performance and competitiveness (UNCTAD, 2018). Three main arguments are made regarding the meaning and importance of the Triple helix. First, it provides a control mechanism for policy implementation, which helps to evaluate its effectiveness and efficiency (Brignall and Modell, 2000; Ivanova and Leydesdorf, 2015). Second, performance evaluation is necessary to improve the interactions between Triple Helix actors, as it allows for the discovery of weaknesses and best practices within the Triple Helix systems under observation (Lebas, 1995; Keramatfar and Esparaein, 2014). Finally, measuring the effectiveness of the Triple helix model can also be applied in the development of innovation competitiveness assessment tools on a global scale (Ye and Wang, 2019; Jovanović et al., 2020). The traditional roles of individual actors represent the activities they contribute to the overall functioning of the model. The transformation and interrelationships between the institutional spheres of universities, industry and government are increasingly shaping the dynamics of innovation at the transnational, national and regional levels (Etzkowitz and Leydesdorff, 1997; Etzkowitz 2008). To stimulate innovation processes, hybrid organisations (Etzkowitz, 2011) can be created at the intersection of these spheres, in which the roles of the different actors partially overlap (Etzkowitz and Leydesdorff, 2000) (Figure 2). Hybrid organisations represent a shared hybrid space in which elements from different spheres of the Triple helix model are brought together and combined to enhance

[4] The initial concept was inspired by Darwin's theory of evolution, according to which the evolutionary development progresses by natural evolution or random mutations. In this case, the Triple helix model is an alternative view of the dynamics of innovation in a triple network in which actors interact in an evolutionarily driven manner to create new innovative combinations (Etzkowitz et al., 2007). However, society is more complex than biology and needs a third helix to model innovation. But the Triple helix is less stable unlike DNA, for cultural or socioeconomic reasons (Hampl, 2008).

collaboration between actors and reduce innovation blockages between them (Champenois and Etzkowitz, 2018). For instance, we can include here science parks, incubators, or venture capital firms (Etzkowitz, 2008; Johnson, 2008; Champenois and Etzkowitz, 2018).

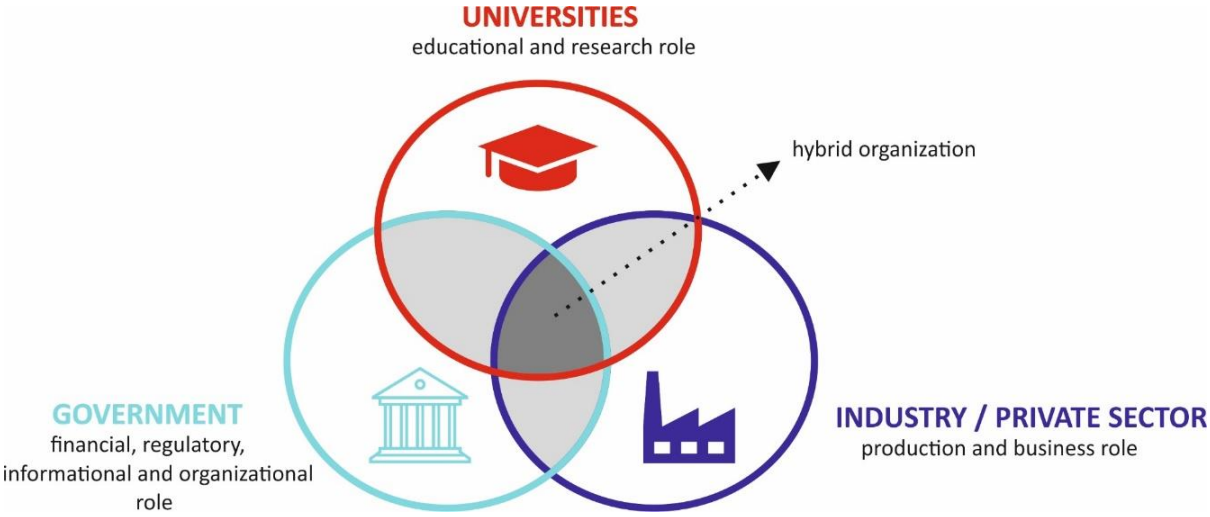


Figure 2: Triple helix system with traditional roles of innovation actors
Source: own elaboration based on Etzkowitz and Leydesdorff, 1995; Champenois and Etzkowitz, 2018

Within the Triple helix concept, innovation is presented as a non-linear process in which activities include basic research, applied research, intellectual property evaluation, marketing activities, and industrial diffusion of knowledge and technology (Kline and Rosenberg, 2009). Universities carry out activities mainly related to their own research and student education. In response to changing market demands, a third entrepreneurial role for universities is essential (Etzkowitz et al., 2000; Trippl et al., 2012), which is closely related to the traditional ones (Piqué, Berbegal-Mirabent and Etzkowitz, 2020), but also strengthens the university's position as a partner that can be a source of new actionable knowledge and innovation. Universities are thus giving back to society what it has invested in them and is an example of opening to greater collaboration with both the private and public sectors in line with the Triple Helix concept (Blažek and Uhlíř, 2011). University research is categorised as innovation if it has been applied to industry and creates value in the form of an increase in the firm's competitive advantage (Audretsch and Caiazza, 2016). Collaboration provides opportunities in spillovers of knowledge generated by universities through strategic partnerships (Trippl et al., 2012), innovation in research of existing knowledge, commercialization of intellectual property or research mobilities of researchers and students (Desai, 2018). Given the limited funding and financial challenges, they need help from the state to address their specific needs in influencing innovation through demand.

The traditional roles of universities in the creation and dissemination of knowledge and innovation should be expanded, so that these processes are aligned with the needs of private companies. In completing the Triple helix model, governments need to define, stimulate, and facilitate reciprocal relationships, thus playing an important role not only as a catalyst but also as an active participant in innovation creation processes (Mascarenhas, Marques and Ferreira, 2019). The roles of government are multidimensional - they are primarily based on the allocation of tasks within the planning, budgetary and financial environment. They consist of financial, regulatory, informational, and educational instruments. The roles of government are constantly evolving through different phases, commercialization of research and innovation processes, with government as an actor representing several functions - innovator, controller, or consolidator (Edler, 2009). The actions of governments (also represented by government or regional agencies) systematically improve the demand and scope for scaling up innovation (Edler, 2009; Gachie, 2019). It happens that some industries are hesitant to undertake new innovations because the process is viewed as a commitment with a high level of risks and uncertainties in the market (Fudickar and Hottenrott, 2019). Governments therefore take on the role of investor (or co-investor) at least at the beginning to reduce the risk of the innovation process. Equally, governments also invest in partnerships for the country's own economic development, which is achieved through the creation of strong and sustainable business partnerships (also with the assumption that these businesses promote job creation and increase regional competitiveness) (Dalmarco et al., 2018). Government is static, allowing for stability and role reallocation in a planning and budgeting environment (Gachie and Govender, 2017; Gachie, 2019). The private sector is mainly represented by industrial enterprises, including small and medium-sized enterprises (SMEs), large enterprises, foreign companies, and research and development (R&D) companies. The role of industries is therefore significant as they are an important donor of industrial innovation.

In the theory, the Triple helix model is very easy to apply, but in practice it is extremely hard. The concept of the model is defined as a set of three systems - components, relationships between components and functions (Figure 3). Components include individual or institutional actors, innovators in or outside the R&D field, institutions focused on a single discipline or multidisciplinary. Relationships between components are manifested by new combinations of innovation knowledge, including technology transfer, collaboration on projects, conflict resolution, substitution or networking. The main function

is the generation, dissemination, and use of technology. The competences needed to achieve these functions are selective (strategic) competence, organisational (coordination) competence, technical and adaptive competence in three spaces: knowledge, innovation, and consensus. To fully understand the dynamics of the model, it is essential to explore its mechanisms within these spaces that stimulate cooperation between actors (Ranga and Etzkowitz, 2013). The creation of knowledge, consensus and innovation spaces is the result of interactions between universities, industry, and government, which are gradually closing in on each other.

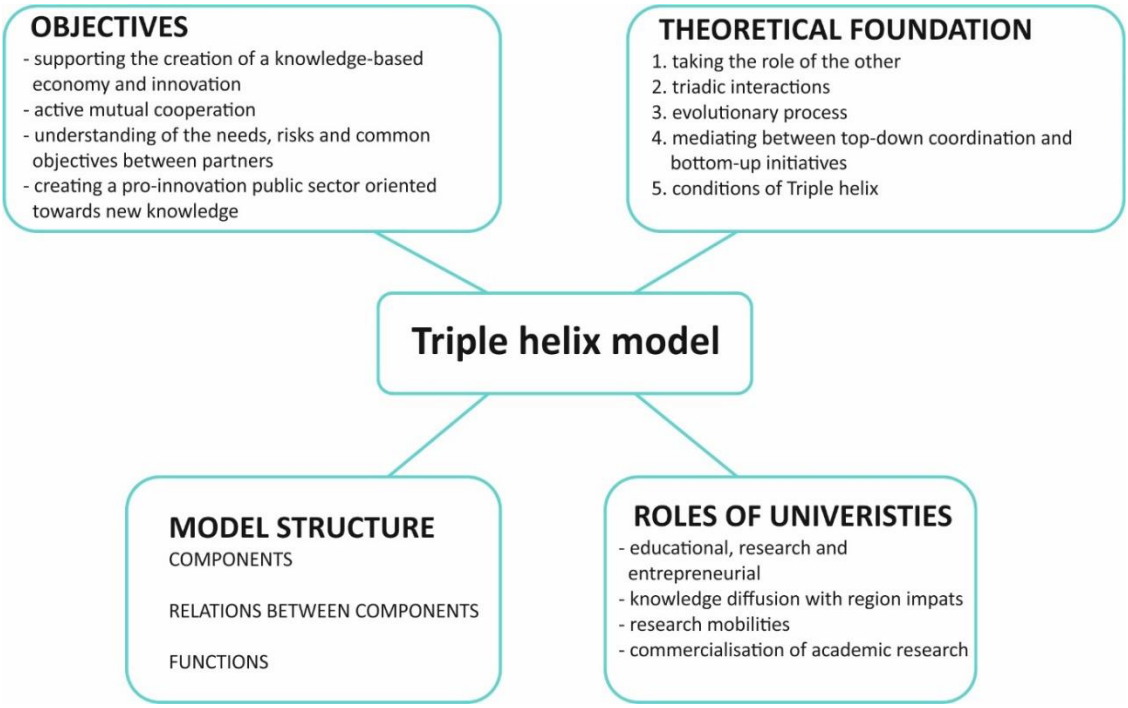


Figure 3: Triple helix model characteristics
Source: own elaborations based on Blažek and Uhlíř, 2011; Trippl et al., 2012; Ranga and Etzkowitz, 2013; Razak and White, 2015; Desai, 2018; Cai and Etzkowitz, 2020

There are different degrees of involvement of actors in collaboration, which is also a major factor indicating substitution mechanisms, with the more powerful actor also taking over the roles of others or reinforcing their development. For the concept to really work and fulfil its pro-innovative role, mutual respect between actors, awareness of interdependence or complementarity and partial overlapping of roles is necessary (Etzkowitz and Leydesdorff, 1998). The main benefit of applying the model to practice is to analyse or look for where collaboration works or does not work. Blažek and Uhlíř (2011) point out that the Triple helix model does not offer specific guidance on its implementation, rather it highlights

the types of mechanisms that may work under different circumstances and conditions. A fundamental characteristic of the Triple helix model is its constant transformations, which occur mainly under the influence of changes in market forces, political changes (cyclical changes of political representatives), institutional changes, social movements and technological developments. The interactions in the model are manifested in the formation of overlapping activities in different ways (Ranga and Etzkowitz, 2013). Innovations then emerge because of a systematic and non-linear process (Rusnák and Korec, 2020). From a theoretical perspective, there are several success factors. By applying individual steps, it is possible to achieve more effective and active collaboration or to increase the dynamics of the Triple helix model. In Figure 3, we have identified five main prerequisites (success factors) of an ideal and balanced Triple helix model with optimal conditions for the emergence of innovation (Ranga and Etzkowitz, 2013; Razak and White, 2015; Cai and Etzkowitz, 2020).

The Triple helix model faces its own challenges arising from the shift from older innovation models to new ones. These reflect the increasing complexity in dealing with the social and economic problems of today (Ranga, 2012). The first challenge is the transition from less differentiated regional innovation potential to smart specialisation. Next, moving from competing regions to collaborating regions, creating regional consortia to empower strengths, identifying the local leaders needed to manage change. Moving from the traditional strategy of exogenous development, attracting multinational subsidiaries to the region to promote development, to endogenous development, based on building local capacity and investing in local talent and infrastructure. In addition to identifying the strengths, benefits and motivating factors, it is also necessary to focus on the barriers and weaknesses of joint innovation activities that inhibit mutual cooperation between the actors of the Triple helix model. Establishing closer collaboration between universities and businesses requires not only the removal of barriers, but also the recognition of the benefits of this relationship by both partners (Pleśniarska, 2018). The efforts required to create a truly functional Triple helix model in practice encounter many obstacles. Issues related to the linkages or relationships within the Triple helix system have been discussed by several authors (Leydesdorff, 2000; Mello and Etzkowitz, 2008; Blažek and Uhlíř, 2011; Gachie, 2019). First, it is necessary to point out the over-optimism that this model can generate among those responsible for the design of support policies. The complexity of the Triple helix system, as well as the great heterogeneity of actors, means that the outcomes of a proactive approach are largely unpredictable, with a high probability of the occurrence

of unconsidered consequences that can break the Triple helix relationships (Leydesdorff, 2000). Although universities are generally under pressure to increase interactions with the private sector, academic environments vary considerably in the extent of collaboration with businesses (Muscio and Vallanti, 2014).

1.1.2 Triple helix model transformation

An enhancement to the Triple helix model is the Quadruple helix, the Quintuple helix, or the addition of other actors (N-tuple helix) (Figure 4). These conceptual extensions are precisely to better capture the third role of universities and their activities beyond the original ones - the educational and research function (Carayannis and Campbell, 2012; Barth and Schlegelmilch, 2013; Carayannis et al., 2018). In this conception, there are new actors - society and the environment - as active participants in innovation processes. To contribute to socio-economic development, universities need to understand and exploit new networks of stakeholders (Miller et al., 2014). Therefore, relationship networking is seen as a key determinant of university technology transfer mechanisms to lead to social innovation. Those following challenges and their dynamic complexity require new cross-domain, cross-scale, and action-oriented approaches at the universities. New roles of universities in the contexts of additional helixes models playing an important role in fostering the shift from technical to social innovation (Morawska-Jancelewitz, 2022).

Quadruple helix emphasizes that the government in developing innovation policies and economic development must adequately communicate its strategies to the public through the media to gain support for new strategies and policies. The fourth mission concept is particularly relevant as it puts emphasis on the university's roles in sustainable development. Finding balance between participation in solving global issues and local issues is one of the challenges for the whole academic environment today. Different models and approaches are investigated that reflect those new university roles and rely on the multi-stakeholder initiatives (Morawska-Jancelewitz, 2022). Höglund and Linton (2018) argue that the fourth spiral should be seen not only as a new helix, but as a model of society. Carayannis and Campbell (2012) define the fourth spiral as media, culture, and civil society. They also argue that its focus is on the human being and the associated democratic knowledge, artistic research, and innovation-based arts. Perkmann et al. (2013) points to a wide range of other factors - the quality of the university, climate, discipline, organizational culture, public policy and regulation, and organizational strategic agendas - that can all influence individual motivations and attitudes toward UBC and end-users.

As the concept of spirals has been extended to include multiple actors, the Quintuple helix calls for the inclusion of considerations of the socio-ecological setting of research processes, while ensuring appropriate accountability for the ecological impact of innovations. The Quintuple helix model adds natural environment relevant for addressing sustainable economic space (including climate change) as a new subsystem for knowledge and innovation models to establish nature as an equivalent part of knowledge production and innovation. This model recognised that if universities wish to actively contribute to sustainability they need to go beyond their traditional roles and functions of research, education and community involvement and further integrate social innovation in their new missions and core (Bayuno et al., 2020). The key question in this model is to find out what the relationship between knowledge is, innovation and the natural environment. The complexity of the five helices structure suggests that a full analytical understanding of all the helices requires continuous engagement across the disciplinary spectrum from the natural sciences, through the social sciences and the humanities (Carayannis and Campbell, 2010). A renewed EU Agenda for Higher Education (2017, p. 7) emphasise „*HEIs should be engaged in the development of their cities and regions, whether through contributing to development strategies, cooperation with businesses, the public and voluntary sectors or supporting public dialogue about societal issues. Outreach beyond the academic community in local languages should be incentivised and rewarded, including as part of career development* ".

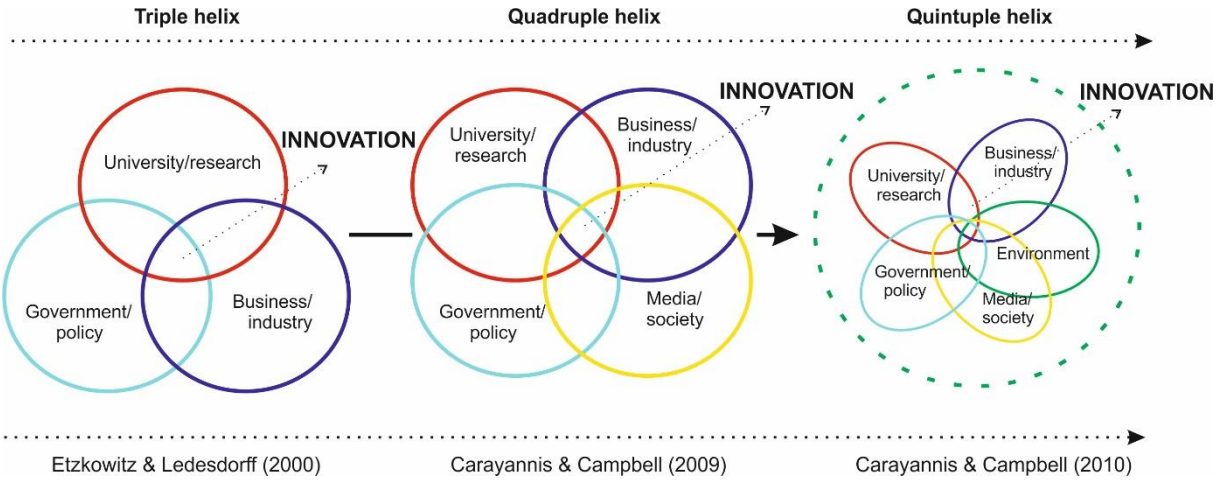


Figure 4: Position of helixes in innovation processes
Source: own elaboration based on Barth and Schlegelmilch, 2013

Some studies dispute the relevance of adding additional helixes in relation to innovation processes (Leydesdorff and Lawton Smith, 2022; Lawton Smith and Leydesdorff, 2022). Leydesdorff and Lawton Smith (2022) paid particular attention to Simmel's triad concept (1902) and argued that while the third helix contributes substantially to the dyadic model by allowing us to study possible conditions for innovation, higher-order spiral models decompose and recombine into interacting triple helices. Leydesdorff and Lawton Smith (2022) argue that research and policy programs that apply higher-order spiral models have so far stagnated based on empirical results. Since the mission of universities is not just to provide a source of new ideas - as in the linear model - but to exploit the confluence of demand for innovation and further theoretical and/or methodological advances, it remains unclear how the four- and fivefold models have contributed to this goal (Lawton Smith and Leydesdorff, 2022).

Cai (2022) argued that the surplus of alternative perspectives is that additional helices models have contextualizing functions rather than additional constituencies, e.g., the public conceived as subsystems rather than primary actors or institutional spheres (Zhou and Eztkowitz, 2021). Leydesdorff and Etzkowitz (2003) were equally sceptical of this because they did not see civil society as an institutional sphere on the same level as the university, industry, or government, but rather a social framework that focuses on freedom of speech and organisational initiatives. Carayannis and Campbell (2022) proposed a new eco-systemic approach called EUTOHA (Emerging Unified Theory of Helix Architectures). The EUTOHA framework and is based on democracy and ecological sensitivity and provides us with an opportunity to operationalize socio-economic transformation of industry and society (Indrustry 5.0 and Society 5.0).

1.2 Academic and private sector cooperation in innovation processes

The potential of functional Triple helix model is becoming increasingly accepted, especially bilateral relations between higher education institutions (HEIs) and business. University[5]-business cooperation (UBC) is still specific field of research. In this case we try

[5] In our thesis, we generally use the term university / universities when introducing collaboration with the private sector. The university as one of the actors of the Triple helix model is thought of as the highest level of HEI with highest academy creditials in teh higher educational system and play a significant role in academia and business (or industry). But the term HEIs according to International Standard Classification of Education (ISCED, 2011) includes all institutions providing higher education (third level education, tertiary education leading to award of academic degree, post-secondary education, final stage of formal learning) provided by public or private universities, colleges, academies, seminaries, institutes of technologies, universities of applied sciences and others career-based schools that award degrees. Higher education includes research, teaching, applied work and university social services and activities in specialised fields of education (Pucciarelli and

to creation a conceptual framework about main highlights, important elements and explanations closer relations and processe that ensure the functioning effective collaboration despite many barriers.

1.2.1 Collaboration processes

Since the 1980s, university-industry collaboration has intensified and received increased attention from researchers, policy makers and business professionals (Etzkowitz, 1998). The application of the Triple helix model can be observed at two levels - theoretical and practical. From a theoretical perspective, the Triple helix model is presented as a suitable conceptual framework for institutional collaboration between universities, the private sector and government (Etzkowitz, 2003; Blažek and Uhlíř, 2011; Ranga and Etzkowitz, 2013; Cai and Etzkowitz, 2020). In its practical implications, it is applied, for example, by the European Commission in the framework of smart specialisation strategies in countries where cooperation is weakly developed (the example of Romania[6]). Understanding its theoretical underpinnings is to a large extent the basis for our research.

The first step in the formation of the Triple helix model is to define a collaboration between institutional spheres in which each actor represents its traditionally defined role (Etzkowitz, 2008). Collaboration begins with discussions between universities, firms and/or governments. It is generally a response to a perceived gap, which may be caused by an economic crisis, the planned development of a regional project, or some other issue (Svennson et al., 2012). First, it is necessary to start the collaboration by making each of the stakeholders aware of what inputs they have and can potentially be included in the collaboration. The capability to innovate is crucial not only for the development of businesses, but also for the development of the general economy of any country. Sharing scientific competencies from universities to industrial firms allows firms to absorb and exploit knowledge developed in academia (Kunttu, Huttu and Neuvo, 2018). Almeida (2008) highlights that universities foster the stimulation of innovation and entrepreneurial activities using different approaches. Thus, interactions with firms can contribute to the more effective

Kaplan, 2016). From our point of view, we understand these terms as synonyms, but we will use the term university.

[6] As part of the Smart Specialisation Platform, the European Commission organised a series of workshops to strengthen university-private sector-government cooperation in the project "Targeting support to smart specialisation strategies in Romania (2016-2020)", where the Triple helix model and its implications were presented at the beginning (European Commission, 2020).

achievement of universities' objectives in the areas of education, research and knowledge transfer or the generation of new revenues. Raising revenue from the private sector is increasingly important as many governments are reducing public funding allocated to the university sector in the current economic environment (Jongloed, 2015). Identifying appropriate inputs is important to understand what could be provided to support collaboration between universities and the private sector (Chatterton and Goddard, 2000). Support mechanisms are part of the process to help create favourable conditions (Galan-Muros et al., 2015) and work towards changing the traditional university culture (Kliewe et al., 2013). They can take the form of policies, strategies, structures, and activities (Davey et al., 2011) and their effectiveness is widely acknowledged as they reduce or directly remove barriers to collaboration between the academic and private sectors (Henrekson and Rosenberg, 2001). With the assistance of support mechanisms, actors can carry out joint activities that subsequently produce outputs in various forms. Further, the internal transformation of existing institutions is essential, which take on each other's roles beyond their traditional roles (Etzkowitz, 2008). The overall process ultimately produces effects at different levels with impacts and influences not only on stakeholders but on society and regions (Figure 5).

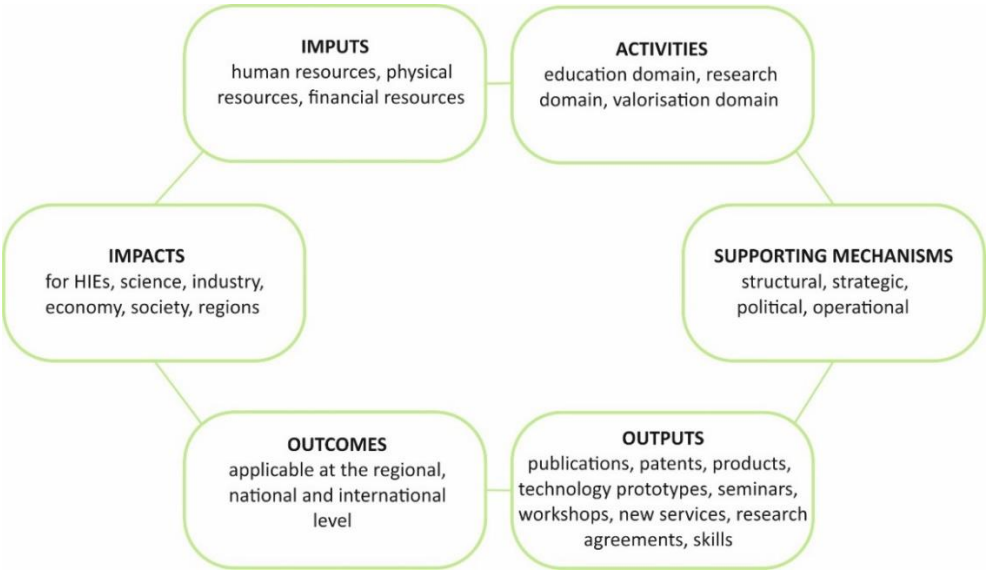


Figure 5: Collaboration processes between universities, private sector and government
Source: own elaboration based on Galan-Muros and Davey, 2019

University-business linkages have many types, different objectives, institutional arrangements, and scopes. The different dimensions of these links have been suggested to capture several frameworks. Cooperation may be less or more intensive and may focus on research activities, teaching, mobility, technology commercialization or collaboration

processes. Links can be classified according to where they stan - between industry-pull (such as contract research) and university-push logics (such as spinouts) (Poyago-Theotoky, Beath and Siegel, 2002). High relational involvement links include situations where teams and individuals from academic and industrial spheres produce common outputs, work together on research partnerships or share common infrastructure – they can be reffered as relationships (Figure 6).

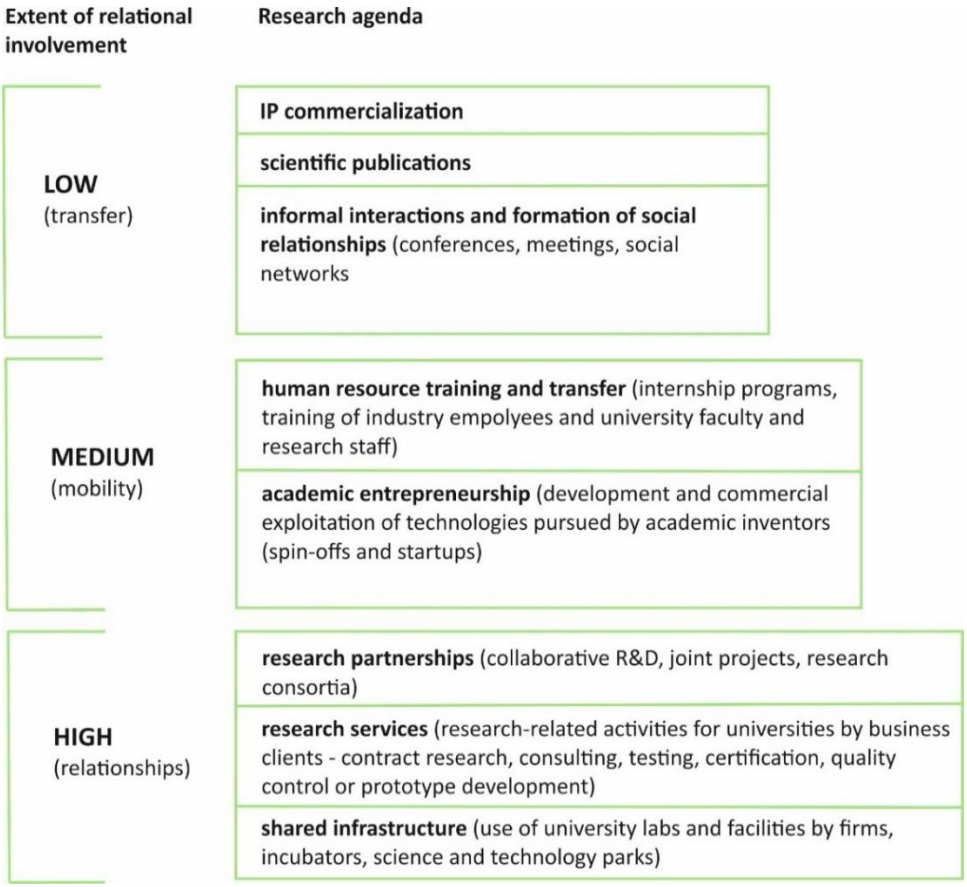


Figure 6: Typology of university-business linkages, from lower to higher intensity
Source: own elaboration based on Perkmann and Walsh, 2007; Guimón, 2013

On the contrary, informal interactions and formation of social relationships, the use of scientific publications and the licensing of university-generated IP represent links with low relation involvement, because they do not require relationships between university researchers and industry users. The following agendas come closest to what we commonly reffered as „technology and knowledge transfer “, although they may be present in association with mechanisms with higher relational involvement (Agrawal, 2006). Finally, the mobility-based linkages can be classified as linkages with medium relational involvement (such as individuals move between academic and industrial contexts). Mobility

can be permanent (in the case of graduates who take up positions in industry, or academics who decide to manage their own academic spin-off or startup, or temporary (such as in the case of industrial scientists working temporarily in a university laboratory. Medium relational involvement can respresent some linkages with previous colleagues are often maintained even after the move (Perkmann and Walsh, 2007; Guimón, 2013).

Although, there are many benefits to collaboration, various constraints that hinder collaboration, which is reflected in the different levels of engagement of countries in innovation activities. One possible solution that strengthens collaboration (Etzkowitz, 2008; Etzkowitz, 2011; Jongbloed, 2015; Champenois and Etzkowitz, 2018) are hybrid organizations (incubators, university science parks) in which collaboration can take place. They offer not only space and research facilities, but also various other added services not only for university staff and students, but also for companies interested in sharing these facilities with them.

1.2.2 Barriers to UBC

The identification of UBC is essential to understand and improve weaknesses. Despite all advantages, strengths and successful examples around the world, there are many barriers to effective cooperation between actors. *„At the most general level, this is the existence of a "Berlin Wall" between academia and the private sphere, where the two spheres have different value rankings, different criteria for selecting employees, different criteria for evaluating achievements, different time horizons, etc. "*(Mišúnová and Korec, 2019, p. 206). The imaginary „Berlin wall"between academia and the private sphere, the cultural differences in terms of university, industry or the different corporate strategies create a lack of natural opportunities for new interactions. The UBC is based on a mental attitude of all actors in innovation ecosystem, it is driven by inner and psychological elements (trust, mutual commitment, common objectives) and not by rules or measurable elements (Edmondson et al., 2012). All this leads to mutual mistrust, a lack of understanding and the absence of a common goal for the actors to work towards. Regardless of the type of cooperation, trust between stakeholders is important and fundamental point on which cooperation is built. Lack of trust and disinterest in cooperation cause that universities have weak links with the business sector, which results in poor cooperation on joint projects (contract research) and has an impact on the overall cooperation between universities and the private sector. There are the limited absoption capacity of firms to take projects,

internships or business / research activities and offerings (Davey et al., 2013). A lack of contact people and no appropriate initial contact person may further deepen the lack of interest in cooperation in future. Weak links between actors also result in a lack of production by universities of the required human capital needed by the private sector. Mello and Etzkowitz (2008) point out that lack of interest in joint activities is another reason for ineffective collaboration and play greater role in meantaining the relationships (Schilke and Cook, 2013). Trust represents a crucial effective negotiation element, when actors trust each other, they are more likely to problem solving, value creation, sharing information, needs and help the other party with achieving objectives (de Klerk, 2012). Trust provides mutual confidence which is associated with the problems specific risk and its resolution, because in the absence of an uncertainty of risk environment, trust has no meaning. Thus, trust mean behavior results based on right, fair and serious where actions and decisions are connecting with ethnical principes that protect and recognize the rights and interest of others (Hewitt-Dundas, Gkypali and Roper, 2019). The objectives and motivation of each partner are clearly explained and definied. All partners can decision influence of these objectives (Anderson, Michael and Peirce, 2012). Successful and effective collaboration does not just happen. It must be carefully planned and then is important to fully understand what makes collaboration successful (Rajalo and Vadi, 2017). Other examples of barriers to UBC are, for example, concerns about disclosure of corporate know-how during collaboration with academia.

Organizational barriers include limitations related to the overall functioning, including restrictions related to the operation of UBC. The country effect is most evident in external barriers that universities and parks cannot influence from their positions – such as higher education law, evaluation of research infrastructures, government unstability, lack or fluctuation of qualified researchers, administrative and bureaucratic barriers, and time management. More „classic“ administrative barriers related to institutional differencies (such as administrative procedures and orientation) are still remaining substantial in UBC (Bruneel et al., 2010). They are differencies between timescales, limited time, transactional cost, lack of flexibility and operating environment (Tartari and Breschi, 2011; Bruunel et al. 2010). Garcia et al. (2019) note that transactional factors, bureaucracies and administrative procedures are major barrier to more cooperation with firms.

Financial obstacles that relate to the provision of finance for UBC in terms of missing internal and external funding are relevant barriers for both university and firms (D'Este, Guy and Iammarino, 2013). Public financial support can lower the barriers for each partner to

engage the innovation and have positively influence university's R&D proportion in external partnerships with firms and increase a chances for further and more intense UBC (Aristei et al., 2016; De Fuentes and Dutrénit, 2016; Fontana, Geuna and Matt, 2006; Laursen and Salter, 2004; Segarra-Blasco and Arauzo-Carod, 2008; Yu and Lee, 2017). Universities have usually great limitations with internal and external funding sources – lack of external funding from such as operational programms by EU Funds or from private sector capital. In the same way universities are limited by regulations at the faculty, university and state level, their own budgets are often very limited (Davey et al., 2011).

Technical barriers could be solved by cooperation with other partners because they can help with technical assistance. The most common technical barriers are obsolete or missing infrastructure / facilities for specialized research and services, insufficient spatial capacity for the implementation of activities and poor publicity and marketing which cause a lack of awareness and interest in establishing cooperation (Figure 7).

TYPE OF BARRIER	EXPLANATION	BARRIER
FINANCIAL BARRIER	barriers that relate to the provision of finance for UBC from the both internal and external sources, including: lack of external funding for UBC (e.g. EU Funds), lack of financial resources of the business, HEIs funding for UBC, financial crises	- insufficient research funding - unsuitable institutional funding - long-term unstable funding - changing operating conditions of state support
ORGANIZATIONAL BARRIER	barriers related to the overall functioning, including restrictions related to the operation of parks which are part of the university and thus subject to the university law, unclear measurable indicators and requirements from the government, lack of quality staff to improve the results of the research	- higher education law - unclear evaluation of research infrasructures - government unstability - lack of qualified employees / fluctuation of qualified specialist - excessive administrative burden / bureaucratic barriers - poor time management
TECHNICAL BARRIER	barriers related to technical security may be related to insufficient research infrastructure, public relations or marketing	- obsolete or missing infrastructure / facilities for specialized research - poor publicity and marketing - insufficient spatial capacity for the implementation of activities
SOCIETAL BARRIER	barriers related to cultural differencies of academia and business, different strategies and psychological elements	- different attitudes of actors in innovation ecosystem - mistrust, lack of understanding - different objectives

Figure 7: Barriers in UBC

Source: own elaboration based on mix of barriers from literature review and case studies

All these obstacles lead to a lack of cooperation. Gachie (2019) highlights the insufficient human resource capacity and lack of support structures for the implementation of national goals to link governments, universities and the private sector. Creation of new knowledge because of collabration processes often try to change the perspectives of the parties – researchers have an incentive to spread results at the beginning and improve their reputation in the whole scientific community), whereas companies have an incentive to delay disclosure of result to ensure a competitive edge.

1.3 Hybrid organizations

The Triple helix model points to an increasing and necessary overlap of activities between universities, government and private sector. Within the model, can be created some independent hybrid organizations at the intersection of overlapping activities, which may be one of the solutions to innovation blockages (Champenois and Etzkowitz, 2018). While research on the actors of the Triple helix model has generally focused on its individual structures and the dynamics between spheres, much less attention has been paid by the authors to the outcomes of overlapping spheres or the creation of autonomous innovation-promoting organizations. Hybrid organizations[7] are not considered a new phenomenon (Dahl and Lindblom, 1953; Bozeman, 1987). However, attention to 'hybridization' in the context of organizations seems to have increased in recent decades and we are witnessing an increasing number of multi-sectoral collaborations and activities across boundaries (Ferlie et al., 2011; Jay, 2013; Head and Alford, 2015; Anttonen et al., 2018). This blurring of sectors does not only take place at the public-private boundary. Hybrid organizations are also created at the intersection of the actors from private sector and civil society, the private sector and academia, and the public sector and civil society (Ferlie et al., 2011; Seibel, 2015; Anttonen et al., 2018). These hybrid constellations are created as platforms for resource sharing and creativity, as well as for spurring technical and social innovations that can solve today's complex and 'wicked' problems (Head and Alford, 2015; Klijn and Koppenjan, 2012; Anttonen et al. 2018).

One of the examples of an organizational form involving different actors is Triple helix model. The existence of hybrid organizations situated between institutional ones requires deeper exploration that can help us gain new insights into the foundations of the model.

[7] We understand hybrid organisations as exiting built entities, not as an imaginary online hybrid space.

Hybrid organizations are built within a consensus space (Etzkowitz, 2002b; Etzkowitz, 2008; Ranga and Etzkowitz, 2013), which is defined as a set of activities connecting the components of the Triple helix model. These activities greatly facilitate coordination between institutional spheres (Villarreal and Calvo, 2015) and develop and shape the links between them by implementing the Triple helix model. The Triple helix has thus been likened to a "platform" for institution building (Etzkowitz, 2008) or hybrid organizations in which elements from each of the model's spheres are synthesized. Champenois and Etzkowitz (2018) introduced the term "boundary space" to refer to the process of creating hybrid organizations that are situated between spheres across institutions. A boundary (imaginary line) means a clear separation between non-overlapping spheres, but boundary space refers to a territory in which elements from different overlapping institutional spheres are integrated. The creation of hybrid organizations[8], which combine and integrate elements from different institutional spheres, fosters innovation because together they form the interface between universities and businesses. At the same time their role is to mediate this interface (Etzkowitz, 2003). The reason for the formation of hybrid organizations is the combination of resources and competencies from different sectors, the results of which lead to innovation and new creative solutions (Jay, 2013). Hybrid organizations take advantage of available local resources and more efficiently achieve results that individual actors might not achieve on their own. Due to capabilities, they represent an innovation space for creating innovations using already existing resources in universities, research institutes, R&D departments of companies and governments and improve them by interacting with each other (Ranga and Etzkowitz, 2013). The results of active relationships between actors of the Triple helix model can take different forms.

The creation of new hybrid organizations combining elements of the Triple helix model's actors includes STPs, incubators or venture capital firms with the common objective of fostering innovation (Champenois and Etzkowitz, 2018). Organizational innovation in this form synthesizes elements of several institutional spheres at the same time (Etzkowitz, 2008) and is characterized by its own autonomy (it is not explicitly part of only one sphere). The creation of hybrid support organizations is a collective task, and therefore it is particularly important for their operators to secure and build an internal team as well as an

[8] These institutional syntheses are analogous to cross-border regions formed between nations, such as Oresund, which includes southern Sweden and Copenhagen. Stimulated by an EU programme to promote joint projects and identity building, Oresund crosses national borders and is based on a combination of geographical and institutional elements, with the bridge between them becoming a symbol of unification (Etzkowitz, 2011).

external network of mentors and specialists from different spheres (mainly entrepreneurs and venture capital firms) (Champenois and Etzkowitz, 2018).

In the preparation of strategic documents and initiatives before and during EU Funds programming period 2007-2013, the aim was to ensure the construction of large infrastructure in particular, in addition to direct financial support for building of technical infrastructure from public sources (the state budget and structural funds) such as STPs through investment aid - by creating conditions for domestic investment and foreign investors in the building and development of technical infrastructure. Given the focus and research of our work, we have taken a closer look at only one type of hybrid organizations - university science parks, as they have close links with universities in particular and improving cooperation between the different R&D sectors (public sector, HEIs sector, the business sector and the non-profit sector) and each of them with user practices contributes to increasing the exploitation of R&D results in economic and society practice. In our dissertation we reflect on the support and role of hybrid organizations as centers of interconnection of the actors of the Triple Helix model. We further replace the term hybrid organization with the more specific name - STPs, because we consider it to be the most complex form of hybrid organization. Since the specific objectives of hybrid organizations are not related to a specific domain, given the focus of our dissertation, we did not further search for the boundaries and differences between the concepts of STP, incubator or venture capital firms. Hybrid STPs mean that they realize a variety of distinct values with the integration of the advantages of universities, the private sector, and governments. All the other organizations mentioned above (incubators, venture capital firms, spin-off firms) can also be an integrated part of STPs.

1.3.1 University science and technology parks

Intensive development of STPs was registered in the 1980s 20th century, when universities often playing an important role in their creation. For this reason, science parks are usually located at universities or operate as components of universities. Based on the success of the first STPs (Stanford Science Park, Cambridge Science Park), policy makers could see their potential in terms of fostering economic and technological wealth behind universities' efforts to generate revenue from their estates and research activities. The effects of STPs in the United States have inspired other countries to transfer this type of new hybrid institution to their specific conditions. STPs have thus gradually have become part of a few countries around the world (Link, 2003). In an ideal world, industry structure, universities

and STPs may complement each other's activities and thus not replicate them (Friel, 2018). The setting up of STPs is an example of a policy that seeks to generate complex of interactions between firms through clustering or proximity. Their aim is to provide an infrastructure of technical, logistic, and administrative assistance to start-ups, that seek to establish themselves in competitive markets (Bakouros, 2002). STPs[9] are innovation that reorganises the way of research resources are used to create and application of knowledge by combining university and industrial resources in a new way (Link and Scott, 2003). STPs represented a huge institutional innovation at the time of their creation. STPs in the USA were established thanks to policies of opening and encouraging UBC. This approach generated a few effects, such as reducing research time and costs. The effects of STPs in the United States inspired other countries to transfer this type of new hybrid institution to their own conditions, and STPs have gradually become part of several countries around the world, the EU too (Balog, 2018). The first European park was Sophia Antipolis in France, which was established at the end of 1960s. Science parks in Greece were established in the mid-1990s. Europe experienced a boom period for STPs in the 1980s and 1990s. By the mid 1990s, 310 science parks had been created in Europe in 15 countries, where 14 790 companies were in parks, employing 236 285 employees. The main drivers for the creation of STPs are reindustrialisation, regional development, and the creation of synergies (Bakouros, 2002).

There are many possibilities and views on defining STP, as explained above we will use the term "science and technology park" (STP) as a hybrid organization. According to the UNESCO (2021) definition, includes any other type: technopolis, science park, science city, cyber park, hi-tech (industrial) park, innovation centre, R&D park, university science park, research and technology park, technology park, technology incubator, technopark, technopolis and technology business incubator. It should be noted, however, there are only minimal differences between some of the terms and they may be interchangeable where justified. The common element in is the stimulation and management of the flow of knowledge and technology between universities, R&D institutions, companies and markets (Hobbs, Link and Scott, 2017; IASP, 2021). It is very important to clarify that each of the

[9]We understand STPs as an innovative tool in terms of Oslo Manual (2018) definition of innovation *„An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)."*

countries studied defines STPs differently. Different terms are used in the work - research infrastructure, innovation infrastructure or research centre. From our point of view, the process of creating innovation usually starts with research, therefore these are synonyms for us in analysis of support, as they are just different phases of this development process. As the calls for non-repayable funds in the programming period 2007-2013 were conceived and prepared with the same objective of setting up new R&D capacities, we observe slight differences in the definitions by countries, which will be discussed in the section 2.1.

There is a heterogeneity between STPs, which is also pointed out by some authors:
„*No two science parks are alike, and it would be unwise to generalise on the success or otherwise of the science park movement by considering one or two examples however famous or prestigious they may be*. " (Grayson, 1993, p. 119, cited in Westhead 1997).

Similarly, Albert Link wrote:
„*If you've seen one research park ... you've seen one research park.* " (Link, 2009)

University STPs represent a specific type of STPs with a direct affiliation to a university by proximity, ownership and / or management (Link and Scott, 2007), where universities offer space and facilities for researchers to facilitate the development processes of projects with market potential (McCarthy, 2018). One of the important objectives of STPs for tenants is some form of access to university resources (knowledge, talent, infrastructure facilities) that are expected to further regional economic development. For the university as coordinator, the added value is to facilitate the commercialisation of university research, attracting and funding excellent scientists, increasing publication activity and patent generation (Link and Scott, 2003). At the same time, they bridge the gap between the supply side of universities and the demand side of the private sector by requiring the knowledge and expertise of universities (Leyden, Link and Siegel, 2008). Universities expect STPs to enable them to commercialise their research and secure funding for more. Information flows from academia to the business sector are accelerating in geographically proximate regions and are an essential tool in the creation of innovation (Alegre, Berbegal-Mirabent and Guerrero, 2019). To be successful, university STPs should integrate into their design functions to support technology by-products, attract, and aggregate external R&D initiatives from multinational companies, but also from public and non-profit institutions (Almeida et al., 2020). STPs will mediate for established companies a higher level of interaction with

universities through formal or informal relationships (Henriques, Sobreiro and Kimura, 2018), proximity to research resources (Etzkowitz and Zhou, 2018), thus increasing interaction and fostering the transfer of scientific knowledge to the commercial environment (Hansson et al., 2005).

With the growing popularity of this tool among policy makers, there was a need to concretize their roles and functions. A STP is a place typically associated with HEIs designed for a concentration of high tech, science, research related to business and promote the economic development and competitiveness of regions and cities by creating new business, kowledge-based jobs and ading value to companies (Pramuka, 2017). Universities' collaboration with the private sector takes place at all levels, from education and research to entrepreneurship and collaboration with partners. Edquist (2005), in his research on the systematization of functions and activities to be provided by an innovation system, considers 10 functions that cover several areas in innovation system – R&D; competence formation; shaping markets for new products; identification of user needs; creation of organizations, innovation networks; creation and change of institutions; incubation activities; financial resources and advisory services. Edquist's identification of functions is also referred to Almeida et al. (2020), who consider them appropriate in terms of the range of STPs competencies (Table 1). The major source of new knowledge creation is R&D activities and competence building. In university STPs, this function relies on university and company R&D. In innovation processes, networking corresponds to the process by which knowledge is transferred through collaboration and long-term agreements (OECD, 2002). Innovation collaboration and networking (Žítek and Klímová, 2016) is a reliable means for knowledge accumulation and exchange or development of new ideas between organisations (Powell and Grodal, 2005). Activities within innovation networks involve the creation, combination, exchange, transformation, absorption, and use of resources through a wide range of formal and informal relationships (Fischer, 2001). As Edquist (2005) further points out, the innovation system must include the processes to create and change the organisations required to develop new areas of innovation that foster entrepreneurship and emergence of new organisations. The STP is an example of a complex organisation based on innovation management and stimulates the emergence of other organisations such as applied research centres and technology transfer offices (TTO). What separates STP from the university - its role in creating, attracting and clustering firms. This process necessitates the creation of new institutions and the modification of existing ones because of the required interactions

between universities, industries, and governments. As the interactions increase, each component evolves to adopt some characteristics from another institution. The functions associated with the provision of business support services within the STP promote entrepreneurial organization, especially for start-up firms. Consultants who operate within the university STPs are more aware of the technological dimensions and develop skills oriented to a specific group of firms as well as those in the early stages of development.

Table 1: Functions of STPs and their contribution to innovation systems

FUNCTIONS	CONTRIBUTION TO THE INNOVATION SYSTEMS	INDICATORS
Knowledge creation – university R&D	Creation of technological opportunities	own research (basic or applied)
Knowledge creation – business R&D	Facilitating the access to technological inputs	joint research with entreprises, contract research
Provision of consultancy services in technology transfer	Technology transfer and interactive learning, STPs can promote a market for knowledge and reduce transaction costs	transfer technology offices, patent activities, legal advice
Networking	Joint location of companies in the region	sectoral, regional
Common infrastructures	STPs generate some agglomeration economies by the existence of common infrastructures and amenities. High quality, low building construction ratio	renting facilities and laboratories to extern institutions
Competence building	occurs on universities (education) as well as in firms, and leads to the creation of human capital	provision education and training, creation of human capital, induvidual learning, skills, workshops
Business support	Provision of business support services within an STP fosters business sophistication for newly created firms. Business consultants are more aware of technological aspects	cooperation with venture capital funds, establisment of new firms
Specialization	High degree of specialization for one activity	specialized professional workplaces
Creation of new firms	Technological opportunities and its transformation into economic opportunities	incubators and projects supporting business, business consulting
Clustering	As an attractor for foreign firms that seek technological inputs for their R&D activities	collaboration with international partners
Community involment	Local or regional governments and external nonprofit agencies make the STP a node of the RIS	cooperation with local actors (government, NGO, agencies, society)

Source: own elaboration based on Edquist 2005, Almeida et al., 2020

A few authors point out that STPs are presented by governments as a panacea by which countries try to catch up and accelerate expensive processes of structural change (Guadix et al., 2016; Almeida et al., 2020) or as a solution to complex political and economic regional problems in society, for example in industry (Autio and Klofsten, 1998), in addressing the

lack of commercialization of publicly funded research (Nowotny, Scott and Gibbons, 2001) or in addressing the lack of new innovations in the market. Hobbs, Link and Scott (2017) also point to the regional aspect and the positive push towards structural change. Globally, successful examples such as Silicon Valley, Cambridge or Grenoble have led to a boom across Europe just by promoting universities or regional development agencies. They have thus become an element of the operationalisation of regional innovation policy (Vásquez-Urriago et al., 2016; Guadix et al., 2016). But in regions with limited R&D capacity, these investments have proved highly controversial. A strong focus on science in regions with weak linkages between firms and universities and a small technology market has led to inefficient outcomes (Almeida et al., 2020). STPs are widely regarded as important tools for economic and technological development (Audretsch and Link, 2012; Phan, Siegel and Wright, 2005). On the other hand, it is also necessary to look at their weaknesses, which have been pointed out by some authors in relation to not fulfilling the real purposes of STPs for which they were set up (Massey, Quintas and Wield, 2003; Miao, Benneworth and Phelps, 2015). They therefore provide several reasons for the failure: unfulfilled promises that did not consider the socio-economic context of the regions in which they operate; promoters failed to adapt the concept over time, making STPs unsuitable for changing political and economic contexts (van Winden et al., 2013). The identity of STPs create an access to qualified research and development personnel in the knowledge areas, high value market products and services, the capability to provide marketing expertise and managerial skills to firms (particulary small and medium-sized enterprises). A clearly defined identity is very important right from the start when planning the STP (STP's name, logo, or management discourse). Leadership should be made up of active people with vision, authority, decision-making powers, strong and visible profile, who are perceived by the relevant actors in society as the embodiment of the interface between academia and industry, long-term plans, and good governance. The inherent is an economic support of a strong, dynamic, and stable economic actors, such as a funding agency, a political institution, or a local university. Continued access to finance and funding sources from both private sector (such as angel funders) and governance include more benefits. From the perspective of the private sector, companies are expected to have a business plan that is consistent with the STP identity.

With sense of successful STPs, there are som attributes, which are like the functions of STPs in the innovation system but refer to key elements in the STPs themselves (Friel and

Vukotich, 2018). Within a triangular relationship between government, private industry, and support institutions must be shared resources such as education, training, and technical assistance centers. STP can be perceived as an institutional facilitator throughout university network centers, regional communities, networks brokers and continue technical assistance. Other attributes, like collective contribution from SMEs experts in terms of expertise, technology, finance, marketing, sales or whatever important for the creation new innovative society (new firms) (Figure 8). There are key elements that appear to mark each STP to one degree or another. If one park is considered more successful than another, the definition of success will rest in the region and its own goals over time (Friel and Vukotich, 2018).

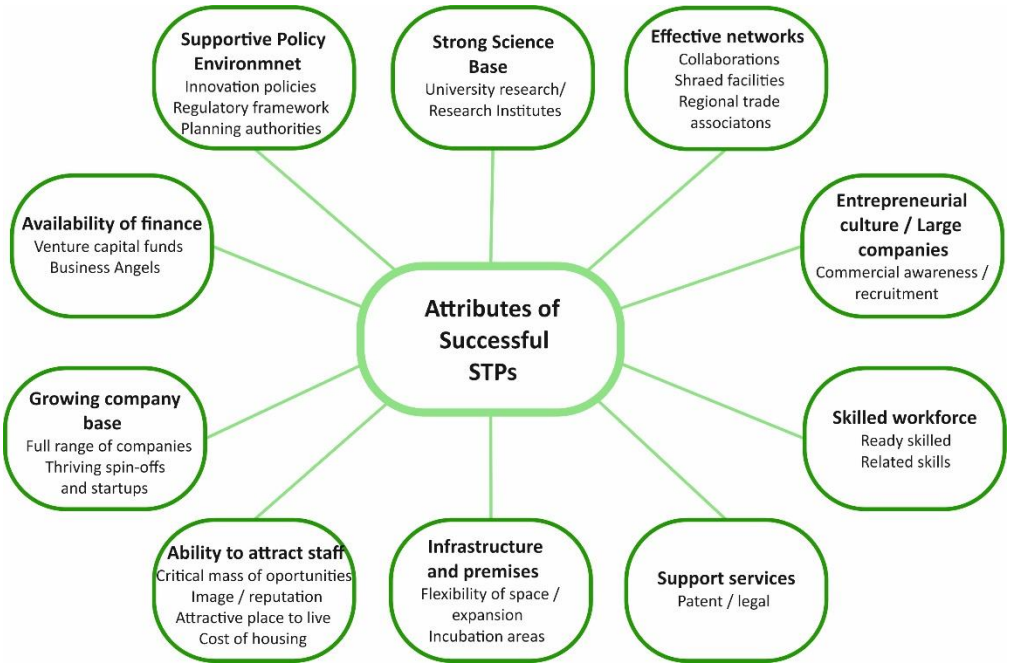


Figure 8: Attributes of successful STPs
Source: own elaboration based on Friel and Vukotich, 2018

1.4 Policy mechanisms to supporting collaboration

Despite the high innovation potential for universities to play a leading function in innovation ecosystem, there is an increasing connection of supporting UBC. HEIs received some sort of external support and extra funding for the application their development and implementation for successful selection at European level. Institution received some variety of external support and extra funding for the application their development and

implementation for successful selection at European level in the context of UBC (Glittová, 2021[10]).

Policy mix is based on early examples in the United States (including Stanford Research Park as an element of Silicon Valley development). As Massey, Quintas and Wield (2003) have shown, interaction does not necessarily take place despite geographic proximity - "something else“ is needed. This phrase "something else" is often described simply as "synergy" (Stöhr, 1986; Castells and Hall, 1994), but probably requires the existence of social structures of sociability, trust and industrial structure that requires interaction between firms (Amin, 1994). Each hybrid organisation at the interface between universities and the private sector is not an end, but a tool for development. Given that the nature of the activities and the facilities to be coordinated and financed, the infrastructural projects must have adequate support from a wide range of partners in the early stages (European Investment Bank, 2010). Studies indicate that policy makers have often supported STPs given their role in facilitating technology transfer and hosting R&D active firms (Ferguson and Olofsson, 2004). Further, hybrid organisations are important players – as one of the bridging organisations in the innovation system.

The literature shows that support mechanisms are used in number of key areas of UBC. Supporting mechanisms need to be aligned with the culture and mission that facilitating UBC through the fast development of dedicated strategies (Siegel and Phan, 2005). The absence of supporting mechanisms causes that UBC remains isolated and a rare activity only reliant on the whims of those individuals willing to engage in collaboration. Governments or HEIs put in place support mechanisms in the form of measures for the development of UBC to create favourable conditions and make UBC beneficial to the wider society (Galan-Muros et al., 2017), because without these mechanisms, UBC would remain isolated and dependent on individuals (Galan-Muros and Davey, 2019). Furthermore, they are expected to link and connect all levels of the institutions. Taking on the additional task of developing support mechanisms and implementing processes, it requires the university to transform into an institution in which UBC linkages are encouraged, supported and fostered for all relevant stakeholders (Ambos et al., 2008). Triple helix interactions require necessary policy

[10] These findings were partially published at a scientific conference:
Glittová, K. (2021). Supporting Mechanisms in European University-Business Collaboration. *EDAMBA 2021: The Need for Speed*. International Scientific Conference for Doctoral Students and Post-Doctoral Scholars. Bratislava: Vydavateľstvo EKONÓM.

interventions. The rationale for policy interventions in promoting UBC leads to knowledge transfer and is based on several assumptions (Spinoglio, 2015). The role assigned to the government in any area depends on the principles adopted for the organization of society in general. The government has various tools at its disposal; it is not only a provider of funds, but also a facilitator, moderator and trainer. Governments create a system by which they define and regulate innovation processes in society. Location of the HEIs might also relate with the development of UBC. Several international studies point to a difference between countries (Klofsten and Jones-Evans, 2000; Kaufmann and Tödtling, 2001; Davey et al., 2011), with a great diversity environment that can support and / or inhibit UBC (Geuna and Nesta, 2006). Authors in their articles present many instruments and activities for technology transfer provide by HEIs, business sector and government. In the system of cooperation between the academic and private sectors, their organisational level is often unclear, nor are the situations carried out at the joint or individual level as complementary. Therefore, to successfully deal with these obstacles, it is necessary to develop a framework for higher education and policy mechanisms (Fini et al., 2011). Their efficiency is universally positive and recognized (Tornatzky et al., 2002; Herrmann, 2008; Fini et al., 2011) for removing and mitigating obstacles to the possibility of adapting to a particular fellow partner (Henrekson and Rosenberg, 2001).

Policy mechanisms as part of supporting mechanisms can be classified as: economic and financial mechanisms, regulation mechanisms and other policy mechanisms that do not belong to either of the first two categories (Borrás and Edquist, 2013). They are known as regional, national and international conditions applied by governments to maximize the long-term socioeconomic performance. Governments provide various conditions, such as – giving a space for UBC strategic mechanisms to creating and involving the establishment of structural mechanisms (e.g., creation of a knowledge transfer center) that can initiate the development of operational mechanisms (e.g., UBC workshops for academics) (European Commission, 2018). Public policy can influence the intensity of UBC and the scope of its specialization in various forms - for example, through a direct role in the provision of university funding and R&D projects or regulatory policies that govern the rules of public universities and shape the intellectual property rights regime. In addition, through soft measures, governments can stimulate cooperation, such as providing specific support services to firms/universities in finding partners and carrying out outreach activities to promote networking and raise awareness of the importance of cooperation. Given these challenges and the financial limitations of budget allocations, competing priorities and other

issues, governments should concentrate their efforts on the most appropriate policy instruments.

Economic and financial mechanisms are created to provide specific incentives and support specific social and economic activities to stimulating UBC, including funding, research and matching grants and subsidies, infrastructure, stimulus package, public seed capital, taxation concessions (Harman, 2011; Polt et al., 2001; OECD, 2002). Another possible instrument to promote collaboration are innovation vouchers, which are among the most popular type of state aid in the form of subsidies (the de Minimis aid). This support rule represents an instrument that supports the cooperation of enterprises (especially SMEs) with the research sector - external knowledge institutions (universities, research centers or other institutions of this type) (Sala, Landoni and Verganti, 2016; Coletti and Landoni, 2018; Caloffi et al., 2022). The limitation and containment of UBCs solve a series of *regulatory mechanisms*. These mechanisms include laws and regulations on UBC and establish frameworks that permit or prohibit something (Tartari and Breschi, 2011). They represent fields at different levels, from organizational policies to international regulations.

Role in funding public universities governments can seek though performance measures (numbers of students, PhD graduates, patents, publications and citations). To stimulate UBC, there are other criteria such as the number of consulting or R&D contracts with business, income from licensing, number of startups of spin-offs etc. Another role of public policy is to provide the necessary R&D infrastructure and intermediary organizations such as technology transfer offices (TTO), science and technology parks and business incubators or accelerators. TTO (transfer technology office) has become a widespread institutional mechanism to support and assist researchers in patenting their science results (such as TTO provide help with patent application process, funding sources, searching partners, licensing agreements (Correa and Zuñiga, 2013). Commercialization efforts and IP reform cannot compensate a country's weak national innovation systems, thus (mainly in developing countries) may be the results of IP reform tend to be disappointing (Brundenius, Lundvall and Sutz, 2009; Zuñiga, 2011) because of the limited understanding of the benefits of IP among researchers and companies, low technological capacity of universities (infrastructure and human capital), lack of interest of firms in technological development and institutional deficiencies. Support mechanisms is typically in the middle of the mechanisms supporting the transfer of technologies, such as technology transfer offices and university incubators (Plewa, Quester and Baaken, 2006). Further, government

role is very important, because they can shape university-business linkages by developing and setting up STPs in the university vicinity. Through grants for entrepreneurs and public venture capital can spur university research spin-off and startup companies. Key roles of universities – education and training is the most important link to preparing skilled graduates. In this stage, governments may seek to improve university graduate's quality by stronger cooperation with private sector, especially SMEs (can support or establish student internship programs, participation of firms in graduate programs, joint supervision of PhD students). In global innovation network systems collaboration can play a critical role in the adaptation and absorption of knowledge developed abroad. In the following Table 2, we present detailed options for government support through various forms of cooperation support.

Table 2: Forms of policy support UBC

FORMS OF POLICY SUPPORT	MAIN OBJECTIVE AND FOCUS
R&D incentives and grants	• design R&D incentives and grants (financed by state aid, national agencies, EU Funds, the World Bank) • innovation vouchers (state aid)
Performance-based funding of universities and reward systems for researchers	• performance measures, reward system for university researchers depend on high education laws
Intellectual property rights regime and technology transfer offices	• commercialization of research products • creation of university TTO, IP reforms
Science parks, spin-offs, and business incubators	• setting up university science and technology parks • university research spin-offs and start-ups with university connections, for example through public venture capital and grants to entrepreneurs
Education and training	• skilled graduates are very important for the majority of firms • establish and support student internship programs for undergraduates, joint supervision of PhD students, lifelong learning
Globalization and university-industry collaboration	• integration with global innovation networks (internalization, technology transfer and diffusion) • collaboration with foreign universities and companies

Source: own elaboration based on Guimón, 2013

The using of governance mechanisms aims at mitigating risks of opportunistic behavior and coordinating resources (Bosch-Sijtsema and Postma, 2009; Hoetker and Mellewigt, 2009), because of governments serve to avoid dysfunctionalities, predominantly

in the context of collaboration and integration complementary to the competencies of the cooperating partners (Yeung et al., 2009). Therefore, heterogeneous regional and national research programs have been initiated by governments (e.g., Vinnova – Swedish government agency for innovation policy which promotes sustainable growth by funding research). Governments have been compelled by the global changes in the competitive and technological challenges to take actions to support research interactions between the two actors. Governments believe that universities could aid in long-term economic regeneration (Mora Valentin, 2004; Perkmann et al., 2013).

In the context of hybrid organizations, governance relates to the structures setting up for operational and strategic decision-making and the reporting arrangements within them. Government R&D expenditures are widely recognized as a policy instrument capable of stimulating regional innovation policy (Zhao et al., 2019). This policy instrument can also incentivize companies to invest in R&D, which in turn will positively affect regional innovation inputs (Guellec and Potterie, 2003; Lopes João et al., 2021). Governance sets out answers to a few questions about legal status of hybrid organizations, owning of parcels, funding the development of the sites and building, making stratetgic and operational decisions, and reporting arrangements. These different dimensions of governance issues are interrelated, because for example, strategic decision-making is linking with ownership and funding, and the legal status of a STP will reflect ownership and funding (European Commission, 2013). Policymakers are therefore advised to adopt operating models that combine local regional and industry characteristics to stimulate the regional economy and act as an innovation driver (Dorocki et al., 2017). As complexity of innovation geography, innovation models should be followed for each region (Camagni and Capello, 2015). Policy makers can also use the insights gained from this R&D the necessary tools to strengthen collaboration with the most relevant actors, including strengthening university collaboration (Chen and Liu, 2021). This can help overcome the complexity of geographically related incentives, as STPs are sometimes compared to impulsive agglomerations (Huang et al., 2012).

We should be cautious in these statements around support, because one model fits all regions is not true (Gomes et al., 2022). Any support for local innovation activities should be accompanied by a strengthening of local funding in terms of knowledge, education and skills to ensure the best results in terms of innovation policies (Rodríguez-Pose and Crescenzi, 2008), as the performance of RIS depends on the interactions of knowledge actors, whether outside or inside the region (Lopes and Franco, 2019).

2 INNOVATION PERFORMANCE IN V4 COUNTRIES

As we have shown in the theoretical background, UBC is key to innovation processes. In recent years, we can observe in the Visegrad countries (V4) an increased emphasis on improving cooperation between academic and private sector through various initiatives, either directly from the university environment or through government agencies. In this chapter, we look at UBC based on international statistics. In the second part, we will present the processes involved in directly supporting the setting up of university STPs in the V4 countries.

In the past, due to the lack of market opportunities, universities in the V4 countries were used to cooperate on their own initiative in case of the need for co-funding or with the help of launching a major product on the market (they mainly implemented bottom-up activities). V4 countries are members of the Visegrad Group with similar post-communist history, political systems, administrative cultures, accessing to the EU and level of development. On the other hand, they have heterogeneous university systems, innovation level, functionalities and other specific research features. V4 countries have been transformed in the 1990s and joined to the EU in 2004. Today, together share some similar views, for example, on some political and economic challenges. Because of their common history, they founded the Visegrad Group in 1991 and were working together even before joining the EU. After joining the EU, they are still cooperating to a larger or lesser extent, not only in general terms, but also in the EU area (Kowalska et al., 2018). The acknowledgement of the importance of innovation has contributed at the level of different types of organisations to the development of measures by which we can evaluate innovation efficiency. The widest range of measures is focused on the economic dimension of innovation. These measurement tools may differ slightly in terms of the definition of innovation or the subject and method of its assessment (national level, regional level, sectoral level, firm level), the data on which they are based (qualitative and quantitative), or the methodology used to collect data and measure innovativeness. The V4 countries are usually on last stages in R&D and innovation international rankings and statistics.

For brief comparison we have selected three international rankings related to innovation performance and the position of the surveyed countries in the international innovation space (Graph 1). Several international indicators of innovation performance show that Slovakia is not only behind the EU27 average, but also behind neighbouring countries.

According to the analysis of the EIS (European Innovation Scoreboard[11]), an international integrated innovation performance benchmarking tool, Slovakia, Poland and Hungary are long-term emerging innovators in terms of comparative research and innovation rankings. Only Czech Republic are moderate innovator among them. There is heterogeneity in the evolution of innovation performance across European countries. According to the EIS 2022, innovation performance of EU has grown about 10% since 2015. Sweden continues to be the best performer in the EU area; Belgium, Denmark, the Netherlands and Finland are innovation leaders (Eurostat, 2022 – EIS[12]).

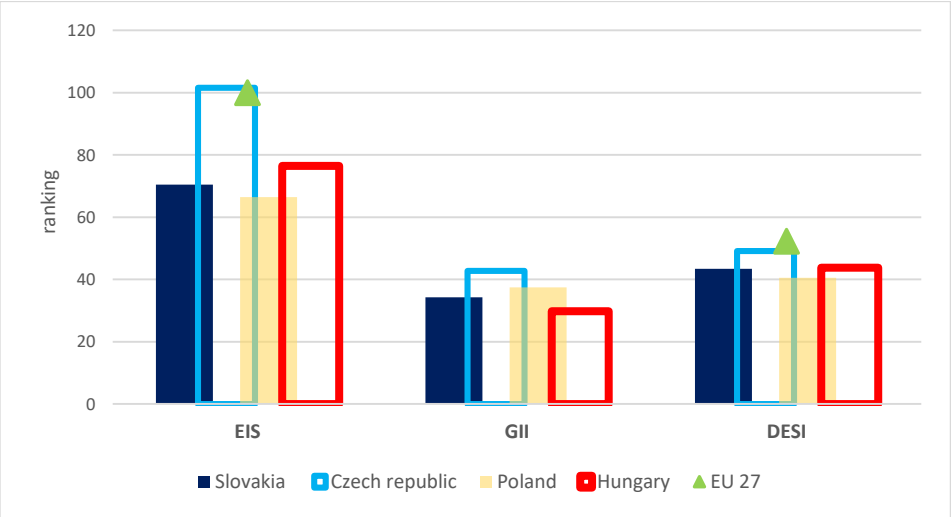
The most recent global innovation trends within science and innovation investments, technological progress, socioeconomic impact of innovation and technology adoption are the focus of Global Innovation Index[13] (GII). Each country represents its own development potential. Looking at the latest Global Innovation index 2022 results, Slovakia belonged to 41 economies performed below expectation on innovation (46^{th}). Overall global R&D increase in government budget allocations showed Hungary with strongest growth (+100 %). Only a small number of economies have consistently delivered as innovation leaders with peak innovation performance, but Poland is among 25 economies with notable progress this year.

Nevertheless, there is a rapidly developing digital wave. Digital technologies are becoming innovation drivers with increasing impact and dynamic development of innovation. The level of the countries studied in DESI indexess is approximately the same as the EU average. Slovakia and Hungary have the main problems with open data. Poland and Czech Republic made significant progress. Poland increased itc unicorn count from 2 to 11 and Czech Republic has now 4 unicorns started from zero in 2021. Digital skills in the Recovery and Resilience Plans include new digital reforms in Slovakia (include such as digital skills and teaching computation thinking).

[11] Since 2001, EU demonstrate the commitment to innovation, as well as to competitive research based on excellence, open and driven by talents. The EIS provides a comparative analysis of innovation performance in EU countries and other European countries and regional neighbours. It looks for relative strengths and weaknesses of national innovation performance and support all countries to identify problem areas they need to address.

[12] Website available <https://ec.europa.eu/commission/presscorner/detail/en/IP_22_5682>

[13] Website available <https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2022-section1-en-gii-2022-at-a-glance-global-innovation-index-2022-15th-edition.pdf>



Graph 1: Comparison of V4 countries in selected international rankings in 2022
Source: own elaboration based on data from EIS, GII and DESI

Investment in R&D is important because it can identify process improvements and efficiencies as well as potential cost savings. When comparing the share of R&D expenditure as a percentage of GDP (%) in 2021, the Czech Republic reached 2,0 % in 2021, thus being significantly closer to the EU27 average (2,26 %) and ranking 10th. Hungary 1,65 %, Poland 1,44 %, Slovakia ranked 24th with 0,93 % (compared to 2007 – Slovakia 0,45 %, Czech Republic 1,3 %, Poland 0,56 % and Hungary 0,95 %). In all of the monitored countries we see positive development in this area, but still below the EU average. It can be stated that Hungary is growing in terms of R&D expenditure, despite the fact that STP parks were not developed in the programme period. R&D is central to many European and national policies, so the significantly lower share of spending below the EU average also points to ineffective implementation of innovation policies.

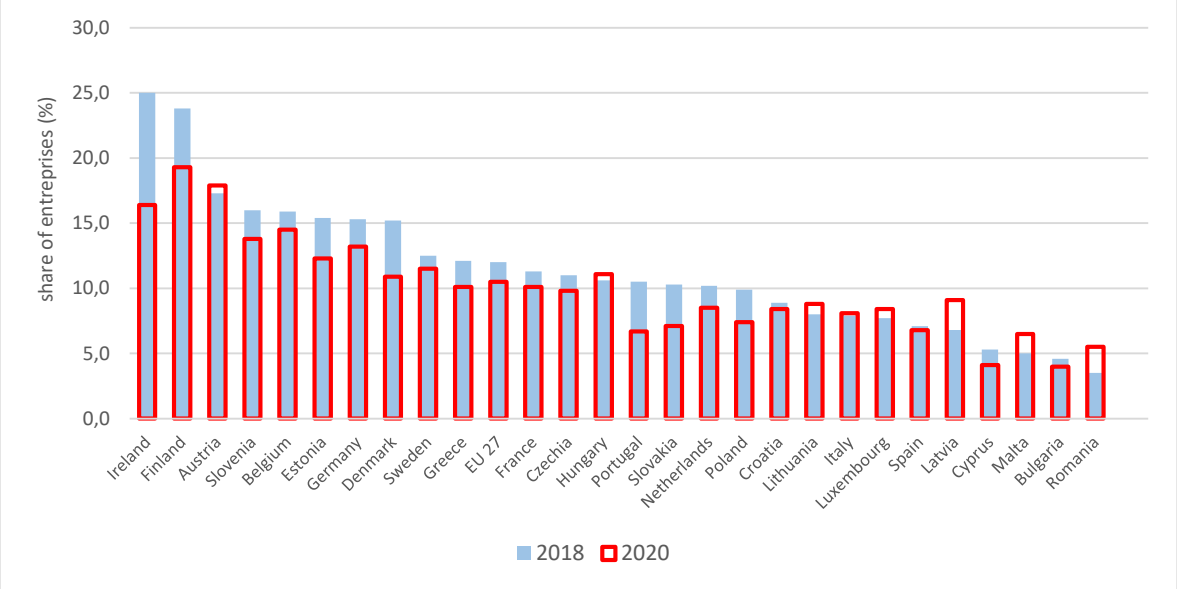
2.1 University-business collaboration

More comprehensive assessment of innovation cooperation at country level is provided by the European statistical tool named *Community Innovation Survey (CIS)*[14], which is part of the European statistics of science and research by Eurostat. It makes it possible to monitor Europe's progress in innovation and to better understand the innovation process by analysing the objectives and effects of innovation. Using data from the CIS 2018

[14] The Harmonised Survey of Innovative Activity in enterprises provides statistics by country, type of innovator, economic activity and size class. The survey is designed to provide information on the innovativeness of sectors by type of enterprises, types and aspects of innovation development, objectives, sources of information, public funding, innovation expenditure, etc. The statistics are a direct part of the EU statistics on science and technology maintained by the EU statistical office Eurostat database (Eurostat, 2021a).

and CIS 2020[15] at EU27 country level, we have further explored the evolution of collaboration over the time horizon of statistical measurements. Given the focus of our thesis, we have concentrated on only one indicator from the CIS - *Innovative enterprises that cooperated on R&D and other innovation activities with universities or other HEIs.* Our aim was to conduct a detailed review of the available CIS data and a subsequent assessment of business-university collaborations in R&D and other innovation activities.

Graph 2 shows a comparison of innovative companies' collaborations with universities or other HEIs in 2018 and 2020. Most countries record a declining share of enterprises cooperating with universities or other HEIs, despite the joint entrepreneurial activities of universities, which are steadily strengthening their third role. However, if we look at the second half of the Graph 2, the trend is the opposite - the share of enterprises cooperating with universities is increasing (Hungary, Latvia, Lithuania, Malta and Romania). In the case of Poland, Slovakia and the Czech Republic, the share of cooperating enterprises has even decreased significantly.



Graph 2: Innovative enterprises that co-operated on R&D and other innovation activities with universities or other HEIs

Source: own elaboration based on data from Eurostat, 2021b [INN_CIS12_COOP]

Clearly, the V4 countries have struggled with other important elements that limit innovation progress (we do not include among the main international indicators, but we want to mention

[15] Data of 2014 and 2016 surveys could not be compared together because the questions were designed differently in 2014 and 2016 than in the following years, so we have not included them.

them because of the synergies of the research theme) – availability of research funding and supply of highly skilled researchers, the creation of a functional national research and innovation systems and high shares of innovative enterprises (Baláž a kol., 2016). Other problems identified by the European Commission in 2015 consists of weak national funding and underdeveloped public–private collaboration, as well as the low embeddedness of international companies in the national economy, and low cooperation between MNCs and national universities and research centres. This is compounded by underdeveloped and / or unstable systems of research and innovation governance system. Other weaknesses include low levels of innovativeness amongst domestic small and medium-sized companies (SMEs), lack of a clear thematic focus in publicly funded research, and hesitant integration of national R&D systems into the European Research Area – for example, low participation in the framework programmes, and in European joint technology initiatives and partnerships.

2.2 Influence of EU Funds

Given the limited funding of HEIs and financial challenges, they need help of goverment and other funds to influence innovation through demand to meet their specific needs. Many HEIs are facing national funding and a directing of research priorities towards research areas of direct industrial, political and social importance (such as issues of EU relevance through Operational Programmes) and demands of higher public accountability and user involvement (Shove and Rip, 2000; Klenk and Hickey, 2013). In European countries, a key factor in changes in support orientation has been European policy level with funding programmes (Structural Funds) animating HEIs to strengthen focus on regional economic development within initiatives and goals of national and regional smart specialisation strategies (Kempton et al., 2013). The Structural EU Funds are one of key policy instruments to support regional R&D level and collaboration between university and private sector (nore than 80 % of public investment in these countries flows through EU Funds, so we address them as policy support). Since the 1990s, dominance of knowledge economy concept in EU policies and an emphasis on supporting economic competitiveness though innovation and knowledge has led to a general shift in EU programmes towards multisectoral approach and multidisciplinary collaboration to address grand societal challenges (Benneworth and Cunha, 2015). It is funding earmarked for specific activities and institutional units, in most cases it is also limited in time (Lepori at el., 2007). The EU Structural policy offers various operational programmes, schemes, projects, grants, financial instruments that can be used to foster innovation. These include sectoral Operational

Programmes (OPs), which give priority to research or economically oriented research projects and research-business joint partnerships. One of the most important and useful priorities of the mentioned OP in the last years from financial perspectives of supporting is innovation, treated as a necessary factor of university research and entrepreneurial development. There is currently no area of greater interest in terms of regional policy than innovation because there is currently a predominance of development paradigm attributes innovation as a factor of development (Farole, Rodríguez-Pose and Storper, 2011). In a few countries, regional programmes include a focus on themes in addition to other priorities. There are also transnational, national or cross-border programmes that may cover these areas. Within the programmes, policy instruments have so far been mainly based on non-repayable grants, although financial instruments are increasingly being used (Weresa, 2015).

The 2007-2013 programming period of EU Funds has created unique conditions for the development of research and development (R&D) infrastructure. The common objective was modernisation and improvement the support system for research and development, improvement of the infrastructure of universities so, to contribute to increasing the competitiveness of economy, reducing regional disparities, the creation of new innovative (high-tech) small and medium-sized enterprises, the creation of new jobs and the improvement of the conditions of the educational process at universities. Until the programming period of EU Funds 2007-2013, infrastructural capacities of public R&D organisations were not systematically supported.

In the case of Slovakia, disregard for the development of universities and the Slovak Academy of Sciences led to the emergence of a significant technological debt, which created a few systematic problems around implementation of quality projects in both basic and applied research. The technological backwardness of public R&D organisations was visible especially in comparison with partner institutions from developed countries. The technological handicap caused several negative effects, including outflow of skilled personnel abroad or outside the R&D sector. The deepening of infrastructure debt was linked to the disengagement of public R&D organisations from cooperation with industry, which took place in the framework of the economic transformation in the 1990s, when domestic industry reduced innovation efforts and lost interest in carrying out joint projects with public R&D organisations. This situation was also reflected in the setting up of support for the financing of scientific research activities of public R&D organisations. Support from public sources with a limited amount was mainly oriented to the implementation of basic research without any link to the economic performance of the country (Šofranková, 2017; Balog,

2019). Projects were implemented via OP Research and Development – priority axis 2 and 4 Support for research and development (Investment priorities „Transfer of knowledge and technologies obtained through research and development into practice“). *"The main objective of the call was to support the set up of university science parks and research centres, focused in particular on cooperation within the state and university sector of research and development or cooperation of enterprises with the state and university sector of research and development. The applicant could be a research organisation from the academic sphere (HEIs, the Slovak Academy of Sciences or a specific research institute of the Slovak Academy of Sciences). The intention of this call was to create university science parks or research centres, composed of academic institutions, which will be equipped with modern, high-tech research infrastructure, and whose research and/or development results will be: qualitatively at an international level, applicable in practice, linked to the needs of key industries of the Slovak Republic.“*[16]

Slovakia had the least number of supported projects of the countries studied, but with the specific challenge of building university science parks and research centres. A total was supported 14 projects (including 7 university science parks and 7 research centres[17]).

In case of Czech Republic, research and innovation infrastructure was supported by two different programmes - OP Enterprise and Innovation[18] and OP Research and Development[19] for Innovations. By OP Enterprise and Innovation were supported setting up innovation infrastructure viac support programme Prosperity (Priority Axis 5) in which part I. was aimed at supporting universities (this programme implements Priority Axis 5 "Environment for entrepreneurship and innovation"). This support scheme is therefore aimed at projects for the setting up and further development of science and technology parks, business incubators and technology transfer centres, which are implemented by public bodies (universities, public research organisation, autonomous territorial administrative unit) or legal entities entities owned by these public entities. The second programme OP Research and Development for Innovations in Priority Axis 4 research-related infrastructure for teaching on HEIs supported development of quality infrastructure universities with the aim of improving and increasing the capacity of tertiary education and creating conditions for improving the quality of education with links to research and development and innovation

[16] Ministry of Education, Science, Research and Sport of Slovak Republic, 2012
[17] We did not include research centres because the Slovak Academy of Science was the beneficiary of the support, and the university was in the consortium of cooperating partners according to the individual projects.
[18] Ministry of Industry and Trade of the Czech Republic, 2009
[19] Ministry of Education, Youth and Sports of Czech Republic, 2009

activities, to create conditions for accelerating the transfer of new knowledge from the application sphere into the teaching process and educational activities, for the emergence and dissemination of innovations and for increasing the practical relevance of study programmes.

In Poland, research infrastructure was supported by one operational programme - OP Innovative Economy, Priority 2 - R&D infrastructure. The objective of Priority Axis 2 was to increase the competitiveness of Polish science by consolidating and modernizing the research and IT infrastructure of the best scientific units operating in Poland. Development of centers with high research potential, including those operating based on scientific-industrial consortia and regional scientific-industrial consortia, by co-financing the development of their research infrastructure. Projects involving the maintenance and development of modern IT infrastructure of science by co-financing network and equipment investments of national importance, considering their key importance for the environment. Projects in the field of development of scientific information resources in digital form regarding the creation and maintenance of databases containing information on the results and conditions of access to the results of research projects and the creation and sharing of databases of scientific publications (Table 3).

Table 3: Setting up STPs by HEIs in V4 countries

	SLOVAKIA	**CZECH REPUBLIC**	**POLAND**
Programming period	2007-2013	2007-2013	2007-2013
Operational Programme	**OP Research and Development**	**OP Enterprise and Innovation** (Innovation infrastructure) **OP Research and Development for Innovations** (Research Infrastructure)	**OP Innovative Economy**
Responsible authority	Ministry of Education, Science, Research and Sport of the Slovak Republic	Ministry of Education, Youth and Sports of Czech Republic Ministry of Industry and Trade of the Czech Republic	National Center for Research and Development

Source: own elaboration

In our comparison missing Hungary, we were unable to find the available database of supported projects. In The New Hungary Development Plan for PP 2007-2013, Priority 1 Economic development confirm that will be supported: establishment and strengthening of research and innovation institutes, integrated bridge forming, competence, knowledge,

incubation, innovation and technological research centres, the establishment and effective operation of international level research infrastructures, innovation services, especially offering technological breakthrough solutions for the Hungarian economy in areas expected to have a high growth potential. Calls for STPs in HEis have not been opened. But in 2019, the Hungarian Minister for Innovation and Technology said that the government had set a target of building 8 university science parks for the next period[20].Institutional instability in the Hungary in the innovation and public administration systems was impaired following the parliamentary elections in 2010. After the elections, key national and regional organizations involved in managing and implementing innovation support lost status and autonomy. The implementation of innovation-related programs was frozen and the high level of institutional instability[21] disrupted previously established linkages and reduced both innovation policy effectiveness and social capital (Szalavetz, 2015).

[20] Website available <https://abouthungary.hu/news-in-brief/eight-university-science-parks-to-launch-across-hungary>

[21] The Hungarians have long-term been the subject of criticism in Brussels for concealing the use of EU funds, which was not sufficiently secured against corruption and clientelism.

3 AIMS AND OBJECTIVES

Collaboration between universities and business is an important part of innovation processes. As we have pointed out in theoretical basis - in addition to the many strengths, advantages and opportunities of cooperation, there are also many barriers that inhibit these activities. Hybrid organizations are contributing to overcoming the barriers between the academic and private sectors, bringing a new field where collaboration can take place. In our research, we chose STPs as a hybrid organization for the intersection of Triple helix actors. W are looking at the role of STPs in the university ecosystem, which should take a more proactive approach to removing barriers and initiating collaboration on various projects. Investments in setting up STPs have been significant for projects in the EU funds programming period 2007-2013, so we chose these projects that have been in operation for several years. This topic is very important for us from several levels. From the point of view of the academic sector, it is about supporting and improving the quality of scientific, research and innovation activities beyond the framework of the universities' core activities. For the private sector, it is a significant link to the knowledge potential of universities and networking. In terms of national and economic impact, it is also important for the interests of the government, as the impacts are visible on a society-wide basis. Not all countries perceive STPs tool positively and therefore we would like to use our research to point out problem areas and recommend actions for better policy settings in future policy strategies.

The main aim of the dissertation is to *analyse the role of university STPs as an innovative tool for improving university-business collaboration by realization of activities and services, and role of government support in the setting up and the operation of this tool.*

To fulfil the main research objective, we have set sub-objectives with research questions:

1. Examine the theoretical knowledge of the addressed problem in the field of Triple helix model actor's interconnection. In the framework of the space of overlapping actors and strengthening their cooperation, define the role of STPs and activities and services that they implement.

2. Identify support tools for universities and specially for R&D and innovation projects by HEIs in programming period 2007-2013 in V4 countries with a focus on STPs.

3. Based on qualitative research - questionnaire survey and semi-structured interviews analyse the position of STPs in university ecosystem, analyse activities and services that contribute to the development of cooperation and innovation creation between universities and enterprises and to identify key barriers that limit them.

   Q1: Which of the theoretically defined activities and services are fulfilled by STPs in the V4 countries?

   Q2: What are the biggest barriers that limit UBC and sustainable development of university STPs ?

4. Describe the support mechanisms of the government in relation to the additional systematic support of STPs and the view of individual parks on this support.

   Q3: How government suppport has influenced the setting up and operating of STPs in V4 countries?

5. Suggest recommendations to universities and governments towards better implementation of this type of projects regarding monitoring conditions.

4 METHODOLOGY AND DATA COLLECTION

This section describes the methodology used for the preparation and realization research of dissertation thesis. In first part, we describe the methods that have been applied to research in similar research areas, and in the second part we describe the procedures and implementation of our questionnaire survey and semi-structured interviews.

4.1 Research methods

The literature review points to the heterogeneity of methodological approaches to conducting of university STPs. First, it is not possible to generalize them due to heterogeneity, mission and internal structure. In most cases, the authors apply qualitative research methods, as we can say that each single STPs is a unique entity. They adopt the methods of case studies, semi-structured interviews, or questionnaire surveys. However, the disadvantage of case studies (Park, 2002; Albahari et al., 2013; Etzkowitz and Zhou, 2018; Albahari et al., 2019; Cadorin et al., 2019) is that they cannot be generalized because each presents a unique specific example from practice. Usually, the number of entities compared is low (e.g., Cadorin et al., 2019 compared three STPs). However, the advantage is the large number of qualitative examples for deductively understanding the processes behind the activities taking place (Eisenhardt and Graebner, 2007).

In other cases, authors use the method of questionnaire survey and interviews (often in combination) (European Commission, 2014; Lis and Romanowska, 2018; Balog, 2019; Olvera et al., 2020), as they not only bring quantitative and qualitative data collections, but especially help to better understand the results obtained and the specificities of the infrastructures under study (Balog, 2019). Some authors approach a combination of qualitative and quantitative methods (European Commission, 2014; Almeida et al., 2019; Olvera et al., 2020) - particularly in cases when the sample of hybrid organisations or established firms studied were much larger (e.g., Almeida et al., 2020 used cluster analysis to study 55 STPs). In terms of the application of quantitative methods, we did not find a uniform quantitative method (Table 4), as each author used a different research method. For example, Guadix et al. (2016) investigated the impact of the degree of university involvement in the innovation processes of STPs using linear regression; Almeida et al. (2020) empirically used cluster analysis to investigate the typology and distance of STPs from universities. A common feature of these quantitatively based studies is to find

homogeneous elements to explain the observed phenomena. However, this requires a large amount of data and variables.

Foreign studies have examined hybrid organizations in terms of geographic localization mainly in Spain (Albahari et al., 2013; Guadix et al., 2016; Alegre, Berbegal-Mirabent and Guerrero, 2019; Almeida et al., 2020; Olvera et al., 2020), the Netherlands (Ng et al, 2019), Sweden (Park 2002, Albahari et al., 2017; Albahari et al., 2019; Cadorin et al., 2019), Portugal (Almeida et al., 2020), Italy (Albahari et al., 2013), Poland (Lis and Romanowska, 2018) and the Czech Republic (Klímová and Žítek, 2016). Of those studies, only one has been conducted in Slovakia (Balog, 2019). In addition, we have studied many best practises such as Utrecht Science Park[22] and Kennispark Twente in the Netherlands[23], Turku Science Park Ltd in Finland[24], Johanneberg Science Park in Sweden[25], Technology Park Brno in Czech Republic[26], Lakeside Science & Technology Park in Austria[27], Gdańsk Science and Technology Park in Poland[28], Tartu Science Park in Estonia[29], University of Nottingham Innovation Park in the United Kingdom[30], Carasso Science Park in Israel[31], Tech Parks Arizona in the United States[32]. Further, there are lot of country's science parks associations such as The United Kingdom Science Park Association[33], Association of Science and Technology Parks of Spain[34] or Portuguese Association of Science and Technology Parks[35].

Authors evaluate the contribution of the STPs inconsistently, as it is not specified exactly which indicator should be used or which is the most appropriate to evaluate the implemented activities. There is also no consensus on what makes a successful STP and what does not anymore (Dabrowska and Ferreira de Faria, 2020) and whether it must fulfil all the functions mentioned in the theory. The problem of little theoretical knowledge

[22] Website available <https://www.utrechtsciencepark.nl/nl>
[23] Website available <https://kennispark.nl/en/>
[24] Website available <https://turkubusinessregion.com/en/>
[25] Website available <https://www.johannebergsciencepark.com/>
[26] Website available <https://www.technologypark.cz/>
[27] Website available <https://www.lakeside-scitec.com/en/>
[28] Website available <https://gpnt.pl/>
[29] Website available <https://teaduspark.ee/>
[30] Website available <https://www.nottingham.ac.uk/workingwithbusiness/services/university-of-nottingham innovation-park.aspx>
[31] Website available <https://www.sci-park.co.il/?lang=en>
[32] Website available <https://techparks.arizona.edu/>
[33] Website available <https://www.ukspa.org.uk/>
[34] Website available <https://www.apte.org/>
[35] Website available <https://web.tecparques.pt/>

on STPs points to different strategies for conceptual solutions (McCarthy et al., 2018), as actors may differ in the types of activities, research methods or roles in the region.

Table 4: Comparison of research methods in studies

AUTHORS	METHODOLOGICAL APPROACH	RESEARCH METHODS
Park (2002)	qualitative	case study
Squicciarini (2008)	quantitative	PWP model
Albahari et al. (2013)	qualitative	literature review, semi-structured interviews, case study
European Commission (2014)	qualitative	questionnare survey, interviews
	quantitative	counterfactual analysis
Guadix et al. (2016)	qualitative	comparative analysis
Klímová and Žítek (2016)	quantitative	Pearson correlation
Albahari et al. (2017)	quantitative	linear regression
Etzkowitz and Zhou (2018)	qualitative	case study
Lis and Romanowska (2018)	qualitative	interviews
Mccarthy et al. (2018)	qualitative	literature review
Albahari et al. (2019)	qualitative	case study
Alegre, Berbegal-Mirabent and Guerrero (2019)	qualitative	document analysis
Cadorin et al. (2019)	qualitative	case study
Balog (2019)	qualitative	questionnare survey, interviews
Almeida et al. (2020)	qualitative	document analysis
	quantitative	cluster analysis
Dabrowska and Ferreira de Faria (2020)	qualitative	action research, questionnare survey
Díez-Vial and Montoro-Sánchez (2015)	qualitative	questionnare survey
Olvera et al. (2020)	qualitative	semi-strucutred interviews
	quantitative	principal component analysis (PCA)

Source: own elaboration

After reviewing the above studies, we decided that our research would be based on mainly qualitative methods with combination of brief quantitative analysis. There were several reasons for our decision. As each STP is a unique entity, each case study, questionnaire survey or interview was unique, so there was no possibility of generalisation. We followed the initial development of the STPs, it was the qualitative research that allowed us to deal with their functions. Quantitative results for individual STPs would not yet be available in the necessary quantity of STPs. Potential of the qualitative studies gather a broader array of information relating to STP context, processes, inputs and outcomes. To theory, qualitative studies can gather information from a single STP, or a limited number of tenants in the STP (conceptualized different types of STP tenants, extreme cases, etc.). Qualitative studies focusing upon process issues relating to Why? How? Where? So what? The qualitative interviews relating to a sample of STP tenants can provide rich data over several points in time. Questions can provide insights that cannot be explored in quantitative

cross-sectional studies (Wright and Westhead, 2019). Some authors consider that responding to questionnaire survey is a sophisticated cognitive process and often iterative for respondets (Lietz, 2010). Qualitative research methods throw light on the importance of how people interact with the questionnaire survey and survey questions (Bavdaž et al., 2019). In line with quantitative studies, such qualitative information can be complemented by data relating to each STP held on an online database (Wright and Westhead, 2019). Compared to quantitative research methods, there are far fewer methodological guidelines on how to proceed with qualitative research. Unsurprisingly, the same is true - how should be these qualitative methods used when testing and evaluating data collection methods for surveys. The scope of available methodologies is also wide, given the thematic focus of the research. Although the range of authors dealing with these guidelines has expanded considerably in recent years (Willimack, 2013; Miller et al., 2014), it is impossible to generalise them due to the specific characteristics of individuals, companies or institutions. These methods are widely applied to the testing and development of all kinds of surveys. Although their implementation may vary regarding the type and sensitivity of questions, target group and administration mode (Willis, 2005).

It is important to point out that even slight details can affect the overall narrative value and return rate of questionnaires (Lietz, 2009). This is especially the appropriate linking of content and stylistic structure - question weight, question order, grammar, specificity and simplicity, social desirability, double-barrelled questions, or negatively worded questions (Brace, 2004). The advantages of online questionnaire surveys are numerous - in comparison to face-to-face or telephone questionnaires, it is a significant cost-saving measure. Fast feedback in the online world allows you to reach more people at once using different web platforms for creating surveys (we used the Survio platform[36]). Unless a name or job title is explicitly disclosed, the online questionnaire ensures high anonymity, which is an advantage if sensitive questions are included in the questionnaire. If anonymity is provided, it immediately comforts and encourages them to answer truthfully. The great advantage of an online questionnaire is that the respondent can choose the time and place to complete the survey, which is highly flexible. With online questionnaires on online platform, the risk of data loss is also reduced as they are stored on online web platform. On the other hand, there are also many disadvantages of this survey method. Initial differences in the interpretation and understanding of the questions can lead to

[36] Website available <https://www.survio.com/sk/>

misunderstandings within the questions. Some respondents may not understand the questions as well as in a face-to-face interview, which may lead to skewed results. When designing the questions of a questionnaire, it is essential to think them through well so that they cannot be analysed (e.g., too many open-ended questions). In recent years, questionnaire surveys have been very widely used on all fronts, so it is possible that the unwillingness to fill in the questionnaire may occur before or during the actual filling in, which will negatively affect response rates (Cleavea, 2021).

Along with the questionnaire survey, we also conducted semistructured interviews in the same case, which can better exploit the potential of knowledge creation dialogues by providing much more space for establishing topics and different perspectives that the respondent considers important compared to structured interviews. The interviewer also has a greater chance to draw the interviewee's attention to other issues that he or she considers important in relation to the research project (Brinkmann, 2018). A more specific definition of a semi-structured qualitative research interview is: *„It is defined as an interview with the purpose of obtaining descriptions of the life world of the interviewee in order to interpret the meaning of the described phenomena"(*Brinkmann and Kvale, 2015, p. 6).

The dissertation deals with the brief analysis of collaboration based on both quantitative data - initially in terms of evaluating data from the support for R&D projects in the 2007-2013 programming period, focusing on the funding of hybrid organizations. The main sources of data were official country websites of implemented Structural Funds (Slovakia[37], Czech Republic[38] and Poland[39]).

4.2 Questionnaire survey and semi-structured interviews

The research we conducted to address the dissertation research questions and was divided into three phases:

- *The preparing phase* – included the definition of the research problems and the basic concepts for theoretical basis needs, the formulation of the dissertation sub-objectives, literature review, study of strategic documents and case studies for preparation of the questionnaire survey and interview questions, preparation

[37] Website available <https://www.nsrr.sk/cerpanie/?csrt=3279509882976108049>
[38] Website available <https://www.dotaceeu.cz/cs/evropske-fondy-v-cr/programove-obdobi-2007-2013/cerpani-v-obdobi-2007-2013>
[39] Website available <https://www.funduszeeuropejskie.gov.pl/strony/o-funduszach/zasady-dzialania-funduszy/poprzednie-perspektywy-fe/fundusze-europejskie-2007-2013/#Projekty>

of materials for pilot data collection (pilot questionnaire survey creation), collection of secondary data to determine the initial situation in the surveyed area,

- *The implementation phase* - data collection and gathering (distribution of questionnaires, conducting personal meetings, processing of the collected data step by step, PhD international research mobility),
- *The evaluation phase* - analysis of the collected data, interpretation of the results, formulation of answers to the research questions, presentation.

Results assess contribution of STP using data obtained through our qualitative questionnaire survey and semi-structured interviews with the individual STP in Appendix 1. Creation of questions in the questionnaire survey was took into several studies, in particular the functions of STPs that we defined in the theoretical background (Edquist, 2005; Friel and Vukotich, 2018; Almeida et al., 2020) and the identification of barriers that limit the implementation of these functions and inhibit the development of STPs. We will also be interested in the government's role in governance and financial support, with an emphasis on opportunities to increase the effectiveness of government support considering the criticisms announced in the research conducted so far. The survey was also complemented by interviews not only with STPs but also with other relevant actors from the private sphere and the government. The research sample consisted only of the following entities - university STPs from the three selected countries (Slovakia, Czech Republic and Poland). STPs projects were funded by the EU Funds in the 2007-2013 programming period with a focus on the setting up of university STPs. It was a total sample of 44 STPs. Qualitative data collection in the form of a questionnaire survey and semi-structured interviews was carried out in several stages of implementation - pilot questionnaire survey in Slovakia, data collecting on research mobility (Czech Republic), questionnaire survey and semi-structured interviews (Czech Republic, Slovakia, Poland). The questionnaire survey was conducted in two stages. The course and set-up of our pilot survey was designed based on a similar survey already conducted in Slovakia in 2017 (Balog, 2019). We conducted qualitative research - an online questionnaire survey through which we collected primary data for the pilot research[40]. The pilot survey was partially identical to the outcome survey we conducted

[40] the pilot survey was realized in cooperation with the Slovak Agency for Investment and Trade Development (SARIO) - government agency of the Slovak Republic within the competence of the Ministry of Economy of the Slovak Republic

during 2022. The main objective of the pilot survey was to test the questions and subsequent feedback. To complete the pilot online questionnaire survey, we contacted the directors / managers / project managers of the selected STPs who are responsible for project implementation and have the most information. In the pilot survey, we contacted all 14 entities in total (in this case we contacted university STPs and research centres – Appendix 1 – Slovakia). We received fully completed questionnaires from seven subjects, so our research had a 50% response rate. The pilot questionnaire survey was conducted in April to June 2021 and consisted of 12 questions, which were divided into close-ended and open-ended questions. As our focus was on evaluating the functions of STPs, in addition to basic background information, we looked at 14 activities and services that are currently underway compared to those that each entity plans to implement in the future. We explain the differences between the overall thematic focus of the pilot questionnaire and the final questionnaire in Table 5. In the pilot phase we tested which question headings would be of interest to us. In the final questionnaire we changed or added a few questions because they were not relevant to us. Based on the results of pilot research, it also seemed ideal to look in more detail at the role of state support in supporting economic and non-economic activities and how they are financed (Igliar, 2020).

We generated the final questionnaire after that we tested and discussed it with STPs during our research mobility in Brno and then used as the basis for interviewing. The final questionnaire consisted of 12 questions (in Czech Republic and Poland 13 questions), which we divided into several areas, which you can see in the table below. The questionnaire contained 4 open-ended and 8 close-ended questions (see attached Appendix 2). We tried to design the questions in such a way that they were as insensitive as possible for respondents, but at the same time we wanted to find out important information necessary for our research. In addition to basic information, we were interested in the motivation of university (the initial impulse) for the establishment of the STPs, a brief description of the sources of funding for the annual operation, the evaluation of success based on measurable indicators, self-evaluation, activities and services implemented in the STPs, barriers to cooperation and further development, the perception of support from the state and the possibility of further continuous functioning of the university STPs. In the case of questionnaires for the Czech Republic and Poland, the question whether they were involved in government programmes to support this infrastructure was also added.

STPs projects were created in the same programming period 2007-2013, we tried to find out through the defined activities and services whether they are currently

implemented (or planned to be implemented) and to what extent the individual activities and services are important for them. Based on our theoretical backround, we have defined 17 activities and services that a successful STPs should perform using various studies about successful STPs (Edquist, 2005; Friel and Vukotich, 2018; Balog, 2019; Almeida et al., 2020) and case studies (Park, 2002; Albahari et al., 2013; Etzkowitz and Zhou, 2018; Albahari et al., 2019; Cadorin et al., 2019) and other relevant sources. In this way, we wanted to find out whether UBC activities are a priority for them. As far as sensitive issues for the parks are concerned (e.g., financial budget, number of employees or established companies) we did not find this, and it was not found in the final reports of these projects because they did not have final reports (especially in the case of Slovakia and Poland).

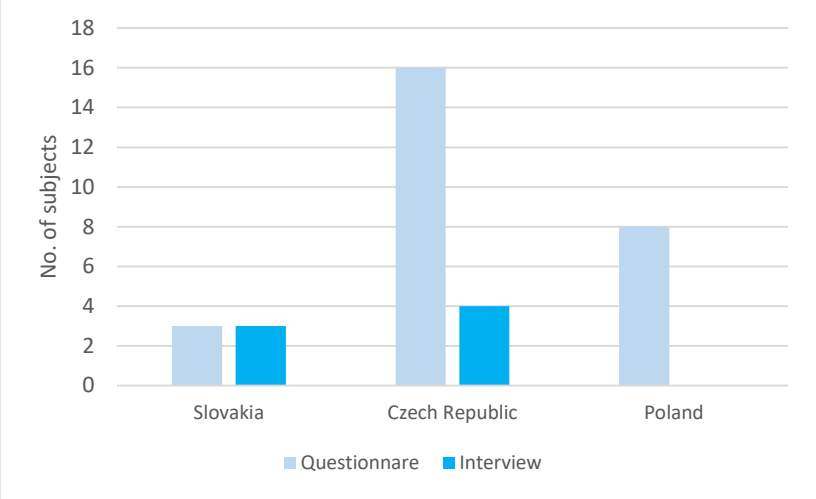
Table 5: Comparing the scope of pilot and final survey questions

Question range	Pilot survey	Final survey	Explanation
Basic information 1 (university assignment and the interviewee's position)	YES	YES	
Basic information 2 (no. of employees, no. of R&D offices)	YES	NO	detailed characteristics have been excluded, as most of them were university employees
Motivation to setting up STP	NO	YES	
Funding sources	NO	YES	
Evaluation of success and self-evaluation	NO	YES	
Activities and services	YES	YES	
Supporting mechanisms	YES	YES	
Patent activity	YES	NO	the interviews revealed that patent activity is not an important indicator of cooperation
No. of cooperating companies	YES	NO	the interviews revealed that they cannot determine the number of cooperating companies
Government support	YES	YES	
Barriers	YES	YES	
Future development	NO	YES	

Source: own elaboration based on questionnaire survey

Totally, we approached 30 subjects in several rounds of the questionnaire survey and conducted 12 interviews. In the final questionnaire, we addressed a total of 44 subjects from three countries – Slovakia – 7 STPs, the Czech Republic – 20 STPs and Poland – 17 STPs

(see Graph 3). The return rate of the final questionnaire is overall 68 % (86 % from Slovakia – 6 STPs, 80 % from Czech Republic – 16 STPs, and 47 % from Poland – 8 STPs (Graph 3). In the case of Hungary, the following types of projects were not supported in the programming period. To confirm this statement, we tried to contact several official authorities - Ministry of Innovation and Technology (Head of Cabinet of State Secretary for EU Funds), Permanent Representation of Hungary to the European Union and other colleagues from partner universities in Hungary. We found out that there were no calls for the setting up of STPs. The first calls with government support did not appear until 2019. We were no longer interested in the data on the supported projects in Hungary because they were extremely time-consuming and technically demanding to obtain, which could endanger the implementation of the research at the expense of other countries.



Graph 3: Number of questionnaires and interviews in STPs
Source: own elaboration based on questionnaire survey and interviews

To summing up, we conducted 7 interviews in STPs (with which we completed an on-site questionnaire and at the same time obtained a lot of useful information that is incorporated in the results) and 5 interviews from other backgrounds that did not initially fall into the STPs category – Slovakia (Ministry of Education, Science, Research and Sport of the Slovak Republic) and Czech Republic (Technology park Brno, CESNET, South Moravian Innovation Center JIC and CzechInvest Agency). We have thus put the Triple helix principle into practice. The information gathered directly during the interviews was especially important and complementary for us because it helps us to bring in a different perspective - that of the STPs owned by the private sector and government representatives who were behind the development of the challenges and are still working on their implementation.

We were particularly interested in the view of the private STPs and their cooperation with universities in the region. From the point of view of government institutions in Slovakia (Ministry of Education, Science, Research and Sport of the Slovak Republic – MŠVVaŠ SR) we were looking at the overall process of setting up the STPs, communication with the STPs and their sustainability in the future. Appendices 1 and 2 provide supplementary information to the main thesis, include materials about questionnare survey, survey questions and lists of respondents of questionnaire survey and interviews.

With the intention of stimulating a debate on the importance of collecting and obtaining adequate quantitative data and developing appropriate methodologies for assessing the success and cooperation within the STP, qualitative research in the form of questionnaires and interviews brings many benefits, namely direct contact with individual STPs and the possibility of obtaining information beyond the prepared questions, a personal visit to STPs, feelings and impressions from the whole meeting and a further opportunity to meet again to complete some of the answers. On the other hand, we consider the biggest problem be the unwillingness and reluctance on the side of the directors / managers or other representatives of the employees to meet (the meetings themselves in 100% of the cases have already gone smoothly in a very pleasant atmosphere). If we can't get to relevant information about STPs (website, contact, social networks, etc.), it is a negative factor for further cooperation.

5 RESULTS

This chapter presents a detailed analysis and interpretation of the qualitative and quantitative results. First part includes analysis of supported projects on HEIs in three countries - Slovakia, Czech Republic and Poland in programmimg period 2007-2013. As well as the results of support for projects with aim setting up STPs at HEIs, the second part presents qualitative research results, which was carried out using a questionnaire survey and semi-structured interviews. From the obtained data we have developed a detailed analysis of university STPs and their overall university environment, which represents an overview of the position of university STPs in the university ecosystem, funding, activities and services, measurable indicators of success, barriers limiting collaboration and development and the position of the government in these processes.

5.1 Support for R&D and innovation projects

Within the framework of Structural Funds programmes, the main assumption shows us regional distribution of approved projects from our final database. At the beginning of our research, we were interested in collecting data on allocations to all supported projects and their expenditure at NUTS3 level from our selected three countries – Slovakia, Czech Republic and Poland selected to three priorities – R&D, Education and Others. As we then focused only on projects whose beneficiaries were HEIs (377 HEIs were supported) in 33 operational programmes (Table 6). HEIs can draw support either for their two basic activities - Research and Education, but also be involved in projects that do not directly support these activities. We were interested how the received support between these three priorities was distributed within the regions of the countries under study. HEIs projects were usually thematically focused on research and innovation, university business activities with the private sector, information society, improvement and modernisation of educational processes, training and adaptability of workers, human capital and innovative ICT. Taking a closer look at overall results[41], the total amount of subsidy in programming period 2007–2013 provides to HEIs in our selected countries amounted to 8,36 mld. EUR. Overall, as we can see on Table 6, these types of investments have achieved important results. Slovakia

[41] These results were partially published at a scientific conference:
Glittová, K., Šipikal, M. (2022). The Influence of EU Funds for HEIs in CEE Countries. *MMK 2022: mezinárodní Masarykova konference pro doktorandy a mladé vědecké pracovníky, 19. – 21. prosince 2022*, Hradec Králové, Česká republika. Hradec Králové: MAGNANIMITAS, pp. 257-265. ISBN 978-80-87952-37-5.

allocated the lowest allocation of all compared countries (only 534,34 mil. EUR). In comparison to other, Czech Republic allocated 2 503,46 mld. EUR and Poland 5 810,21 mil. EUR). From the overall results it is evident that the highest funding was allocated to R&D projects in all countries and regions (highest in Slovakia) (Graph 4). As the project calls varied slightly from country to country we will mention only the most important priorities – R&D activities in research centres, R&D infrastructure, technology transfer and improvement of cooperation networks, information and communication technologies or developing human potential in the field of research and innovation through post-graduate studies (European Commission, 2010).

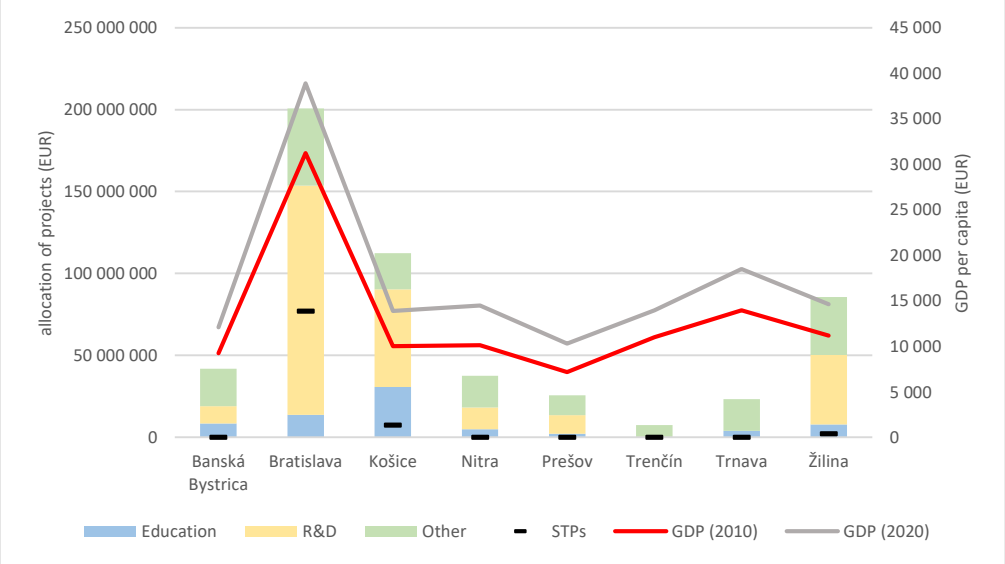
Table 6: Country characteristics of selected database

COUNTRY	OPERATIONAL PROGRAMME (OP)	NO. OF HEIs	TOTAL SUPPORT (EUR)
SLOVAKIA	Research and Development Education	23	534,34 mil. EUR
CZECH REPUBLIC	Environment Enterprise and Innovation Human Resources and Employment Research and Development for Innovations Education for Competitiveness Fisheries ROP NUTS II Moravia-Silesia ROP NUTS II Central Moravia ROP NUTS II South-West Prague – Competitiveness Prague – Adaptability Cross-Border Cooperation CR-Poland	27	2 503,46 mil. EUR
POLAND	Innovative Economy Infrastructure and Environment Human Capital Development of Eastern Poland 16 Regional OP	327	5 810,21 mil. EUR

Source: own elaboration based on selected database

Slovakia as geographically the smallest country received financial resources for R&D and Education for HEIs only from only two operational programmes – „Research and Development“ and „Education“. Graph 4 shows regional allocation of subsidized projects that are divided into three categories – R&D, Education and Others on regional level - eight Slovak regions. We can see that the capital city region (Bratislava) received 37,45 % of the total support for Slovakia. It is understandable, because the Bratislava region is home to the highest number of HEIs, which with their strategic location intensively opens to the

entrepreneurial and innovative environment. It is also the region with the highest GDP per capita in both recent years. Similar case was Poland, where was the highest support in the Masovia region (Graph 6). The opposite example is the Czech Republic, where the highest support was provided by the South Moravian region (not the capital city of Prague), whose GDP is approximately on the same level as all other regions except the capital. The general performance relies mainly on the economic strength of Brno and its wider surroundings. Brno is widely considered as a best practice in the country – there are university research infrastructure with high support from the City of Brno and the regional government of the South Moravian region. Approximately low than 25 ths. EUR was allocated in three Slovak regions – Trenčín, Trnava and Prešov. The least allocation of support was allocated in the Trenčín, which is also because only one university is located there. The share of projects with R&D priority was the lowest in three regions – Trnava, Trenčín and Nitra. On the contrary, in these regions were implemented mainly projects from OP Education with educational thematic focuses with different objectives (support of human resources, modernisation and improvement of the quality of education etc.).

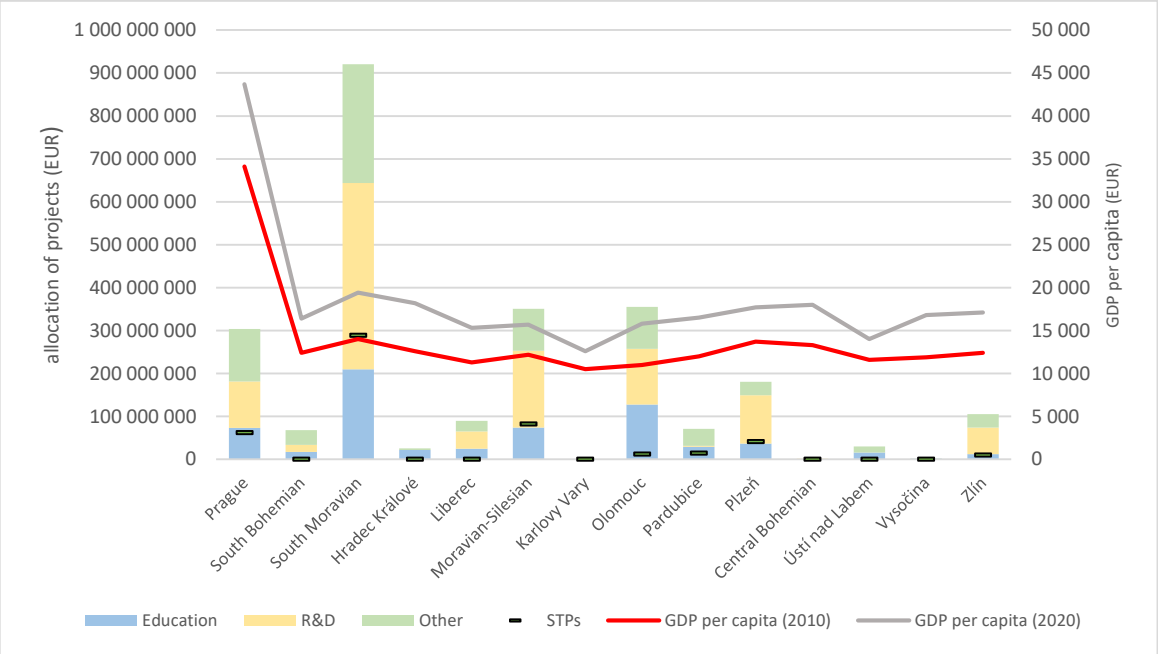


Graph 4: Total support (in EUR) on regional level in Slovakia
Source: own elaboration based on data from our database and Eurostat (2022b)

In Slovakia, the share of support for setting up STPs in total support for HEIs was 16 % (amount 86 mil. EUR). In terms of the regional distribution of STPs, the most of projects in Slovakia have been set in Bratislava region (amount 77 mil. EUR for three projects). The geographical distribution of the individual entities is significantly unequal - almost half of the entities are in the Bratislava region (3), followed by the Košice region (2) and the Žilina region (1) (Graph 4). The Bratislava region is also home to the largest number

of Slovak public universities (5) and institutes of the Slovak Academy of Sciences, and due to its strategic location, intensively opens to the business and innovation environment (Glittová and Šipikal, 2022[42]). In the Bratislava region these projects were setting up in the Comenius University and the Slovak University of Technology. In the Kosice region STPs projects were setting up in Technical University of Košice and Pavol Jozef Šafárik University of Košice.

In Czech Republic, the share of support for setting up STPs in total support for HEIs was 20 % (amount 511 mil. EUR). The most outstanding of the above-mentioned South Moravian region. An allocation of around 300 ths. EUR were in three regions – Moravian-Silesian, Olomouc and Prague. Graph 5 shows the biggest regional differencies between regions from our selected V4 countries.



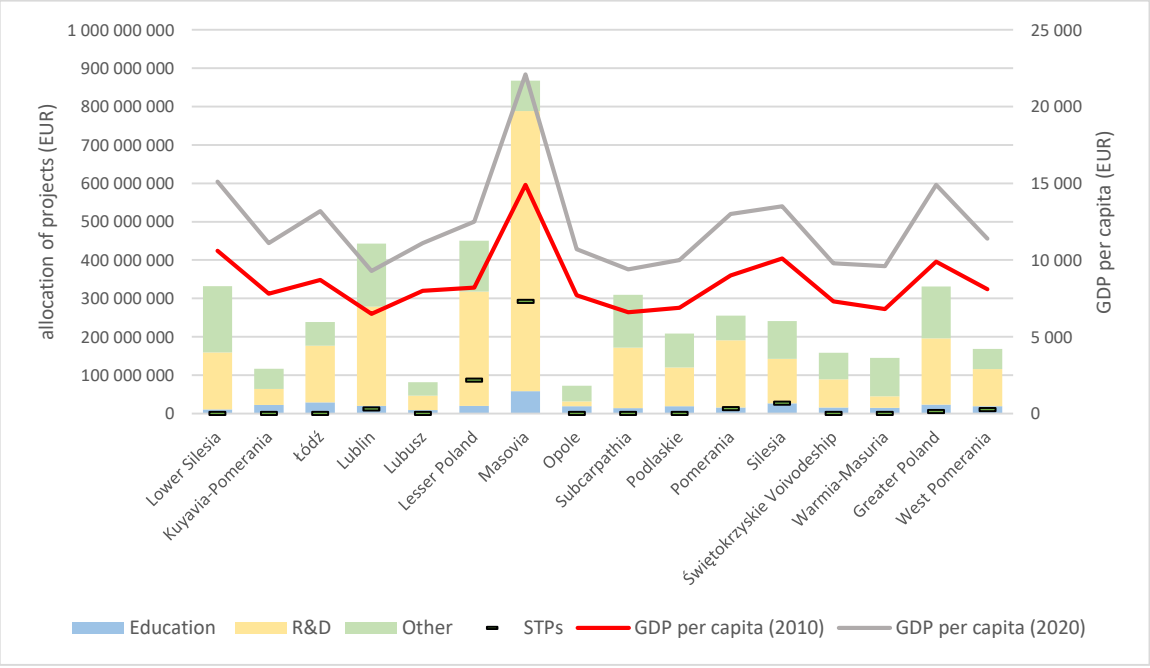
Graph 5: Total support (in EUR) on regional level in Czech Republic
Source: own elaboration based on data from our database and Eurostat (2022b)

Compared to Slovakia, the trend was different, with the largest number of supported projects in the South Moravian region, which is not the capital region of the Czech Republic. A total of 7 projects with a total value of 289 mil. EUR were supported. South Moravian region is

[42] These results were partially published at a scientific conference:
Glittová, K., Šipikal, M. (2022). University Science Parks As an Innovative Tool for University-Business Cooperation. *Proceedings of the 17th European Conference on Innovation and Entrepreneurship ECIE 2022*: Hosted by Neapolis University Pafos, Cyprus 15-16 September 2022. Reading: Academic Conferences International Limited, 2022, 648-656. ISBN 978-1-914587-49-8. ISSN 2049-1069E-BookISSN.

long-term an innovation leader with own regional innovation strategy since 2002 and since 2012 it is the region with the highest knowledge intensity in the Czech Republic. The structure of the R&D system in the South Moravian Region is characterised by a relatively high share of the higher education sector, which is due to the university character of the city of Brno. Other STPs are in Ostrava and Prague regions, but the value of one STP in Ostrava region (82 mil. EUR) is higher than the total value of 5 STPs in Prague. In South Moravian region, projects were setting up in Masaryk University (7 projects), in the region of Prague mainly in Czech Technical University in Prague (2 projects) and University of Chemistry and Technology (2 projects), 2 projects in Univerzita Pardubice in Pardubice region, and one project in Technical University of Ostrava in Moravian-Silesian region.

In Poland, the share of support for park establishment in total support for HEIs was 7 % (amount 444 mil. EUR). There were fewer differencies, 12 regions allocated support from 100 to 400 ths. EUR. The lowest allocation represents the smallest regions by area – Lubusz, Opole and Kuyavia-Pomerania. In case of Opole and Lubusz, there are border regions with a low concentration of HEIs. The same trend as in Slovakia was confirmed, most STPs were supported in the capital region of Warsaw - Masovia region (292 mil. EUR) – 5 projects. Beneficiaries of the support were mainly the University of Warsaw. Other projects were supported in Lesser Poland, Silesia, Pomerania, West Pomerania, Lublin and Greater Poland (Graph 6).



Graph 6: Total support (in EUR) on regional level in Poland

Source: own elaboration based on data from our database and Eurostat (2022b)

The same trend as in Slovakia was confirmed, most STPs were supported in the capital region of Warsaw - Masovia region (292 mil. EUR) – 6 projects. Beneficiaries of the support were mainly the University of Warsaw. Project were setting up mainly in Masovia region – University of Warsaw (4 projects), one project in Medical University of Warsaw, and one project in Warsaw University of Technology. In Lesser Poland region were setting up projects in Jaguellonian University (2 projects) with allocation almos 90 mil. EUR. Other projects were supported in Silesia, Pomerania, West Pomerania, Lublin and Greater Poland.

The trend analysis revealed an interesting subsiding of R&D and innovation projects which can help strenghten HEIs own research, internal educational procesess and collaboration with other innovation actors in innovation ecosystem. Support for R&D priorities are traditionally concentrated in developed regions (regions of capital cities) where strong and constantly evolving innovation environment with is dependent greatly on local HEIs, companies, research institutions. Analyzing regional data, the highest support was allocated in the capital regions (Bratislava and Warszawa) and metropolitan areas. In case of Czech Republic was the highest support allocated not in capital region, but in the South Moravian with the region‘most developed city of Brno. In all compared countries, the highest share represents R&D priorities (with the highest in Slovakia). Comparing to trend of indicator GDP per capita in years 2010 and 2020 we can confirm that there has been a significant increase in all regions.

In case of allocation on total support for setting ups STPs in selected countries, the trend is almost the same. In Slovakia, the highest allocation fot projects were in the capital city region of Bratislava (40 % of overall support for R&D). In the Czech Republic, there was the highest allocation in the South Moravian region (31 %). In comparison with Poland, majority of STPs projects was in capital city region of Masovia (33 %). Regional distribution of setting up STPs confirms the picture that the support of research and innovation infrastructure has been directed to innovation strong regions, where a strong knowledge base with a few innovative actors is concentrated.

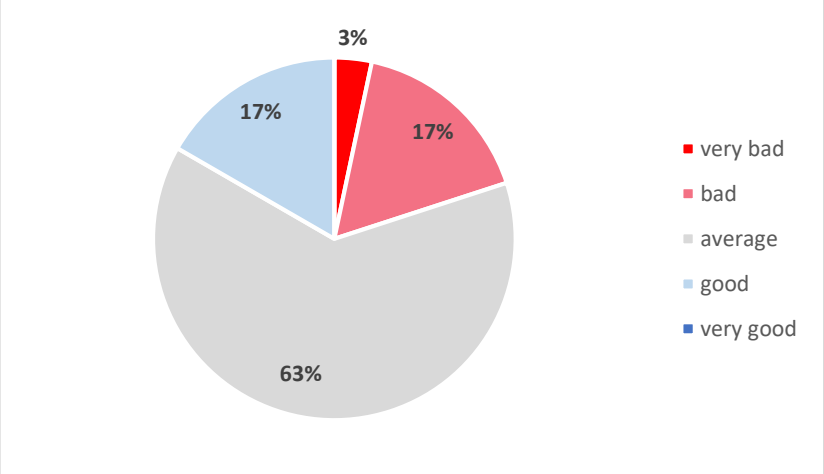
In summary, our research shows that the support of research and innovation projects in higher education institutions in the V4 countries has significantly influenced the programming period of EU Funds 2007-2013. Substantial resources have been invested in supporting HEIs in research, education and other areas. However, one of the common findings of the research is that these investments represent only partial steps in a longer process of development and change. In general, cohesion policy seeks to address specific

development challenges that may have a differentiated territorial concentration. It should be emphasised that the projects in our dissertation were not territorially concentrated - i.e., they were not concentrated in less developed regions. On the contrary, the projects were concentrated in metropolitan regions with high innovation capacity.

5.2 The role of government in supporting university STPs

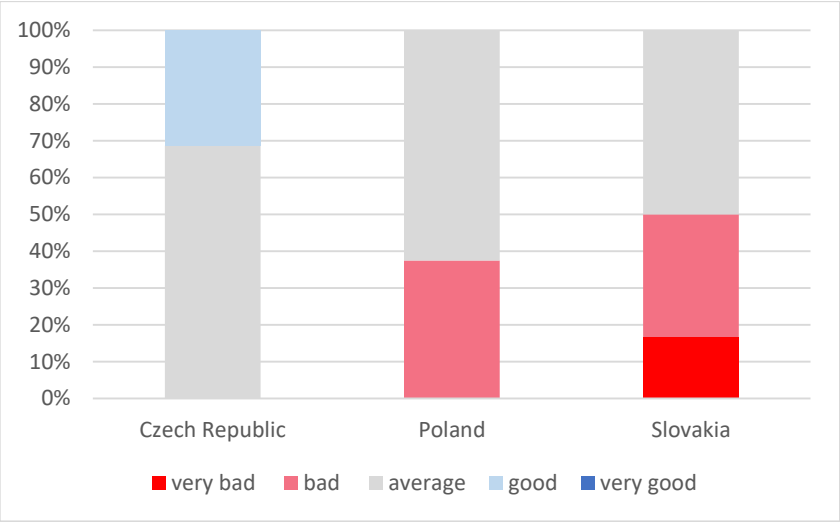
STPs also thematically touch government as one of the main actors in the Triple helix framework, which in the case of our research was the main mediator for setting up STPs through financial and supporting role[43]. Governments can indirectly create an interactive and inclusive ecosystem for actors from different fragmented backrounds or organisations. These linkages and partnerships also provide a source of information in the preparation of an appropriate policy mix and decision-making processes[44].

Our research has confirmed that despite the relatively high support from governments, the results show that individual parks are not satisfied with the support. If we look how STPs perceive government support, we see 63 % of them perceive it as *average*, 17 % as *good*, no one perceives as *very good*. On the other hand, 17 % of them perceive as *bad* and 3 % as *very bad*. In case of negative perceptions, it is mainly Slovak and Polish STPs. Almost 69 % of the Czech STPs perceive government support as *average* and the other 22 % as *good* (Graph 7 and Graph 8). Graph 8 shows that the most satisfied with the support of government are STPs in the Czech Republic.



Graph 7: Perceiving the level of state support
Source: own elaboration based on questionnaire survey

[43] The role of government in UBC support is covered in Chapter 3, where we have presented a number of policy support forms.
[44]For example, in the UK government established the Higher Education Innovation Fund, which has committed to investing £213 million to support UBC interactions.



Graph 8: Perceiving the level of government support on country level
Source: own elaboration based on questionnaire survey

Based on personal interviews with Czech STPs directors and managers, they evaluate the support through support programmes for research infrastructure positively:

- *„In the time of project sustainability, the support was set well. After the end of the project, the functioning will be built on commercial resources. "*

Czech STPs were supported by programmes NPU I and NPU II (National Sustainability Programme I and II), fulfilling the government's commitment to finance a significant part of the STP's sustainability from the state budget to ensure the operation of the built STPs including the necessary renewal of the facilities (reinvestment). The beneficiaries of the support were research infrastructures built in the Czech Republic between 2007 and 2013/2015 with the financial participation of the state budget of the Czech Republic and operational programmes of the EU Funds with building costs exceeding 50 million EUR. During the development of the OP Research and Development for Innovation, the Czech Republic committed to the European Commission to finance the sustainability of the built R&D centres from Axis 1 and Axis 2 of the OP Research and development for Innovation for a period of five years from the end of the project, i.e., until 2020, in the amount of 98,9 mil. EUR (in total for NPU I and NPU II), which corresponds to up to 50 % of the operating and renovation costs of these facilities[45].

[45] Website available <https://www.h2020.cz/files/daniel/Narodni-program-udrzitelnosti-II.pdf>

In Poland, there was the program PANDA INFRASTART supporting the maintenance costs of R&D infrastructure built or rebuilt thanks to the implementation of projects under Axis II of the OP Innovative Economy Infrastructure and Environment, for which the final eligible costs subsidized from the funds of the programming period 2007-2013 amounted to at least 12,5 mil. EUR, and by means of which scientific research and development work can be carried out and research services can be provided to external entities. The total budget of the Program will be 62,6 mil. EUR. All our research infrastructures have shown that they were involved in the support programme. Despite partial financial support, 37,5 % STPs perceived as *bad* and 62,5 % as *average*:

- *"The policy of support for this kind of existing infrastructure is currently not properly structured. Lack of support for further development of well-functioning centers, including the purchase of new or reconstruction of the existing modern R&D infrastructure? Such centers should be assessed by external partners using their services, and based on such an assessment, the opportunity for further support for further development of the best centers should be given?"*
- *"There is a need for long-term and robust (I mean not politically dependent) financial governmental/university support for the system maintenance and upgrade."*

Additional sustainability support calls in Slovakia were cancelled by the MŠVVaŠ SR on European Commission initiative to stopped further support. Another problem related to the late implementation of projects was that the responsible intermediary body announced the first call in Slovakia only in 2012, then almost at the end of the programming period. This meant that the first projects were not actually put into operation until 2015 at the earliest. In the Czech Republic, the calls were already in 2009, which contributed to a quicker implementation of projects and setting of priorities. Exactly 50 % STPs perceived government support as *average*, 33 % as *bad* and 17 as *very bad*, backed by several statements:

- *"We need conceptual state funding and predictability for the future."*
- *"There is a real need to ensure continuity of funding so that the research potential established can be further developed instead of constant turnover due to funding interruptions. The human potential that we develop over a long period of time leaves in the intermediate phases without financial cover and never returns. No workplace can be developed in this way over the long term."*

- *„Slovakia has no concept of development in any area, the policy is not set at all, we are the last country except Czech Republic where there are Academy of Science. In the whole EU, there are the innovation leader's universities. "*

In relation to the further functioning of STPs, all respondents agreed that the policy of support for STPs is not well set up. There is a lack of a long-term and stable strategy for the support and funding of R&D, innovation, and research infrastructures under the responsibility of universities. Respondets have agreed that in the long term it would be ideal predictable or stable budget of institutional funding for more than one year and freer rules for the transferability of financial resources in the years to be able to form reserves were set. We provide some statements from STPs in relation to long-term strategy limitations:

- *„For the operation of such centres, funding should be predictable, there should be no administrative constraints on corresponding commercial research activities, and the volume and importance of joint grant projects should be assessed. "*

Behind the financial and institutional problems there are hidden problems linked to "soft" misunderstandings – communication and mutual institutional cooperation on common interests. Due to the frequently changing political situation, STPs may feel undermined and unappreciated - this view emerged mainly from personal interviews of Slovak STPs. They are discontented with the support, communication and management of the highest responsible authorities. However, on the other hand, we also asked the MŠVVaŠ SR directly about this. The Head of the responsible office also told us that the STPs are not interested in communicating with them in cooperation, but only in the topics of financial assistance. Although he admitted that MŠVVaŠ SR had failed because did not monitor progress during the sustainability period and the call for support infostructures had also been cancelled. In this "systematic" way, Slovakia has achieved that STPs are automatically incorporated into the structures of universities and the infrastructure is slowly becoming obsolete. It should be noted, however, that some parks have "helped themselves" and have developed into very successful ones.

Funding sources that support the operating of STPs in 2021

Although the government is the main financial investor at the beginning of the setting up, universities as founders should also ensure adequate funding in view of the thematic focus of the STP. Funding related to the historical development of the park, ownership and

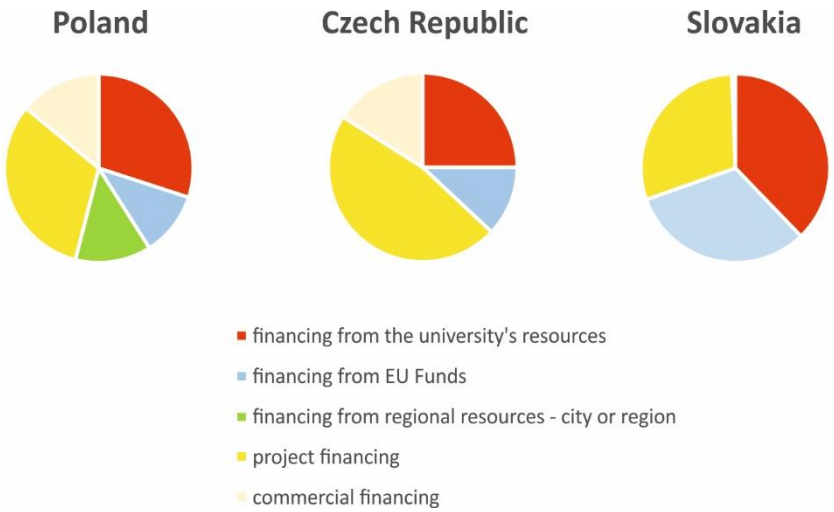
can vary from one country to another. STPs with a different owner are likely to have different financing and goals[46]. This is not a secondary issue, STPs with a different shareholder (university, local administration or private companies) are likely to have different goals and it is important to take account of STPs aims when evaluating their impacts (Bigliardi et al., 2006). Setting up an appropriate funding system for complex projects was a key factor that ultimately influenced their development, activities and effects during implementation, but also in the sustainability phase. At the time of realization our surveys (years 2021-2023), almost all projects were completed, i.e., they were just after the end of the sustainability and monitoring period. In some cases, the complexity of the procurement and the length of the processes caused significant delays in implementation projects and thus delaying the sustainability phase. During the implementation of projects, financing was covered by the EU Funds resources. However, after the funding ended, the founders (universities) who built the new buildings/spaces/facilities were exposed to to problems in ensuring their operation. They must have reallocated part of their budgets to support the operation of STPs (new buildings), while their budgets were not increased by the necessary resources to finance the operation of the university STPs. As a part of the university, it would be expected that the university would be a major supporter and resource for them. This is not quite the case, as universities often have very strict and limited budgets, STPs must provide their funding mainly through project funding. We provide a brief description of the funding sources that support the operating of STPs in 2021.

STPs are financed by universities on average in proportion to total funding of 30,9 % (Czech Republic 25 %, Poland 30 %, and Slovakia 37,9 %)[47]. Project funding is also highest in Czech STPs (47 %) and Polish (32 %). Other types of financing are less represented - financing from EU funds together averaging 18,3 % (highest in Slovakia 31,8 %), commercial financing 10,2 % and financing from regional resources 4,4 %. Specifically, the highest funding of STP from university (or faculty) sources was in Slovakia (37,8 %). Funding from project financing was highest in the Czech Republic (47 %) and Poland (32 %), which gained additional funding, especially with involvement in other European

[46] While STPs in the UK tend to be owned mainly by universities (Westhead and Storey 1995, Siegel et al. 2003), in Spain they are promoted mainly by local governments. Albahari et al. 2013 found that 56% of Spanish STPs and 37% of Italian STPs do not have a university shareholder. Link and Scott (2005) report that 69% of American STPs are not run by a university. Also, the presence of private shareholders varies hugely. For example, 83% of Italian STPs, but only 28% of Spanish STPs have private companies among their shareholders.

[47] We could not ask about specific funding in EUR, because the share of funding itself was a very sensitive question for some subjects, which they did not want to answer.

H2020 projects. In the case of commercial funding - the Czech Republic and Poland had an average of 15 %. Only Poland reported local funding in 2021, at 13 %. Based on personal interviews, Slovak and Czech STPs were also in close cooperation with regional actors but without significant support for management (Graph 9).



Graph 9: Comparison of financing STPs in 2021
Source: own elaboration based on questionnaire survey

Regulatory capacity of public funding has eased off the difficulty in sourcing funds for STPs in a regional innovation system. Despite the multi-source funding of STPs, Slovakia is the only country where STPs have a high share of government funding, despite high dissatisfaction with this type of support. Obviously, the share of government support should gradually decrease and thus the dependence on it should also decrease. STPs should become integrated gradually into the innovation ecosystem in the region and, in cooperation with other partners from the public and private sector, manage independently, with a partial link to university resources. In this case, there is no consensus on what the ideal and balanced share of multi-source funding should be, so we give an example of some respondents and their ideas:

- *"Support policy is highly dependent on the willingness of the university management and the Senate, at least 30 % of institutional support funding is needed for development, currently at about 10 %, ideally up to 70 % institutional and 30 % project funding. Currently, our budget depends on 85 % from project funding - this has a number of disadvantages."*
- *"The sources of funding for our department include, of course, funding from research projects and contract research, but we don't have a completely separate economy -*

most of the funding is redistributed through the faculty, so I can't say what the shares of each source are."

The results of our research are partly confirmed by the *Ex-post evaluation of Cohesion Policy programmes 2007-2013* by the European Commission (2015), which evaluated that investments in infrastructure ("science valleys") in the countries of Central and Eastern Europe did not automatically lead to the creation of innovation activities, such as UBC. The relatively limited level of direct investment in innovation activities from EU funds has also been criticised. Similarly, there are questions about long-term sustainability effects, when funding will need to be found to replace technologies and equipment to maintain infrastructure (Kapil et al., 2013). Evaluations from another EU countries have shown that more systemic and ambitious effects can be achieved through the innovation support from Cohesion Policy, stimulate institutional changes for investment in innovation, stimulate the dynamics of change in businesses and R&D centres, promote openness to new ideas and actors, and stimulating the development of new strategic objectives with a longer-term perspective sustainability. The most effective measures to improve innovation performance are those that allow R&D institutions and entreprises to collaborate and combine resources, cluster and commercialise innovations. This highlights the importance of 'soft' support (brokers, consultants, mentors and acceleration services) (European Commission, 2015).

Self-evaluation

In order to compare government support with the overall self-evaluation of all participants, the questionnaire survey linked approaches to self-evaluation of STP-supported projects. Key strength of individual projects is their own view of their success. Government support is just one of the key issues we have focused on in our research. Overall perception depends on many other aspects that are not dependent on government financial support, so the level of positive perception may be higher. If we look at the self-evaluation of individual STPs on a 5-point scale (*very bad - bad - average - good - very good*), STPs are evaluated (self-evaluation) more positively. The 60 % of them are rated as *very good*, 30 % as *good*, 10 % as *average*. High satisfaction and self-evaluation can be seen especially for STPs in the Czech Republic, where up to 75 % are rated as *very good*. It is worse in Poland and Slovakia – in Poland 50 % rated it as *good* success. *Bad* and *very bad* success rate has not been described by anyone. It seems that the highest self-evaluation is closely related to the overall success of the park. The highest satisfaction is recorded in the Czech

Republic, where is the highest satisfaction with the state support, project management, and the implementation of as many activities and services as possible.

5.3 Strategic function of STPs in university ecosystem

However, as mentioned above, university STPs are an integral part of faculties, universities and innovation ecosystems. They have great potential to contribute significantly not only to development and reputation of universities, but overall regional economic growth. The relevance and contribution to emergence of STPs as a direct part of university environment may appear to be little importance in some regions. There are many alternatives, but consensus of STPs would represent a balance position between the interests of all actors. The initial push that universities want to set up these unique innovation-related infrastructures is also important, universities as catalyst often create the initial plans. Given the STP's position in knowledge and university economy, the STP acts as an arranger of regional resources for shared vision of university and collaborating partners. The guiding principle is to develop a common strategy and identify interfaces with selected industry sectors. STPs are well positioned to create a better vision for the university while engaging functions that are completely outside of university's scope.

The STPs were planned as development of new directions of university activities; to conduct advanced research of great scientific importance, result of which will be used to develop new technologies; to provide laboratory facilities which are important for the fulfilment of the educational and research function (as a replacement of insufficient capacities of university departments). The overall identity of the STPs includes the many names of the STPs; operational diversity and similarities have led to confusion among both the STP founders and those actively involved in STP. In the implementation process, STPs founders (universities) tend to make mistakes in operation, design or strategy that led to the parks functioning differently than they are presented[48]. Research shows that parks would probably be more successful if they were independent, because if they are part of universities they may have an identity problem.

In terms of primary motivation and impulse for setting up STPs in the V4 countries, our research shows interesting results. The 60,7 % of the STPs indicated that the

[48] For example, in Spain - Since the creation of Association of Science and Technology Parks of Spain, Spain STPs have been given many names, ranging from „science park “, „technology park", „technopole", „research park", all encompassed under the acronym "STP" (science and technology park) according to the International Association of Science and Technology Parks and Areas of Innovation (IASP).

establishment of the STPs was planned as part of the long-term university strategy (faculty or departments) (Table 7). At the same time, 46,7 % likewise mentioned that the setting was planned as part of implementation of EU Funds - long-term strategic plans were also supported by EU funding. Another essential factor was expansion of UBC, 40 % confirmed that one of the primary impulses for the establishment and setting up of STPs was planned as part of the expansion of cooperation with external partners (interest from private sector) and 23,4 % want to strengthening institutional cooperation.

Table 7: What were the initial impulse for setting up STPs ?

	Absolute frequency	**Relative frequency**
the setting of the STP was planned as part of the long-term strategy of the university	17	60,7
the setting was planned as part of the implementation of EU Funds	14	46,7
the setting was planned as part of the expansion of cooperation with external partners (interest from private sector)	12	40
strengthening of institutional cooperation	7	23,4
other	6	20

Source: own elaboration based on questionnaire survey

In addition to the primary reasons, 20 % of respondents mentioned others reason that we didn't ask in the questionnaire. For example, the Slovak STP - CAMBO Trnava was inspired by the STP in Dresden and based on this inspiration they decided to ask for support for setting up. A couple of Czech STPs were inspired by concepts in Austria, Germany or the Netherlands. The Benelux concepts of an internationally oriented research-intensive universities is strongly embedded in European innovation ecosystem. Examples of successful European ecosystem collaborations are the Eindhoven-Leuven-Aachen triangle that makes strategic partnerships with many actors (public and private networks, governments, companies, non-profit organisations, etc.) to leverage impact on university as innovation ecosystem integrator. These universities show a strong tradition of universities that works closely with business communities. The university's success in entrepreneurial area is reflected in many spinoffs which were established in STPs (e.g., in Kennispark Twente were founded Booking.com, Takeaway.com, Cheaptickets.nl etc.). Place-based innovation ecosystems usually consolidate and emerge over time, developing hand in hand with university society. A sense of entrepreneurial community and belonging grows among

individuals (students, researchers) started to take initiatives that support a university-wide innovative and entrepreneurial climate (KU Leuven, 2018).

5.3.1 STPs benefits for universities

It is important to study wide range of generated impacts, because STPs have a significant impact on universities. STPs have several direct effects on their founders (universities), established businesses, and other organisations with which they collaborate. The establishment of university STPs has certainly brought many positive effects for universities, faculty and university departments thanks to the promotion of university-industry cooperation. STPs perceive a lot of benefits among which prevailed the most frequent opinion representing the increase of the prestige of the university in regional, national and international level. In general, STPs are some boundary openers for intersectoral and international linkages (Champenois and Etzkowitz, 2018).

Each STP is a unique entity with its own requirements. We mention some interesting statements from respondets:

- *"We have achieved significant visibility of the university through a considerable number of international projects, membership in international organizations and infrastructures, and an increase in the quality of our publishing outputs."*
- *„Our STP is the University's Flagship facility, which is visible and recognised in the field of excellent research, raising the visibility and public relations of the university, it is a department with high standards for quality outcomes and piloting ambitious PhD plans and strategies.“*
- *“Awareness of the driving force behind innovation and research activities in academia and their connection to practice and the market.”*

Another of many benefits is the modernisation of facilities and equipment for teaching and research. The outdated infrastructure is thus renewed, which increases the prestige of the university for new students and the creation of new study programmes. The quality of research has also increased, which has strengthened publishing activity and the commercialisation of intellectual property.

- *„It has established modern facilities for laboratory teaching, which is essential in our fields. Equipment for research in technical fields - applied research projects + commercial research as a complementary activity. Motivation for engineering students (not just learning at the blackboard). Expanding links with academic*

partners and industry (including from abroad). The publicity of the faculty and the university has increased significantly. "

One of the most valuable benefits is the creation of a space for cooperation between the university, the private sector and other collaborators. STPs have solved the problem of lack of facilities and premises for the implementation of collaborative activities. It is perhaps not surprising that universities report more publications, citations, patents or doctoral graduates.

- *„In the long term, further cooperation and partnership portfolio has been expanded. Connections between companies and students in terms of thesis solutions and possible further work in these companies after studies have increased. The location of the STP directly on the faculty's campus with a direct connection to the faculty gives the companies and firms settled there a certain prestigious address."*
- *„Centralisation of top research into one platform."*
- *„We realize transfer of knowledge into practice. Improvement of university funding. Protection of the university's intellectual property."*
- *„Strengthening the link with real practice and fulfilling the third role of universities."*
- *„It was to expand the infrastructure for IT specialists, to establish cooperation with companies, the STP is focused on specific specialized research - it was useful for the faculty, the university and Brno. "*
- *„For the university: Possibility of using experts from practice in teaching. For students: the possibility to get involved in the activities of companies (practice, earnings, etc.)."*

Effects of STPs are heterogenous, also benefits are not necessarily perceived equally by all STPs. Greater formal involvement of university may have negative effects on STPs, such as:

- *„Incorporation of our STP to the structure of university discriminates us by institutional evaluation, when a significant emphasis is placed on basic research and related publications."* – example *from Czech Republic (Prague)*

Few papers provide negative assessments - Albahari et al. (2017) show negative effect on innovation sales, Etzkowitz (2008) the emergence of conflicts and interest, research by EIB (2010) points to the limited infrastructure development due to restricted financial position.

5.4 Activities and services on the road to UBC

Measuring the success of STPs has been a challenge for professionals, government and academics for decades. This is mainly due to their heterogeneity and complexity of STPs model, ownership and the different expectations of stakeholders. In addition, each STP has developed its own priority tasks to develop new and knowledge-based activities that cannot be directly measured or quantified. Through the different mix of activities and services that STPs can perform, their attractiveness increases not only for university employees and students, but also for other companies from the private sector, public administration and cooperation with foreign partners. Internationalization of research, educational activities and entrepreneurship help to increase prestige on foreign markets.

Based on a detailed study of the relevant literature and numerous case studies, we have selected 17 activities and services that STPs in the context of the university can or should carry out in order to establish or strengthen cooperation with the business sector. The most ideal version is if the STP performs all functions. However, reality shows several obstacles that hinder and limit the performance of these functions. It is also necessary to explain at the beggining that, we are comparing three different countries in which STPs, and research centres have been set up for the same purpose, but under different initial conditions and objectives. Some STPs were built primarily for research[49], others for business activities.

Individual activities and services can be divided into several subgroups. All activities and services are related in some way to cooperation, except for the research itself. The groups could be divided as follows - own research (basic or applied) and cooperation (joint research with companies, renting of premises and equipment, business support, training and expert consultations, company formation, networking, community involvement, internationalisation). Despite their name, STPs are not just about science, or just about technology. STPs are mainly concerned with companies, businesses, entrepreneurs, startups, jobs. They are concerned with economic aspects of innovation, technology, and science;

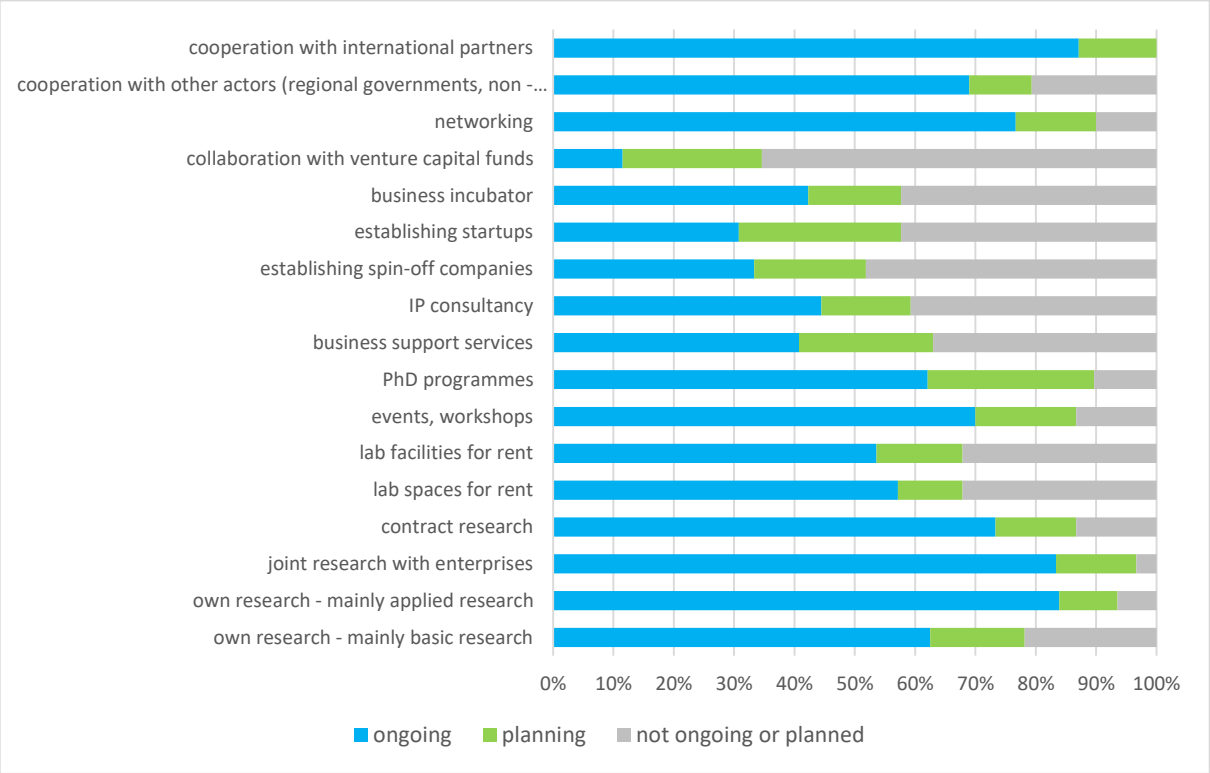
[49] But even in the case of research infrastructures, it is possible, according to Article 107 of the Treaty on the Functioning of the European Union, public aid granted by Member States or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods shall, in so far as it affects trade between Member States, be incompatible with the internal market. Aid schemes are allowed in the form of de minimis - not considered public aid, block exemptions or notification to the European Commission. According to Framework for State aid for research, development and innovation (2014), to use 20 % of the capacity for commercial activities during the 5-year sustainability period and to help (especially financially) with the overall transition. As we did not explore the extent and intensity of cooperation and entrepreneurial activities, we considered it appropriate to ask these questions of all respondents, as they can do so to some extent (although limited).

with applying knowledge and technology to enhance the competitiveness of associated businesses with raising level of innovation in cities and regions, creating wealth for the community by developing a prosperous business community. As can be seen in the Graph 10, 61 % STPs carry out mostly their own basic and applied research. More than 80 % of entities carry out collaborative research with companies and another 10 % plan to do in future. Other services - renting of premises and facilities - are currently provided by approximately provide 55 % entities. It seems that cooperation with other partners is very important for STPs - especially cooperation with international partners (almost 90 %). Similarly, they also engage in cooperation with regional or other actors (70 %). Country specifics show differences especially in ongoing activities in business incubators, establishing startups and business support services. Establishing spin-offs and startups ongoing in 20-30 % of subjects, mainly in Czech Republic (80 %). These types of business activities can generate employment (Spain), student's entrepreneurship, developing new projects and other activities that are quite common in others STPs (Utrecht Science Park and Kennispark Twente in the Netherlands, Turku Science Park Ltd in Finland, Johanneberg Science Park in Sweden).

The following are some statements of managers in STPs in Brno in connection with the implementation of activities and services:

- *„We cooperate with the city of Brno and the region, everyone knows each other, we are now cooperating with the city on a project focused on entrepreneurship. "*
- *"We don't have any problem with cooperation with companies, companies choose us, they book our facilities, if they are registered users. They have access 24/7, who comes first takes first, so we are constantly being sought out."*
- *„We have about 320 registered users of our services, and about 60 companies who do their own research here. They are from many countries (Germany, Austria, France), we rent them our premises and equipment - we give them full service according to their requirements, or we hire them their own employees. At any moment we have about 120 active projects that we are working on throughout the whole month. "*
- *„Since our establishment, 6 startups have been founded here - 4 of which were founded by the same person. "*

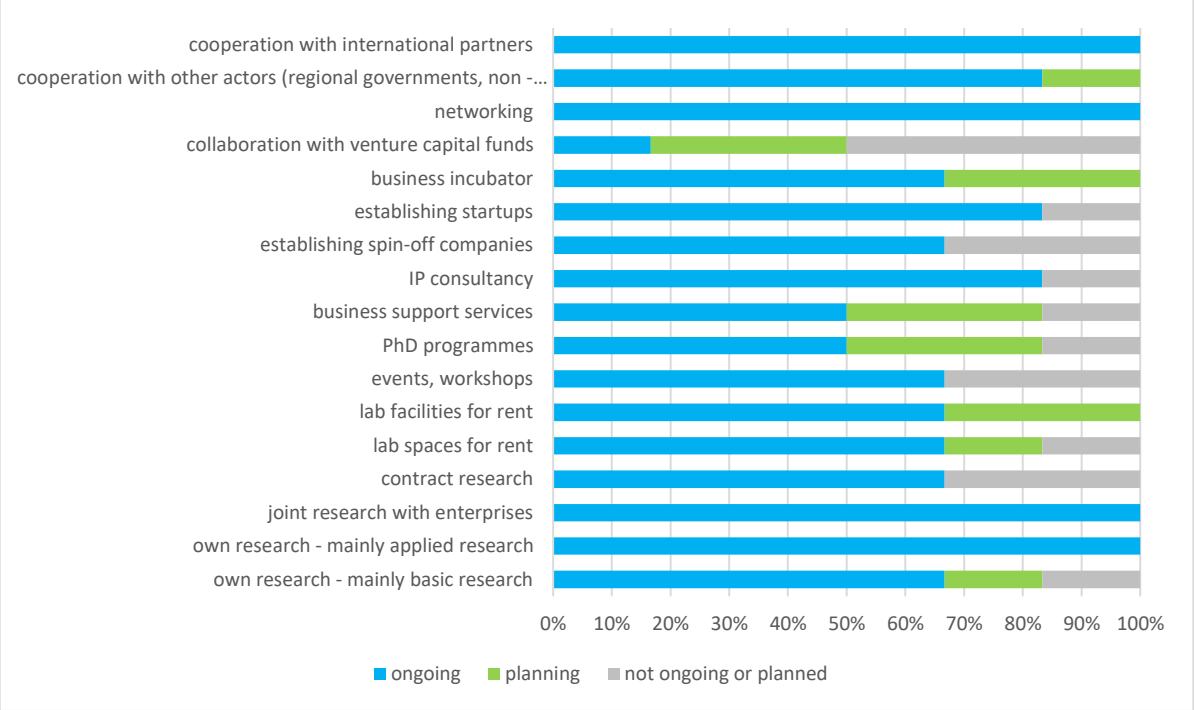
As regards cooperation with venture capital funds, there is a lower proportion - only 12 % (replied one STP in each country). Several STPs commented that they did not really want to work with venture capital funds, which would duplicate the activities of other regional innovation hubs in the region that provide these services. Venture capital investments offer potential for above-average returns but usually with high-risk. Venture capitalists are typically very selective in deciding what to invest in, with approximately 60 % of business plans rejected after a quick scan. These type of funds are not generally suitable for all stages of companies, with many start-ups choosing self-finance (or "soft finance" from grants) until they reach the point where they can approach outside capital providers, such as business angels or venture capitalists (EIB, 2010).



Graph 10: Activities and services which university STPs implement
Source: own elaboration based on questionnaire survey

In comparison with official calls of individual countries for setting up STPs, it is important to compare how they have met their targets. In the case of Slovakia, the eligible activities were - implementation of applied research and development projects, creation of programmes for mobility and innovation, creation of incubators in the environment of universities for potential spin-off projects, support for the formation of local points for contact with industry, management of institutions providing support services for commercialisation of IP, support for activities to remove barriers and support

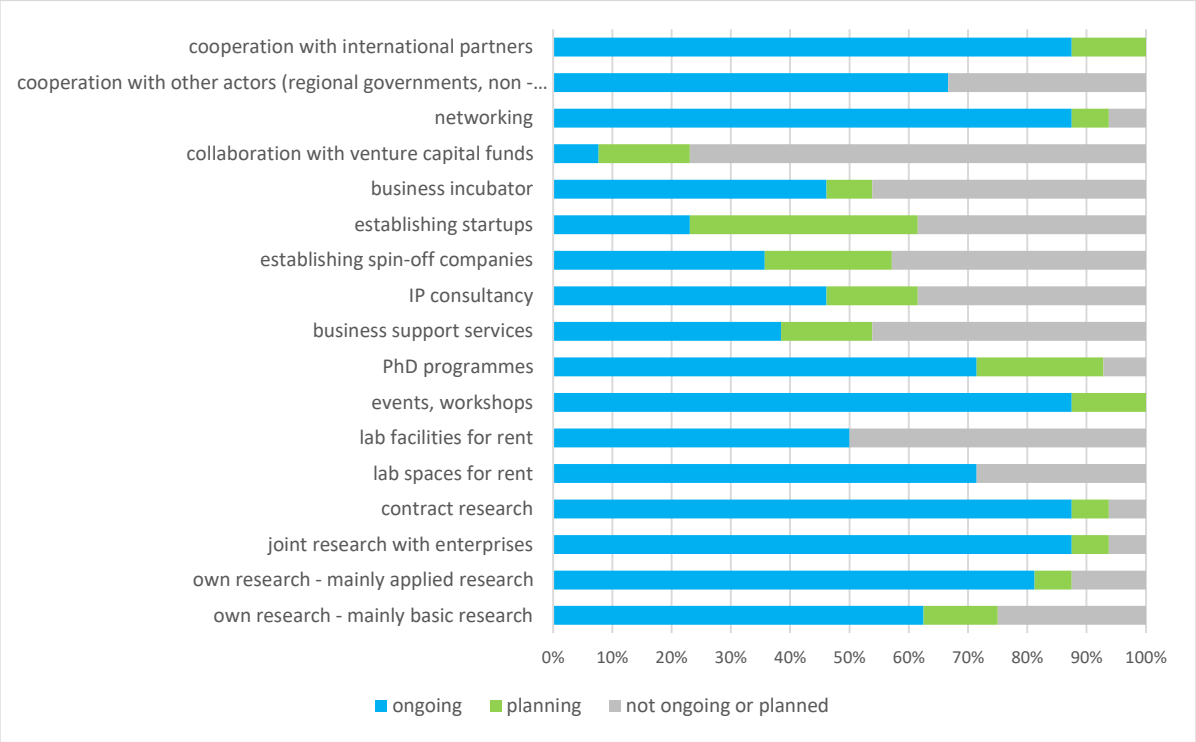
for the promotion and popularisation of R&D to the wider society. Our results show that 67 % of subjects carry out their own basic research, 100 % applied research. Joint research and rent lab spaces and facilites is performed by 67 % of subjects. Business incubator and establishment of spin-offs is realized by 67 % of STPs. Business consultancy is implemented within university departments, not at the level of STPs. Venture capital funds realise only 17 % (1 subject). Cooperation with international partners and networking is applied by all respondents (Graph 11).



Graph 11: Activities and services which university STPs implement - Slovakia
Source: own elaboration based on questionnaire survey

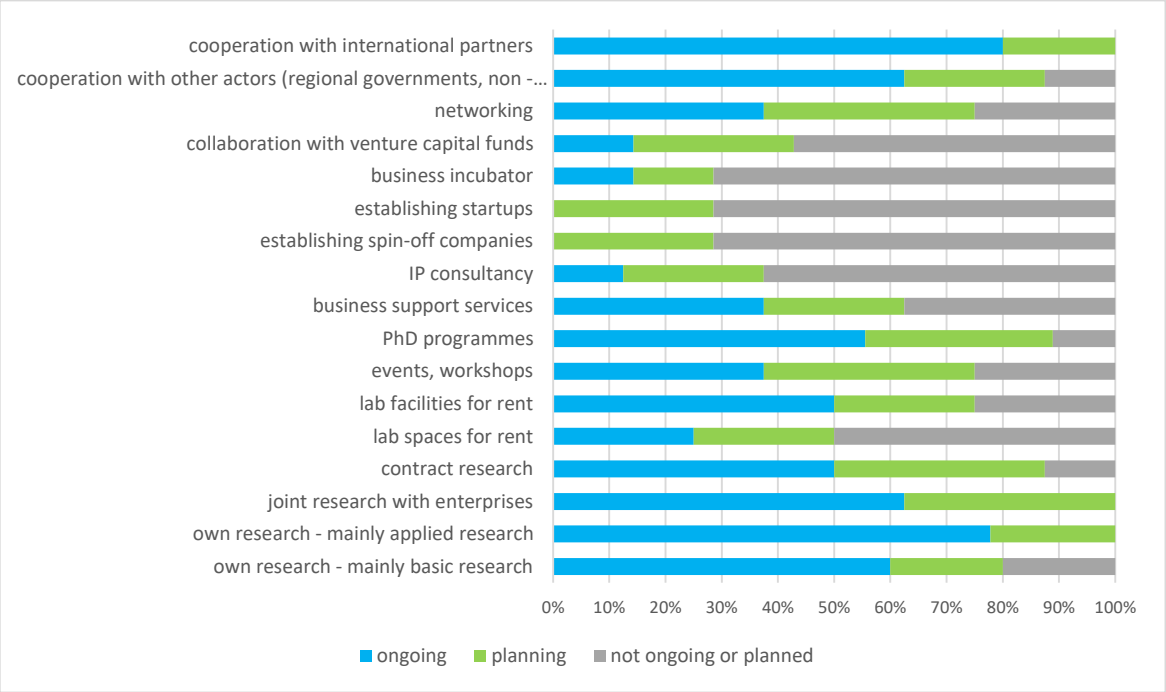
In the Czech Republic, the projects were implemented through several calls, research infrastructure was focused on investments in modern infrastructure regarding creating conditions for the involvement of graduates in R&D agendas (programmes, projects) of the parent institution, and in its cooperation with partner organisations (research organisations, enterprises, application sphere). Investments in the material and technical security of research-oriented universities in relation to ensuring the operation of modern infrastructure for the purpose of linking teaching, research and innovation. Innovation infrastructure has included, in addition to the building and development of STPs and business incubators, the establishment and development of business angel's networks (networking of investors with early-stage companies (spin-offs, startups). The projects of regional R&D centres were mainly focused on the cooperation of the proposed university

regional R&D centres with the application sphere (startup grants) with the aim of creating partnerships that will strengthen the capacity for collaborative research and for contract research. Activities aimed at strengthening the cooperation of the proposed regional R&D centre with the application sphere and the public sector (e.g., preparation of joint projects, networking and promotional events and materials, seminars, establishment of joint information and communication platforms, participation in regional and national platforms for cooperation with the public and private sector, including participation in cluster activities and technology platforms, etc.). Activities aimed at strengthening the cooperation of the proposed regional R&D centre with leading international research partners (i.e., preparation of joint projects, participation in conferences, seminars, technology platforms, promotional and networking events and materials, etc.). The results of our survey show that 62% of the subjects carry out basic research and 81% applied research. 87% of STPs carry out joint research with companies and contract research. Renting of space and facilities is carried out by 62 %, with 25 % planning to do so in the future. Activities in the form of spin-off company's creation are done by 31 % of STPs, startup creation by 19 %, business incubator is run by 37 % of STPs. Only one STP cooperates with venture capital funds. 62 % of STPs cooperate with other actors in the region, 87 % of STPs cooperate with international partners (Graph 12).



Graph 12: Activities and services which university STPs implement – Czech Republic
Source: own elaboration based on questionnaire survey

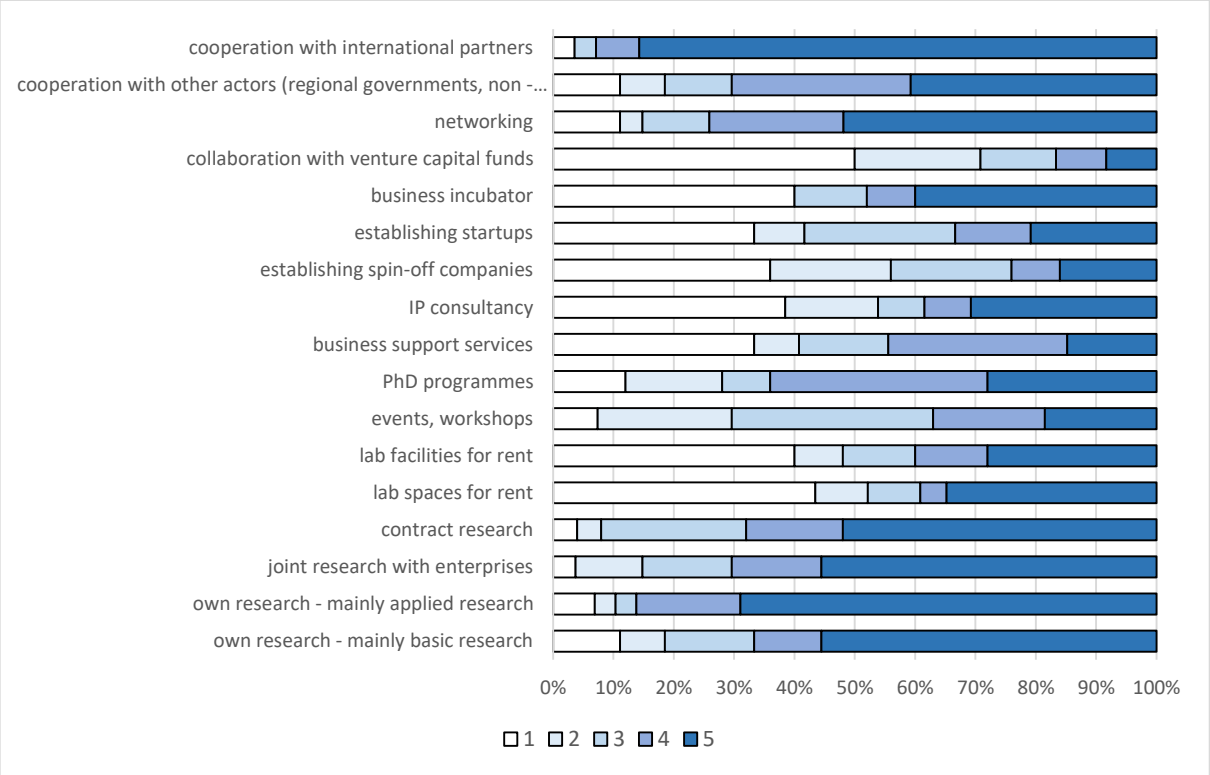
Polish projects included research infrastructure projects, projects of specialised university departments with high research potential, including those operating based on scientific and industrial consortia and regional scientific and industrial consortia, cofinancing the development of their research infrastructure. The results of our survey show that 60 % of subjects carry out basic research and 77 % applied research. Joint and contract research is performed by 50 % and rent of spaces and facilities by only 25 % of the subjects. Only 1 entity establish a business incubator, nobody is setting up spin-off companies and start-ups, but 30 % plan to do so in the future. Only one entity cooperates with venture capital funds. 30 % entities cooperate with other actors in the region and all entities cooperate with international partners (Graph 13).



Graph 13: Activities and services which university STPs implement – Poland
Source: own elaboration based on questionnaire survey

At the same time, it is important to find out how important these activities are for individual STPs. Because on the one hand they can be important for them, but currently there are significant barriers that limit them in these activities. On the other hand, there may not be any barriers, but these activities are not essential for them, and therefore there is no effort to work on their development in the future. As can be seen in Graph 14, based on the ranking of the importance of activities and services (5 being the most important), the most important for STPs is cooperation with international partners, own research (more applied) and networking. Collaboration on joint projects with companies or business incubator is also

important. Other activities and services (like in the previous Graph 10) are currently much less important for them, although they have a great added value for them in the overall development. However, this is very individual, as we also see significant differences in the implementation of these activities. It is very possible that since the period of sustainability has ended in all STPs, the rules have been eased and the STPs will be able to start managing according to their own rules with a higher share of development of business activities. There are no significant differences between countries when it comes to the assessment of significance.



Graph 14: Evaluation of the significance of activities in STPs (1-least important, 5-most important)
Source: own elaboration based on questionnaire survey

Indicators for measurement of STPs activities

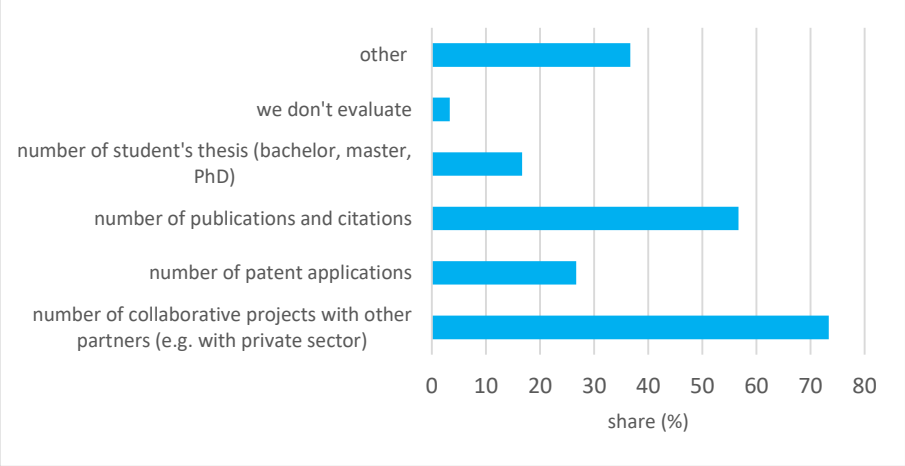
According to the activities and services that STPs perform/do not perform, it was interesting for us to find out based on which measurable indicators they evaluate the success of the STPs (on the basis of what is their monitoring).

From our results point of view, 70 % of them reported that evaluate their success because of number of collaborative projects with other partners (Graph 15). More than 50 % are evaluated by the number of publications and citations (many added that they should be CCC – current content connects publications). This is understandable, they are part

of university structures where exist similar evaluation conditions. The number of patent applications is managed by only 20 % of the entities. In almost all respondents, the predominant views on patent activity were as follows:

- *"We do not deal with patents, rather with licences. It is not a problem to write or create a patent, it is a problem to pay for it, and not everyone can afford that."*
- *"Patenting doesn't make sense for us if we collaborate or support new and small companies. It's a big cost to patent, the market is unforgiving, and a small company can't afford to invest in one patent at the expense of its other costs."*

In addition, 39 % of STPs told us other evaluation indicators, such as 9 different examples: number of projects with international institutions; number of institutions using the services of labs, number of employed specialists, cooperation agreements; number of interfaculty cooperation projects; number of foreign scientists; number of successful graduates, number of incubated companies, startups and spin-offs, de minimis support rate, amount of funding from international projects (Horizon Europe).



Graph 15: According to what do you evaluate the success of the STP
Source: own elaboration based on questionnaire survey

In comparison with the groups of project impact indicators from the official calls in the programming period 2007-2013, it appears that they were aimed at: number of PhD students, number of researchers under 35 years, number of created researcher positions, number of publications in peer-reviewed journals, number of patent applications and and full patents, number of established spin-offs and start-ups, number of UBC projects, number of enterprises implementing innovation and education programmes. STPs as an integral part of universities and their research activities consider similar parameters as success factors.

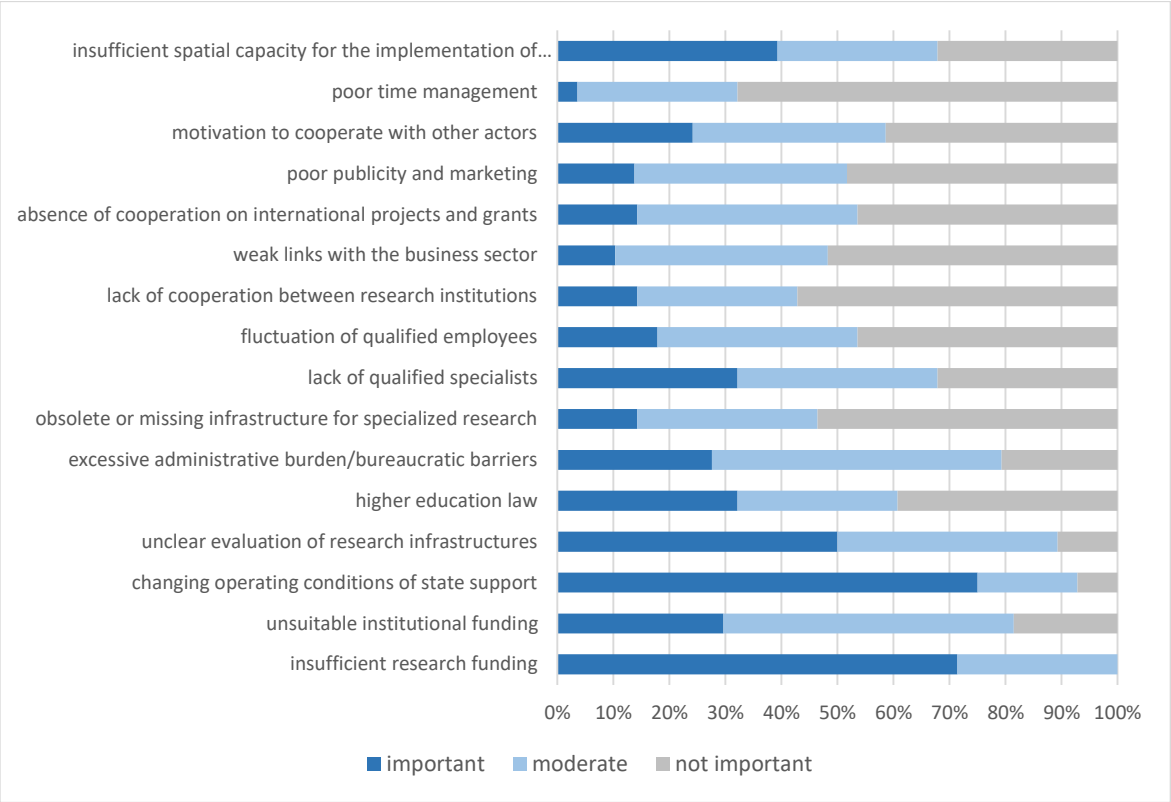
5.5 Barriers limiting cooperation processes and development

In the previous chapter we could see what activities and services that STPs realize, they not realize or plan to realize in the future. However, there are a few barriers behind these activities and services that cause implementation or nonfulfillment and further development. We have identified the limits which, according to the results, show that they have the highest impact on UBC and development of STPs. UBC is complicated and problematic because it is usually associated with a 'paradox of two worlds' in which universities and industry have different institutional logics and priorities (Hall, 2003). For example, the goal of industrial R&D is to make a profit through innovation in short term, whereas the traditional goal of university research is to extend the frontiers of current knowledge beyond the limits of time. To enhance and improve innovation performance, UBC must overcome the barriers caused by institutional differences (Hewitt-Dundas et al., 2019; Zavala, 2019).

Based on the results of our research, on Graph 16 we can see that important barriers include insuficient changing operating condition of state support (75 %), research funding (72 %) and unclear evaluation of research infrastructures (50 %). The least important barriers, on the other hand, include poor time management (68 %), lack of cooperation between research institutions (58 %), and obsolete or missing infrastructure for specialized research (53 %).

The flow of people, ideas, capital, and technology and industry connections between STPs, universities and private sector can be limited. According to the results of the questionnaire survey, the biggest barriers are insufficient research funding and changing operating configurations of government support. STPs need a long-term sustainability and funding strategy, as short-term goals will not ensure their continued operation over a multi-year period. STPs also have a problem with legislative consolidation, as they are a direct part of university and are also subject to the Higher Education Act (in the context of different legislative level of countries):

- "*We are limited by the higher education act because we are half Soviet and half Austro-Hungarian, we need the new methodology for evaluating universities, nobody knows what will happen next year. "* (statement from Czech Republic)



Graph 16: Barriers in the implementation on the above-mentioned activities and services
Source: own elaboration based on questionnaire survey

Previous Slovak control study (Balog, 2019) confirmed, that the limitation of the development of Slovak STPs is in the relatively suboptimal cooperation with local industry due to the setup and selection of support regime. At the time of our survey (years 2022/2023), the statements of the Slovak STPs were mostly related to the missing long-term strategies and settings.

- *"We need a long-term strategy that would link the different programming periods of the EU Funds, calls for the sustainability of STPs."*
- *We need conceptual state funding and predictability for the future."*

Among others, there are less significant barriers. The primary barrier to development at the beginning of cooperation is the lack of trust and the unwillingness to start cooperation at all in early stages. After the STP is set up, it is inevitable, because collaboration is part of every joint project and research with private sector outside the university. One of the managers of the STP said in this context:

- *„The capacity of the people and the willingness to talk to them, the academic world does not want to be disturbed. "*

From country view, the biggest differences in the perception of barriers are in the Czech Republic. While in the Czech Republic the majority of STPs perceive barriers of outdated and missing infrastructure, weak links with the business sector and insufficient cooperation with research institutions as a not important barrier. In Poland and Slovakia, they are among the important barriers. We were positively surprised at the barrier of limited capacity for the implementation of other activities when we visited the CERIT Science Park I in Brno (Czech Republic). We saw solution immediately – a few meters from the first STP were under construction CERIT Science Park II, which will be a solution to the insufficient space capacity of CERIT Science Park I. Similarly, another STP in Brno has admitted that they have a little problem with promotion and marketing. However, after a few months they have a new website with an up-to-date offer of services. It is very important to be aware of your shortcomings and limits, but to try to solve them. In Poland, there is the problem of insufficient research funding, constantly changing conditions of operation by goverment and outdated or missing infrastructure for specialized research. In terms of population and land area, Poland is the largest country in our research with the highest number of HEIs. Problems with infrastructure also cause problems with sustainability. Currently, Poland is facing a general weakening of research, development, and innovation due to disputes with the European Commission over the suspension of the Cohesion Fund and the National Recovery and Resilience Plan. In Slovakia, the most problematic is the area of research and development funding, the unclear definition of research infrastructure by the government together with the changing conditions. This situation should be resolved in 2023 by the creation of an office for national research infrastructures of universities, which will organise and monitor these infrastructures.

In comparison with other countries, for example Bucăr and Rissola (2018) claim that despite the Slovenia as a strong innovator, the weak coordination across responsible departments and collaborative links between major stakeholders in innovation policy are commonly noticed barriers to a more efficient innovation ecosystem.

DISCUSSION

This dissertation analyses the role of university STPs as an innovative tool for improving university-business collaboration by realization of activities and services, and role of government support in the setting up and the operation of this tool. The setting up of the STP was preceded by the support of EU funds in the 2007-2013 programming period, which in the initial phases facilitated the implementation of these projects in the university environment. To achieve benefits from dissertation in case of the implementation of the setting up of STPs, it is also necessary to discuss the assumptions that have been identified from the research results and that should be met for UBC to be successful in the long-term horizon.

We have surveyed the V4 countries, starting with a pilot survey in Slovakia in 2021. Based on its results, we designed a questionnaire survey and interviews which we then conducted in 2022-2023 in Slovakia, the Czech Republic, and Poland. Based on the findings that Hungary did not implement STPs activities in the 2007-2013 programming period, we did not proceed with the qualitative research in Hungary.

To fulfil the main research objective, we have set sub-objectives with research questions.

Sub-objective No. 1: *Examine the theoretical knowledge of the addressed problem in the field of Triple helix model actor's interconnection. In the framework of the space of overlapping actors and strengthening their cooperation, define the role of STPs and activities and services that they implement.*

Following the first sub-objective, we wanted to find out the role of UBC in the Triple helix model in relation to the individual actors. Collaboration as an important part of innovation models because innovation activities success is influenced by the nature of collaborative partners. The Triple helix model highlights the potential for innovation and economic development in the knowledge-based society and the increased roles of universities, the private sector and government in creating new institutional and social formats for knowledge production, transfer and application (Etzkowitz et al., 2007; Champenois and Etzkowitz, 2018). Universities carry out activities mainly related to their own research and education students. In response to changing market demands, an entrepreneurial role is essential for universities (Etzkowitz et al., 2000; Trippl et al., 2012) which is closely linked to those traditional ones (Piqué, Berbegal-Mirabent and Etzkowitz, 2020). As we have seen in the theoretical background, UBC can take many forms and it is up to the individual actors to set

the input criteria, therefore UBC may not always be successful in all cases. If cooperation does not work in some cases, it is probably because the actors did not know / did not want to agree or did not have a primary intention. It is therefore important to have clear objectives, interests and expectations as result of the cooperation.

Effects of Triple helix interactions require necessary policy interventions in promoting UBC leads to knowledge transfer and is based on several assumptions (Spinoglio, 2015). Governments or HEIs put in place support mechanisms in the form of measures for the development of UBC to create favourable conditions and make UBC beneficial to the wider society (Galan-Muros et al., 2017). Although the Triple helix model is a tool for studying the organizational and institutional arrangements of the key actors, its main idea is to continuously strengthen the links between universities and companies in a conducive governmental environment. Catalysing the Triple helix model, the stimulating policy environment has enabled universities to further develop and strengthen their research, education and entrepreneurial role. By combining and integrating elements from different institutional spheres, they support the creation of innovation, the coordination of joint activities and help universities to respond more actively to market needs. We have presented hybrid organisations as one of the possible solutions, which create space for the development of UBC at different levels of institutional actors of universities, private sector and government. Remove, reduce or drive UBC barriers need be adapted to the specific cooperation activity (Henrekson and Rosenberg, 2001). There are supporting mechanisms which can be in form of policies, strategies, structures and activities (Davey et al., 2011), even if discussions tend to be too focussed on TTOs and incubators (Plewa, Quester and Baaken, 2006). Recent research on this theme argues that solving 'wicked problems' such as 'sustainability' requires the kind of cross-sector collaboration (Ferlie et al., 2011; Head and Alford, 2015) that is present in the Triple helix solution (Anttonen et al., 2018). The implementation of cross-sector collaboration will always result in the creation of a hybrid organization (Thomasson and Kristoferson, 2020). Solving these problems therefore requires equally complex approaches (Joosse and Teisman, 2020), with the involvement of multiple actors (Klijn and Koppenjan, 2012). The development of STPs created unique environment (spaces and facilities) for scientists, researchers, students and other external collaborators with a common goal - with research results at international level, applicable in practice and with regard to the national / regional needs. According to Edquist (2005), Almeida et al. (2020) and Friel and Vukotich (2018) we agree, that knowledge creation, consultancy services, commom infrastructure, networking, competence building, business

support, creation of new firms, community involvement and other key points like availability of finance support, ability to attract staff or growing company base make the STPs successful. In addition, we would like to add public relations (PR) as a tool for communication with others, good marketing (web pages, social networks) which proved to be the convenient basis for strategic cooperation.

Sub-objective No. 2: *Identify support tools for universities and specially for R&D and innovation projects by HEIs in programming period 2007-2013 in V4 countries with a focus on STPs.*

In the next steps under the Sub-objective No. 2, we looked at the regional distribution of support for R&D and innovation projects by universities in the 2007-2013 programming period, with a focus on STPs. The calls for setting up STPs and strengthening R&D networks and capacities were not place-based and had no regional specificities. Our analysis revealed an interesting subsiding of R&D and innovation projects which can help strenghten HEIs own research, internal educational procesess and collaboration with other innovation actor in economy ecosystem. Support for R&D priorities are traditionally concentrated in developed regions (regions of capital cities) where strong and constantly evolving innovation environment with is dependent greatly on local HEIs, companies and research institutions. Analyzing regional data, the highest support was allocated in the capital regions (Bratislava and Warszawa) and metropolitan areas. In case of Czech Republic was the highest support allocated not in capital region, but in the South Moravian region with the regions‘most developed city of Brno. In all compared countries, the highest share represents R&D priorities (with the highest in Slovakia). Comparing to trend of indicator GDP per capita in years 2010 and 2020 we can confirm that there has been a significant increase in all regions. Likewise, feedback between the participation in R&D and innovation activities and the building of learning and regional innovation capacities have mentioned in studies (Vence, 1998; Rodil, 2007; Varela-Vázquez, González-López and Sánchez-Carreira, 2019). Varela-Vázquez, González-López and Sánchez-Carreira (2019) underlines that unevenly geographical distribution of projects and funds in developed metropolitan regions leads to the reinforcement of pre-existing innovation and industrial centres. Rodríguez-Pose (2018) argues that place-sensitive policy intervention through specific regional development strategies could balance excellence criteria as well as aims of regional cohesion. This issue raises the debate on the reformulation of innovation policy with more importance to place-sensitive criteria to promote regional cohesion objectives.

Sub-objective No. 3: *Based on qualitative research - questionnaire survey and semi-structured interviews analyse the role of STPs in university ecosystem, analyse activities and services that contribute to the development of cooperation and innovation creation between universities and enterprises and to identify key barriers that limit them.*

Q1: Which of the theoretically defined activities and services are fulfilled by STPs in the V4 countries?

The results from qualitative research - questionnaire survey and semi-structured interviews indicate that STPs don't always have to be an innovative tool for improving UBC by realization of activities and services in university ecosystems. STPs are generally evaluated in literature and in practice as an exceptionally appropriate and successful mechanism for linking UBC. Within the common objective in programming period 2007-2013 of EU Funds was modernisation and improvement the support system for R&D, improvement of universities infrastructure to increasing the competitiveness of economy, reducing regional disparities, the creation of new innovative (high-tech) SMEs, the creation of new jobs and the improvement of the conditions of the educational process at universities. The data suggest that that STPs carry out mostly their own basic (61 %) and applied research (83 %). More than 80 % of entities carry out collaborative research with companies and another 10 % plan to do in the future. Other services - renting of premises and facilities - are currently provided by approximately 55 % of the entities. It seems that cooperation with other partners is very important for STPs - especially cooperation with international partners (almost 90 %). Similarly, they also engage in cooperation with regional or other actors (70 %). Country specifics show differences especially in ongoing activities in business incubators, establishing startups and business support services - Czech STPs have the highest share in these activities. The results show that despite the high support for setting up of STPs, they do not do all the functions that could help them to be successful. The creation of startups and spin-offs is also questionable because most of them only regularly use the spaces and facilities but are not fully established directly in the STPs (especially in Slovakia and Poland). The investments of university STPs in the Czech Republic show that systematic preparation and at least a focus on entrepreneurial culture bring success. We have not seen any studies presenting a problem or negative effect. The final mix of activities and services depends on single STPs, but more activities and services beyond the traditional university STPs, the higher chance for national and international cooperation with high added value.

We recommend that the STP's planned activities include rent of premises and facilities, joint and contract research, business services, incubators and active cooperation with regional and international partners (internationalization of R&D). Its role in creating, attracting, and clustering firms separates STPs from the universities. Compulsory participation in international projects (such as Horizon Europe or Timing) will be necessary. Interconnection of STPs at least at the country level (creation of national associations like in Spain, Portugal or United Kingdom), which would ensure continuous linkages and interdisciplinary involvement of different STPs. The survey showed that university employees have a lack of time for technology transfer with companies and do not want to be disturbed by the private sector. We recommend including outputs from joint projects with companies (e.g. new intellectual property, licensing, publishing) in the measurement criteria of the departments at the university - as it turned out, more emphasis is placed on those activities that constitute the evaluation criterion, therefore it is logical to assume that including outputs from cooperative activities in the measurement criteria will lead to higher motivation of people at universities to engage in these activities. Processes need to be set up for spin-off startups and their support. Spin-offs have potential and are a suitable channel to ensure technology transfer. However, there is no clear process and rules on how to go about setting them up. In addition, current processes are laden with unnecessary formalities that complicate and extend the establishment process, leading to a minimal effort to establish spin-offs. Making the establishment of spin-offs more flexible and transparent will increase interest in their establishment and promote technology transfer between academia and business. Further it is necessary, the creation of a position or department with competencies in the development of university-enterprise relations - a formal establishment that would create an interface between universities and enterprises and facilitate mutual communication, which has proved problems in the research. According to the principles of open innovation, enterprises do not have to carry out R&D themselves but should also use external sources of innovation. In this way they can improve their product portfolio and reduce the time to market for new products. Partnership with a university gives a company advantage over its competitors, e.g., by implementing research results before the university concludes and publishes the research.

The search for additional indicators for future measurement collaboration has potential, especially when secondary data is examined. Studies offer a wide range of collaboration forms that can be tracked - through knowledge creation in the form of own

and collaborative research (Almeida et al, 2020); services and activities provided (European Commission, 2014; Balog, 2019; Almeida et al., 2020); the number of companies established in STPs (Albahari et al. 2017, Guadix et al. 2016, Balog 2019, Almeida et al., 2020); networking and collaboration with partners in the region but also beyond (Almeida et al., 2020), results of collaborative research - number of patents and publications (European Commission, 2014; Albahari et al., 2017; Guadix et al., 2016; McCarthy et al., 2018; Balog, 2019; Almeida et al., 2020), strategies (McCarthy et al., 2018; Alegre, Berbegal-Mirabent and Guerrero, 2019), division of activities into ongoing and planned (Balog, 2019). On the other hand, it is very challenging to fullfil all these missions if university depends on a country's higher education law, government incentives and funding from responsible government ministries, but at the same time wants to strengthen and develop its institutional base. While the changing innovation landscapes focus on traditional formal intellectual property in patents, informal intellectual property grows (like data, processes, technology, knowledge, know-how, strategies, brand and reputation, supplier and customer relationships) (Autio et al. 2014, 2018). During the data collection of our research, we found good practise of collective success monitoring. The Association of Spain STPs has developed the methodology for monitoring and collecting data from its members. They collect 12 indicators of success from members (Campos, 2019): companies, turnover, investment in R&D, employees, employees per gender, employees in R&D, companies with foreign capital, companies in incubation, patents applied, patents granted, set-up companies, settled companies. Thanks to the compilation of these statistics every year, they can see the great impact and growth of the activity of Spanish STPs over the years. An appropriate measure of the success of a STP can be different. For universities as founders, in contrast, have generally focused on commercialisation of university research, attracting and funding excellent scientists, increasing publication activity and patent generation employment growth within in the STP as some success outcomes (Hobbs, Link and Scott, 2017).

> *Q2: What are the biggest barriers that limit UBC and sustainable development of university STPs?*

Based on our previous questionnaire survey results, we would like to know what are the biggest barriers that limit the fully exploitation of cooperation and sustainable development of university STPs and how can they be reduced. We agree with the STPs' statements that the biggest barrier is the lack of a strategy for science, research, and

innovation. Appropriate, clear and comprehensive strategic documents of a long-term nature would ensure the continuous functioning of STPs without major complications. It seems that other barriers such as lack of qualified staff, insufficient cooperation with other research partners or insufficient spatial capacity are not so important, or they are barriers that can be handled and solved. To strengthen cooperation in the STPs, it is also important to recognise and address the barriers that are impeded by the coordination process. For instance, previous Slovak control studies (Balog 2019, Supreme Audit Office of the Slovak Republic 2019) have highlighted the inefficiency of government funding. Athough there are many successful STPs in Europe (Utrecht Science Park, Kennispark Twente, Turku Science Park, Johanneberg Science Park), which can be suitable best practices for the V4 region, high investments and implementation of investments may not strengthen the UBC.

The results show that appropriate policy settings could have influenced the overall success of STPs at the national level. To make collaboration more effective and stronger, the first impulse is important - the willingness to cooperate and share university knowledge with the private sector. Financial barriers can be solved by active participation in projects outside the university. Eliminating administrative barriers - requiring complicated, unefficient and time-consuming processes - will provide greater flexibility for universities to collaborate with businesses, which is currently lacking and thus causes significant barriers to UBC. Accepting the view of Davey et al. (2011) that all these barriers are the result of lack of cooperation. These limitations - lack of trust and disinterest in cooperation cause that universities have weak links with the business sector, which results in poor cooperation on joint projects (contract research) and has an impact on the overall cooperation process. A lack of contact people and no appropriate initial contact person may further deepen the lack of interest in cooperation in future. Of the three countries surveyed, the biggest problem was, surprisingly, arranging meetings in Slovakia, as we wanted to achieve 100 % feedback. Arranging meetings in 7 STPs dragged on for more than 2 years with the fact that even just before submitting the dissertation we did not have answers from all respondents. This lack of interest of course stems from a general scepticism to make any statements on this sensitive topic. However, this lack of interest is also one of the reasons why the results show the failure and dissatisfaction of STPs in Slovakia. As we have also confirmed by talking to the MŠVVaŠ SR, which has confirmed the failure in terms of further sustainability support, which flows from the commitment to the European Commission. STPs should look beyond the financial benefits and in that sense communicate and try to cooperate beyond their "academic" capabilities. It is the difference between academic and business sense that is at

the origin of many problems. The perfect cooperation was with colleagues in the Czech Republic, where there was no problem with ad hoc meetings or communication. Overall, we perceive that in the Czech Republic STPs are an integral part of the universities, regional and national research and innovation system. They form a network of excellent and applied research and represent not only a university platform for the development of the most advanced technologies with a high knowledge intensity and the potential for application of university challenges in the modern innovative and international environment. Communication with regional governments is pleasant and both sides perceive and accept the weaknesses. From the point of view of satisfaction, we can say that STPs no longer expect further financial support for their operation, but only a systematic long-term and conceptual strategy for continuous development. In Poland we had a return rate of 47 %, as communication was also more difficult. We therefore recommend choosing and prepare a suitable communication strategy that will include fast communication from the founder - the university and will be easily accessible to the public - a web page with all contacts, activities, services and opportunities for collaboration, presence on social networks (Facebook, Instagram), podcasts with scientists, social activities and their presentation.

Sub-objective No. 4: *Describe the support mechanisms of the government in relation to the additional systematic support of STPs and the view of individual STPs on this support.*

Q3: How government suppport has influenced the setting up and operating of STPs in V4 countries?

In conclusion of analysis, we examine the position of government from view of STPs in case of government support processes and continuously supporting STPs as fostering collaboration between academia and the private sector on universities. We wanted to explore the role of the government in relation to direct financial support of economic activities and the nature of eligible activities that entities can carry out and we focused more on other topics (activities and services, barriers, government support). We found that 63 % of STPs perceive it as average, 17 % as good, no one perceives it as very good. On the other hand, 17 % perceive it as bad and 3 % as very bad. In this case of negative perception, it is mainly Slovak and Polish STPs. Almost 69 % of the Czech STPs perceive it as average and the other 22 % as good. So, there are several ways to improve it. From the government perspective, STPs should have clear support for the national research infrastructure by developing long-term

partnerships between universities and the private sector - solution maybe systematically support the long-term sustainability of STPs. Like ESFRI infrastructures - creating roadmaps with specific targets for individual years within monitoring periods on national level. Another solution would be to give more autonomy to universities, as the possibilities for university STPs to operate are significantly influenced by their organisational integration into universities. This causes that STPs must adopt process settings and evaluation criteria according to university guidelines. Universities are public institutions, which also negatively affects the flexibility of STPs especially in public procurement. Some universities and regions have dealt with these problems in their own way and STPs are part of university campuses but have a different legal form - for example as a consortium of government, business and universities in the region with their own foundation (Kennispark Twente or Utrecht Science Park in the Netherlands). The uncertainty around state aid must be dealt gradually and carefully, with predetermined rules on the use of STPs for economic activities, so that later there is inactivity of STPs or their use only for the university's own research. Clear and precise criteria for the evaluation of STPs must be established in advance so that the state does not just support the formal setting up of STPs without further control. To set up functional, successful and effective STPs, a suitable and clearly defined innovation policy setting with a clear objective of conditions, monitoring and methodology is necessary. Regulary monitoring by regulatory authorities can support realizing activities and services. An efficiently configured complex support system must be part of the setting up process of STPs.

Sub-objective No. 5: *Suggest recommendations to universities and governments towards better implementation of this type of projects regarding monitoring conditions.*
This part summarizes mainly the findings and recommendations that have been discussed in the previous parts of the discussion.

Table 8: Summary of findings and recommendations

FINDINGS	RECOMMENDATIONS
METHODOLOGICAL ISSUES	
Disadvantages of questionnaire survey and subjective assesments of respondets.	For future research we recommend collect secondary data. Questionnaires and interviews need to be repeated in 2-5 years to show progress.
Problems with arranging personal interviews (Slovakia).	We recommend prepare a suitable communication strategy that will include communication from the founder - the

	university and will be easily accessible to the public - a web page with all contacts, activities, services and opportunities for collaboration, presence on social networks (Facebook, Instagram).
UBC in STPs	
Lack of interest in the early stages of linking actors and finding common interests for the UBC.	Raise the level of awareness of participatory processes among the under-represented. segments of the business population (e.g. innovative start-ups, small businesses).
The data shows that the priority area of STP is the implementation of its own basic and applied research.	We recommend that the STP's planned activities include rent of premises and facilities, joint and contract research, business services, incubators and active cooperation with regional and international partners (internationalization of R&D).
More than half of the activities and services are less important for STPs, the most important being international cooperation and own research.	Each park should set its own strategy for co-operation, but at the same time does not avoid activities that have added value for university cooperation and involvement of scientists and students in the activities of the private sector.
BARRIERS	
There is no “one site fits all” policy approach to STPs support.	Goverments should support HEIs, public research institutions and the private sector in developing innovation activities with the maturity of science-industry linkages.
University employees have a lack of time for technology transfer with companies and do not want to be disturbed by the private sector.	We recommend including outputs from joint projects with companies (e.g., new intellectual property, licensing, publishing) in the measurement criteria of the departments at the university.
Insufficient research funding and changing operating configurations of government support.	STPs need a long-term sustainability and funding strategy, as short-term goals will not ensure their continued operation over a multi-year period. The creation of separate offices to manage and monitor STPs would help.
STPs also have a problem with legislative consolidation, as they are a direct part of university and are also subject to the Higher Education Act.	Take another legal form for STPs - for example, as a consortium of government, businesses and universities in the region, a foundation, or a non-profit organisation.
Negative perception of state support.	Create strategic documents and roadmap on national level to systematically support and monitoring. Give more autonomy to universities, as the possibilities for university STPs to operate are significantly influenced by their organisational integration into universities.

Source. own elaborations

CONCLUSION

This chapter concludes the dissertation by summarising the key findings of the research in relation to the research aims and research questions. It will also explore contribution to practise, dissertation limitations and suggest opportunities for future research.

Dissertation aims to analyse the role of university STPs as an innovative tool for improving university-business collaboration by realization of activities and services, and role of government support in the setting up and the operation of this tool. Based on theoretical implications, we wanted to show the support of hybrid organizations on the intersection of the Triple helix model. We wanted to share new insights into the formation and functioning of STPs in the V4 countries as one of the tools to connect the actors of the Triple helix model. In recent years, we can observe in V4 countries an increased emphasis on improving cooperation between academic and private sector through various initiatives, either directly from the university environment or through government agencies. We analyse the current state of UBC (years 2021-2023) through STPs, identifies the role of UBC at selected university STPs, support and identifies the main barriers from the perspective of individual actors.

The support from the EU Funds thus brought the possibility to implement the idea with limited university budgets. Our research has confirmed that despite the relatively high support from EU Funds implemented by governments, the results show that individual STPs are not satisfied with the support. The presented results show a significant country effect in the overall perception of setting up and supporting STPs, but also in the implementation and relevance of the relation of individual activities and services to the goal of promoting cooperation. As results show, the STPs in Slovakia and Poland are mainly carrying out activities related to their own research (basic or applied) and cooperation with international partners, which is generally done by HEIs. Although 2 types of infrastructures were supported in the Czech Republic - research and innovation infrastructures, both types are nevertheless also significantly engaged in many activities with the business sector and the region to ensure their functioning even after the end of the sustainability period. We agree with Almeida et al. (2020) that the setting up of STP should not be a panacea for structural problems, because a wrongly prepared STP concept will not bring positive effects. This is also the reason why the biggest barrier is the unclear conditions for monitoring STPs and the lack of a long-term systematic strategy for monitoring and continual operation in the future.

Important barriers include insuficient changing operating condition of state support, research funding and unclear evaluation of research infrastructures. The least important barriers, on the other hand, include poor time management, lack of cooperation between research institutions, and obsolete or missing infrastructure for specialized research. This raises questions such as: How can STPs be motivated and stimulated to engage more in entrepreneurial activities and use them for their own development?"

Last but not the least, we wished to ensure that this dissertation has strong implications to practise for all actors in Triple helix model, but especially for policy makers. The most important practical contribution of the dissertation is the applicability of the results of the conducted survey in the development and design of innovation policies and strategic objectives aimed at supporting universities, promoting the strengthening UBC with the private sector. When developing policies and fulfilling the targets set by the European Commission for EU countries, it is extremely important to avoid “pouring money down the drain”. This idiom for wasting money means that policy makers should not be reckless in making policies only for the sake of profit. If investments in STPs infrastructure are useless, if they do not increase innovation performance of countries through UBC, they are so-called cathedrals in desert of science, research, and innovation (Massey, Quintas and Wield, 2003). An analytical approach like evaluation of the conducted questionnaire survey and recommendations, which are part of the dissertation, can be used by governments as feedback for better policy setting, strategic planning, and setting of cooperation activities with the private sector as well as further planning of future cooperation processes. For individual STPs can be useful information from questionnaire survey, in which they can see the views of other actors on individual topics. The results could also be of interest to the private sector, as we can provide them with information on the activities and promises that individual STPs are making with the aim of establishing cooperation. Dissertation will be publicly available and made accessible to relevant departments under the responsibility of innovation policy directors, directors / managers / other employees interviewed, as well as to STPs, universities and private sector that have expressed interest in sending the results of our research.

This research is not without empirical and methodological limitations. The data used in research was collected through a questionnaire survey which was cross-sectional character. Considering the conclusion, we can say that there are still many unresolved research questions and directions that we have not addressed in our work due to time and

administrative capacity limitations. However, since the measurement of some of the research outcomes and statements in this research are based on the subjective assessment of the respondents (e.g., government support, barriers etc.), it would be difficult for the respondent to provide an accurate and clear assessment that is based on objective truthfulness. To examine more thoroughly how collaboration in STPs is evolving based on annual quantitative data (no. of collaborative firms and their specialization, no. of startups and spin-offs, common projects and grants, common projecst with students etc.), there are many topics and research questions that can be continued. We consider that in a period of 2 to 5 years these data will be much more accessible due to the independent management and monitoring of STPs on their own initiative and the need for progress. Future research that relies on longitudinal data is therefore recommended to more thoroughly investigate how UBC affects the success of STPs as well as their economic performance over time.

RESUMÉ

Postavenie univerzít v oblasti spolupráce so súkromným sektorom sa v priebehu rokov výrazne zmenilo. Pri prechode na znalostnú spoločnosť sa spolupráca univerzít a podnikov (ďalej angl. UBC) dostáva do čoraz väčšej pozornosti vlád, výskumníkov aj manažérov súkromného sektora. Univerzity aj podnikateľský sektor prešli významnými transformačnými procesmi, ktoré viedli k vytvoreniu nových foriem UBC so zameraním na riešenie hospodárskych výziev v krajinách. Základným predpokladom pre pochopenie spolupráce akademického a súkromného sektora je pochopenie vzájomných vzťahov medzi aktérmi modelu Triple helix, ktorý je teoretickým východiskom našej práce. Na priesečníku Triple helix modelu môžu byť vytvorené nezávislé hybridné organizácie v priestore prekrývajúcich sa sfér s cieľom riešiť inovačné prekážky. Procesom fungovania týchto organizácií v krajinách V4, ktoré zahŕňajú a kombinujú prvky zo sfér Triple helix, sa zaoberalo len niekoľko autorov. Preto sme sa rozhodli riešiť túto výskumnú medzeru v jednej z foriem hybridných organizácií, ktorá je podľa nášho názoru najkomplexnejšia – v univerzitných vedecko-technologických parkoch (ďalej angl. STPs). Hlavným cieľom vytvorenia STPs je posilnenie vzájomných interakcií aktérov v modeli Triple helix, ktoré patria medzi hlavné strategické politické priority definované Európskou komisiou na podporu dynamických interakcií v programovom období 2007 - 2013 (a samozrejme aj v ďalších a aktuálnych programových obdobiach).

Krajiny strednej a východnej Európy sú dlhodobo priemernými a rozvíjajúcimi sa inovátormi a miera UBC je v porovnaní s ostatnými európskymi krajinami nízka. V podobnej situácii je aj menšia skupina krajín - krajiny V4. S výnimkou rýchlo sa rozvíjajúcej a úspešnej Českej republiky sú ostatné tri krajiny väčšinou na konci inovačného rebríčka. V druhom programovom období fondov EÚ na roky 2007 - 2013 vlády vyhlásili niekoľko výziev na rozsiahle infraštruktúrne projekty STPs na univerzitách. Spoločným cieľom bola modernizácia, zlepšenie kvality výskumnej a inovačnej infraštruktúry a modernizácia podmienok pre vzdelávanie na vysokých školách (ďalej angl. HEIs) s prepojením na výsledky, ktoré možno realizovať v praxi. Týmto projektom predchádzalo vytvorenie menej komplexných projektov kompetenčných centier a centier excelentnosti. Na prvý pohľad jedinečná príležitosť na podporu národného a regionálneho výskumu a vývoja poukazuje na menej ambiciózne výsledky. Vzniknuté STPs, najmä na Slovensku a v Poľsku, ukázali nespokojnosť s podmienkami podpory a ďalšej udržateľnosti.

Hlavným predpokladom výberu témy dizertačnej práce bolo riešenie výskumnej medzery v súvislosti so STPs v krajinách V4. Všeobecný názor o STPs ako úspešnom nástroji podpory spolupráce HEIs a súkromného sektora vo svete potvrdili viacerí autori (Audretsch a Link, 2012; Alegre, Berbegal-Mirabent and Guerrero, 2019; Almeida a kol., 2020 a ďalšie prípadové štúdie v kapitole 4.1), ale vzhľadom na postupnú implementáciu tohto nástroja v krajinách V4 sme chceli pomocou hĺbkového kvalitatívneho výskumu zistiť, ako je to vo vybraných postsocialistických krajinách. Spočiatku sme, minimálne na Slovensku, dlhodobo pozorovali nespokojnosť a nízku úroveň spolupráce, ktorá sa prejavovala najmä na strane akademického sektora a univerzít, ktoré získali podporu na budovanie STP (Jakab, 2020). Negatívne vnímanie bolo takmer vždy spojené s nedostatkom finančných zdrojov na udržateľnosť zo strany vlád, ktoré pôvodne podporovali ich celkové budovanie. Najvyšší kontrolný úrad SR vo svojej správe z roku 2019 identifikoval viacero negatív a neštandardných postupov spojených s nastavením STP na Slovensku. Týkalo sa to aj novovzniknutých STP na vysokých školách, ktoré sú vo svete (ale najmä v Európe a USA) všeobecne vnímané ako dôležitý a úspešný nástroj zvyšovania kvality vysokoškolského prostredia a jeho prepojenia so súkromným sektorom. Tieto projekty mali významne podporiť UBC, preto sme neskôr výskum rozšírili na ďalšie tri krajiny V4 (Českú republiku, Poľsko a Maďarsko), kde sa tieto projekty pripravovali v rovnakom čase.

Hlavným cieľom dizertačnej práce *bolo analyzovať analyzovať úlohu univerzitných STP ako inovatívneho nástroja na zlepšenie spolupráce univerzít a podnikov prostredníctvom realizácie aktivít a služieb, a úlohu vládnej podpory pri vytváraní a fungovaní tohto nástroja.* Naším cieľom bolo priniesť nové poznatky o vzniku a fungovaní STPs v krajinách V4 ako jedného z nástrojov na prepojenie aktérov modelu Triple helix.

V záujme naplnenia hlavného cieľa sme dizertačnú prácu rozdelili do piatich kapitol. V kapitole 1 sme indentifikovali hlavné teoretické rámce, z ktorých naša dizertačná práca vychádza. Rozoberáme úlohu spolupráce v inovačných modeloch s dôrazom na Triple helix model, ktorý kladie dôraz na spoluprácu troch hlavných aktérov - univerzity, priemysel a vláda (Etzkowitz, 1993; Etzkowitz a Leydesdorff, 1995). Pre náš výskum sme si vybrali model Triple helix, pretože v jednej línii zdôrazňuje predovšetkým vysokoškolské vzdelávanie pre vznik inovácií a je kompatibilný so znalostnou ekonomikou. Hoci nové štúdie definovali ďalších aktérov v nových modeloch - Quadruple helix, Quintuple helix alebo N-tuple helix (Carayannis a Campbell, 2012), ktorí prispievajú k vzniku inovácií vzájomnou spoluprácou, tiež zväčša potvrdili, že hlavnými aktérmi sú univerzity, priemysel

a vláda, pretože zohrávajú najdôležitejšiu úlohu pri podpore inovácií. V súvislosti s UBC v modeli Triple helix sa na priesečníku aktérov modelu vytvárajú hybridné organizácie, ktoré predstavujú priestor, kde môže dochádzať k interakciám medzi aktérmi. Z hľadiska možností zlepšenia UBC opisujeme funkcie a atribúty hybridných organizácií ako nástroja UBC. Z hľadiska funkčnosti a priamych väzieb na univerzity sme sa zamerali na možnosti spolupráce týchto aktérov v spoločnom hybridnom priestore - STPs. Z nášho podrobného prehľadu literatúry vyplýva, že zatiaľ čo v západnej a severnej Európe sa tejto téme venovalo veľké množstvo autorov, výskum v krajinách V4 je veľmi obmedzený. Napriek tomu sme sa pokúsili vytvoriť vhodný teoretický koncept štúdií, ktoré zodpovedajú riešeniu danej problematiky a ponúkajú možné riešenia.

Kapitola 2 vysvetľuje inovačnú výkonnosť a UBC v krajinách V4 na základe medzinárodných ukazovateľov. Ciele výskumu sme predstavili v kapitole 3, z ktorej boli vypracované tri výskumné otázky pre naplnenie hlavného cieľa. V kapitole 4 sú preskúmané metodologické možnosti dizertačnej práce. Konkrétne výber a aplikácia kvalitatívnej výskumnych metód - dotazníkového prieskumu a pološtruktúrovaných rozhovorov a širší výskumný plán na realizáciu dotazníkového prieskumu. Vysvetlili sme výhody, nevýhody a obmedzenia výskumu vzhľadom na možnosti aplikované v danej oblasti a popísali sme dizajn pilotného a finálneho dotazníkového prieskumu. Kapitola 5 - časť výsledky prezentuje hlavné zistenia zberu a analýzy údajov, ktoré sme realizovali kvalitatívnym výskumom. Všetky relevantné výsledky uvádzame v logickom poradí od celkovej podpory STPs až po jednotlivé vybrané prvky STPs, ktoré sme hodnotili. V závere diskusie kombinujeme prínos výsledkov s porovnaním prehľadu literatúry a iných štúdií, navrhujeme odporúčania k hlavným zisteniam, navrhujeme možnosti ďalšieho výskumu a formulujeme závery.

Pre naplnenie hlavného cieľa výskumu sme si stanovili tri čiastkové ciele spolu s výskumnými otázkami:

1. Preskúmať teoretické poznatky riešenej problematiky v oblasti prepojenia aktérov modelu Triple helix. V rámci priestoru prekrývajúcich sa aktérov a posilňovania ich spolupráce definovať úlohu STPs a činnosti a služby, ktoré realizujú.

2. Identifikovať podporné mechanizmy pre HEIs, osobitne pre projekty výskumu, vývoja a inovácií v programovom období 2007 - 2013 v krajinách V4 so zameraním na STPs.

3. Na základe kvalitatívneho výskumu - dotazníkového prieskumu a pološtruktúrovaných rozhovorov analyzovať postavenie STPs v univerzitnom ekosystéme, analyzovať aktivity a služby, ktoré prispievajú k rozvoju spolupráce a tvorbe inovácií medzi univerzitami a podnikmi, a identifikovať kľúčové prekážky, ktoré ich obmedzujú.

   Q1: Ktoré z teoreticky definovaných činností a služieb plnia STPs v krajinách V4?
   Q2: Aké sú najväčšie prekážky, ktoré obmedzujú spoluprácu a udržateľný rozvoj univerzitných STPs ?

4. Popísať podporné mechanizmy vlády vo vzťahu k ďalšej systematickej podpore STPs a predstaviť pohľad jednotlivých STPs na túto podporu.

   Q3: Ako vládna podpora ovplyvnila zakladanie a fungovanie STP v krajinách V4?

5. Navrhnúť odporúčania pre univerzity a vlády smerom k lepšej realizácii tohto typu projektov, najmä pokiaľ ide o podmienky monitorovania.

Pri pohľade na metodologické prístupy, dizertačná práca sa najprv zaoberá stručnou analýzou UBC na základe kvantitatívnych údajov - najprv z hľadiska vyhodnotenia údajov z podporených projektov výskumu a vývoja v programovom období 2007 - 2013, pričom sa zameriava najmä na financovanie hybridných organizácií. Hlavným zdrojom údajov boli oficiálne webové stránky implementovaných štrukturálnych fondov v jednotlivých krajinách (Slovensko, Česká republika a Poľsko). Výsledky výskumu hodnotia prínos STPs na základe údajov získaných prostredníctvom nášho kvalitatívneho dotazníkového prieskumu a pološtruktúrovaných rozhovorov s jednotlivými STPs (viď Príloha 1). Výskum, ktorý sme uskutočnili s cieľom odpovedať na výskumné otázky dizertačnej práce bol rozdelený do troch fáz:

- *Prípravná fáza* - zahŕňala definovanie výskumných problémov a základných pojmov pre potreby teoretických východísk, formuláciu čiastkových cieľov dizertačnej práce, prehľad literatúry, štúdium strategických dokumentov a prípadových štúdií pre prípravu otázok dotazníkového prieskumu a rozhovorov, prípravu podkladov pre pilotný zber údajov (tvorba pilotného dotazníkového prieskumu), zber sekundárnych údajov pre zistenie východiskovej situácie v skúmanej oblasti,

- *Realizačná fáza* - zber a zhromažďovanie údajov (distribúcia dotazníkov, uskutočnenie osobných stretnutí, postupné spracovanie získaných údajov, medzinárodná výskumná mobilita pre doktorandov),

- *Hodnotiaca fáza* - analýza zozbieraných údajov, interpretácia výsledkov, formulácia odpovedí na výskumné otázky, prezentácia výsledkov a diskusia.

Pri tvorbe otázok v dotazníkovom prieskume sme vychádzali z viacerých štúdií, najmä z funkcií STPs, ktoré sme definovali v teoretických východiskách (Edquist 2005, Friel a Vukotich 2018, Almeida et al. 2020), a z identifikácie prekážok, ktoré obmedzujú realizáciu týchto aktivít a bránia rozvoju STPs. Zaujímala nás aj úloha vlády v oblasti riadenia a finančnej podpory s dôrazom na možnosti zvýšenia efektívnosti vládnej podpory vzhľadom na kritiku avizovanú v doterajšom výskume. Dotazníkový prieskum bol doplnený aj rozhovormi nielen so samotnými respondetami zo STPs, ale aj s ďalšími relevantnými aktérmi zo súkromnej sféry a vlády. Výskumnú vzorku tvorili iba tieto subjekty - univerzitné STPs v troch vybraných krajínách (Slovensko, Česká republika a Poľsko). Projekty STP boli financované z fondov EÚ v programovom období 2007 - 2013 so zameraním na zakladanie univerzitných STPs. Išlo o celkovú vzorku 44 STPs. Kvalitatívny zber údajov formou dotazníkového prieskumu a pološtruktúrovaných rozhovorov sa uskutočnil v niekoľkých fázach realizácie - pilotný dotazníkový prieskum na Slovensku v roku 2021, zber údajov počas výskumnej mobility (Česká republika), dotazníkový prieskum a pološtruktúrované rozhovory (Česká republika, Slovensko, Poľsko). Dotazníkový prieskum sa uskutočnil v dvoch etapách. Priebeh a nastavenie nášho pilotného prieskumu bolo navrhnuté na základe podobného prieskumu, ktorý sa na Slovensku uskutočnil už v roku 2017 (Balog, 2019).
V záverečnom dotazníkovom prieskume sme oslovili celkovo 44 subjektov z troch krajín - Slovensko - 7 STPs, Česká republika - 20 STPs a Poľsko - 17 STPs. Návratnosť finálneho dotazníka je celkovo 68 % (86 % zo Slovenska - 6 STPs, 80 % z Českej republiky - 16 STPs a 47 % z Poľska - 8 STPs. Celkovo sme v niekoľkých kolách dotazníkového prieskumu zozbierali odpovede od 30 subjektov a uskutočnili 12 pološtruktúrovaných rozhovorov. V prípade Maďarska neboli v programovom období podporené tieto typy projektov. Na potvrdenie tohto tvrdenia sme sa pokúsili kontaktovať niekoľko oficiálnych orgánov - Ministerstvo pre inovácie a technológie (vedúci kancelárie štátneho tajomníka pre fondy EÚ), Stále zastúpenie Maďarska pri Európskej únii a ďalších kolegov z partnerských univerzít v Maďarsku. Zistili sme, že žiadne výzvy na zriadenie STPs sa v tomto programovom období neuskutočnili. Prvé výzvy s podporou vlády sa objavili až v roku 2019.

Dáta o podporených projektoch v Maďarsku sme preto nezbierali, pretože ich získanie bolo mimoriadne časovo a technicky náročné, čo mohlo ohroziť realizáciu výskumu na úkor iných krajín.

Finálny dotazník pozostával z 12 otázok (v Českej republike a Poľsku z 13 otázok), ktoré sme rozdelili do niekoľkých tematických okruhov. Dotazník obsahoval štyri otvorené a osem uzavretých otázok (Príloha 2). Otázky sme sa snažili zostaviť tak, aby boli pre respondentov čo najmenej citlivé, ale zároveň sme chceli zistiť dôležité informácie potrebné pre náš výskum. Okrem základných informácií nás zaujímala motivácia univerzity (prvotný impulz) pre založenie STP, stručný popis zdrojov financovania na príklade ročnej prevádzky, hodnotenie úspešnosti na základe merateľných ukazovateľov, sebahodnotenie, aktivity a služby realizované v STPs, bariéry spolupráce a ďalšieho rozvoja, vnímanie podpory zo strany štátu a možnosti ďalšieho kontinuálneho fungovania. V prípade dotazníkov pre Českú republiku a Poľsko bola pridaná aj otázka, či boli zapojené do vládnych programov na podporu infraštruktúry.

Výsledky kvalitatívneho výskumu - dotazníkového prieskumu a pološtruktúrovaných rozhovorov naznačujú, že STPs nemusia byť vždy inovatívnym nástrojom na zlepšenie UBC prostredníctvom realizácie aktivít a služieb v univerzitných ekosystémoch. STPs sú vo všeobecnosti v literatúre a v praxi hodnotené ako mimoriadne vhodný a úspešný mechanizmus na prepojenie UBC. V rámci spoločného cieľa v programovom období 2007 - 2013 fondov EÚ bolo hlavným cieľom modernizácia a skvalitnenie systému podpory výskumu a vývoja, zlepšenie infraštruktúry vysokých škôl na zvýšenie konkurencieschopnosti ekonomiky, zníženie regionálnych rozdielov, vznik nových inovatívnych (high-tech) malých a stredných podnikov, tvorba nových pracovných miest a zlepšenie podmienok vzdelávacieho procesu na vysokých školách. Z údajov vyplýva, že STPs realizuje najmä vlastný základný (61 %) a aplikovaný výskum (83 %). Viac ako 80 % subjektov realizuje výskum v spolupráci s podnikmi a ďalších 10 % to plánuje v budúcnosti. Ostatné služby - prenájom priestorov a zariadení - v súčasnosti poskytuje približne 55 % subjektov. Zdá sa, že spolupráca s inými partnermi je pre STPs veľmi dôležitá - najmä spolupráca so zahraničnými partnermi (takmer 90 %). Podobne sa zapájajú aj do spolupráce s regionálnymi alebo inými subjektmi (70 %). Špecifiká jednotlivých krajín ukazujú rozdiely najmä v prebiehajúcich aktivitách v oblasti podnikateľských inkubátorov, zakladania nových podnikov a služieb na podporu podnikania - české STPs majú v týchto aktivitách najvyšší podiel. Výsledky ukazujú, že napriek vysokej podpore, STPs nevykonávajú všetky funkcie,

ktoré by im mohli pomôcť k úspechu. Otázny je aj vznik startupov a spin-offov, pretože väčšina z nich len pravidelne využíva priestory a zariadenia, ale nie sú plne etablované priamo v STPs (najmä na Slovensku a v Poľsku). Investície do univerzitných STPs v Českej republike ukazujú, že systematická príprava a zameranie na podnikateľskú kultúru prinášajú úspech. Nezaznamenali sme žiadne štúdie, ktoré by prezentovali problém alebo negatívny efekt. Finálny mix aktivít a služieb závisí od jednotlivých STPs, ale čím viac aktivít a služieb nad rámec tradičných univerzitných, tým väčšia šanca na národnú a medzinárodnú spoluprácu s vysokou pridanou hodnotou. Odporúčame, aby plánované aktivity STPs zahŕňali prenájom priestorov a zariadení, spoločný a zmluvný výskum, služby pre podniky, inkubátory a aktívnu spoluprácu s regionálnymi a medzinárodnými partnermi (internacionalizácia výskumu a vývoja). Jeho úloha pri vytváraní, priťahovaní a zoskupovaní firiem odlišuje STPs od univerzít. Bude potrebná povinná účasť na medzinárodných projektoch (ako je Horizon Europe alebo Timing). Odporúčame vzájomné prepojenie STPs aspoň na úrovni jednotlivých krajín (vytvorenie národných združení ako v Španielsku, Portugalsku alebo Spojenom kráľovstve), ktoré by zabezpečilo kontinuálne prepojenie a interdisciplinárne zapojenie rôznych STPs.

Prieskum ďalej ukázal, že zamestnanci univerzít majú nedostatok času na transfer technológií s firmami a nechcú byť rušení súkromným sektorom. Odporúčame zahrnúť výstupy zo spoločných projektov s firmami (napr. duševné vlastníctvo, licencie, publikačná činnosť) do kritérií hodnotenia STPs - ako sa ukázalo, väčší dôraz sa kladie na tie aktivity, ktoré tvoria hodnotiace kritérium, preto je logické predpokladať, že zahrnutie výstupov z kooperačných aktivít do kritérií hodnotenia povedie k vyššej motivácii ľudí na univerzitách venovať sa týmto aktivitám. Je potrebné nastaviť procesy pre vznik spin-offov, startupov a ich podporu. Spin-off podniky majú potenciál a sú vhodným kanálom na zabezpečenie transferu technológií. Okrem toho sú súčasné procesy zaťažené zbytočnými administratívnymi formalitami, ktoré komplikujú a predlžujú proces zakladania, čo vedie k minimálnemu úsiliu o založenie spin-offov. Flexibilnejšie a transparentnejšie zakladanie spin-offov zvýši záujem o ich zakladanie a podporí transfer technológií medzi akademickou obcou a podnikmi. Ďalej je potrebné vytvorenie pozície alebo oddelenia s kompetenciami v oblasti rozvoja vzťahov medzi univerzitami a podnikmi - formálne zriadenie, ktoré by vytvorilo rozhranie medzi univerzitami a podnikmi a uľahčilo vzájomnú komunikáciu, ktorá sa vo výskume ukázala ako problematická. Podľa zásad otvorených inovácií podniky nemusia vykonávať výskum a vývoj samy, ale mali by využívať aj externé zdroje inovácií. Takto môžu zlepšiť svoje portfólio výrobkov a skrátiť čas uvedenia nových výrobkov na trh.

Partnerstvo s univerzitou poskytuje podniku výhodu oproti konkurencii, napr. tým, že implementuje výsledky výskumu skôr, ako univerzita výskum uzavrie a zverejní.

Na základe výsledkov dotazníkového prieskumu sme chceli vedieť, aké sú najväčšie prekážky, ktoré obmedzujú plné využitie spolupráce a udržateľný rozvoj univerzitných STPs a ako ich možno zmierniť. Súhlasíme s vyjadreniami respondentov, že najväčšou prekážkou je chýbajúca stratégia pre vedu, výskum a inovácie. Vhodné, jasné a komplexné strategické dokumenty dlhodobého charakteru by zabezpečili kontinuálne fungovanie STPs bez väčších komplikácií. Zdá sa, že ostatné prekážky, ako je nedostatok kvalifikovaných pracovníkov, nedostatočná spolupráca s inými partnermi v oblasti výskumu alebo nedostatočné priestorové kapacity, nie sú až také dôležité, resp. ide o prekážky, ktoré sa dajú zvládnuť a z krátkodobého alebo dlhodobého hľadiska vyriešiť. Na posilnenie spolupráce v rámci STPs je dôležité rozpoznať a riešiť aj prekážky, ktoré bránia procesu koordinácie. Napríklad predchádzajúce slovenské kontrolné štúdie (Balog, 2019; Najvyšší kontrolný úrad SR, 2019) upozornili na neefektívnosť financovania zo strany štátu. Hoci v Európe existuje mnoho úspešných STP (Utrecht Science Park, Kennispark Twente, Turku Science Park, Johanneberg Science Park), ktoré môžu byť vhodnými osvedčenými pre krajiny V4, vysoké investície a realizácia investícií nemusia posilniť UBC.

Výsledky ukazujú, že vhodnejšie nastavenie politiky mohlo ovplyvniť celkový úspech STPs na národnej úrovni. Na zefektívnenie a posilnenie spolupráce je dôležitý prvý impulz - ochota spolupracovať a zdieľať poznatky univerzít so súkromným sektorom. Finančné bariéry sa dajú vyriešiť aktívnou účasťou na projektoch mimo univerzity. Odstránenie administratívnych prekážok - vyžadujúcich komplikované, neefektívne a časovo náročné procesy - poskytne univerzitám väčšiu flexibilitu pri spolupráci s podnikmi, ktorá v súčasnosti chýba a spôsobuje tak významné prekážky. Ak akceptujeme názor Daveyho a i. (2011), že všetky tieto prekážky sú výsledkom nedostatočnej spolupráce. Tieto obmedzenia - nedostatok dôvery a nezáujem o spoluprácu spôsobujú, že univerzity majú slabé väzby s podnikateľským sektorom, čo má za následok slabú spoluprácu na spoločných projektoch (zmluvný výskum) a má vplyv na celkový proces spolupráce.

V závere analýzy výsledkov skúmame pozíciu vlády z pohľadu STPs v prípade procesov kontinuálnej vládnej podpory. Chceli sme preskúmať úlohu vlády vo vzťahu k priamej finančnej podpore ekonomických aktivít a charakteru oprávnených aktivít, ktoré môžu subjekty vykonávať. Zistili sme, že 63 % STPs ju vníma ako priemernú, 17 % ako dobrú, nikto ju nevníma ako veľmi dobrú. Na druhej strane 17 % ju vníma ako zlú a 3 % ako veľmi zlú. V prípade tohto negatívneho vnímania ide najmä o slovenské a poľské STPs.

Takmer 69 % českých STPs podporu vníma ako priemernú a ďalších 22 % ako dobrú. Existuje teda niekoľko možností, ako ju zlepšiť. Z pohľadu vlády by STPs mali mať jasnú podporu národnej výskumnej infraštruktúry prostredníctvom rozvoja dlhodobých partnerstiev medzi univerzitami a súkromným sektorom – riešením možno systematicky podporovať dlhodobú udržateľnosť STPs. Podobne ako infraštruktúry ESFRI - vytvorenie cestovných máp s konkrétnymi cieľmi pre jednotlivé roky v rámci monitorovacích období na národnej úrovni. Ďalším riešením by bolo poskytnutie väčšej autonómie univerzitám, keďže možnosti fungovania univerzitných STPs sú výrazne ovplyvnené ich organizačným začlenením do univerzít. To spôsobuje, že STPs musia prijať nastavenie procesov a hodnotiace kritériá podľa univerzitných smerníc. Univerzity sú verejnými inštitúciami, čo tiež negatívne ovplyvňuje flexibilitu STP najmä v oblasti verejného obstarávania. Niektoré univerzity a regióny sa s týmito problémami vysporiadali po svojom a STPs sú súčasťou univerzitných areálov, ale majú inú právnu formu - napríklad ako konzorcium vlády, podnikov a univerzít v regióne s vlastnou nadáciou (Kennispark Twente alebo Utrecht Science Park v Holandsku). Neistotu okolo vládnej podpory je nutné riešiť postupne a opatrne, s vopred stanovenými pravidlami využívania STPs na hospodárske činnosti, aby neskôr nedošlo k ich nečinnosti alebo ich využívaniu len na vlastný výskum univerzity. Vopred treba stanoviť jasné a presné kritériá hodnotenia STPs, aby štát nepodporoval len formálne zakladanie STPs bez ďalšej kontroly. Na zriadenie funkčných, úspešných a efektívnych STPs je potrebné vhodné a jasne definované nastavenie inovačnej politiky s jasným cieľom podmienok, monitorovania a metodiky. Monitorovanie zo strany regulačných orgánov môže podporiť realizáciu aktivít a služieb. Súčasťou procesu vytvárania STPs musí byť efektívne nastavený komplexný podporný systém.

Na záver, náš výskum potvrdil, že napriek relatívne vysokej podpore z fondov EÚ realizovanej vládami, výsledky ukazujú, že jednotlivé STPs nie sú s touto podporou spokojné. Prezentované výsledky poukazujú na výrazné rozdiely na úrovni krajín v celkovom vnímaní zakladania a podpory STPs, ale aj v realizácii a relevantnosti vzťahu jednotlivých aktivít a služieb s cieľom podpory spolupráce. Ako ukazujú výsledky, STPs na Slovensku a v Poľsku realizujú najmä aktivity súvisiace s vlastným výskumom (základným alebo aplikovaným) a spoluprácou so zahraničnými partnermi, ktorú spravidla vykonávajú vysoké školy štandardne. Hoci v Českej republike boli podporené 2 typy infraštruktúr - výskumná a inovačná, oba typy sa napriek tomu významne zapájajú aj do mnohých aktivít s podnikateľským sektorom a regiónom, aby sa zabezpečilo ich fungovanie aj po skončení

obdobia udržateľnosti. Súhlasíme s Almeidom et al. (2020), že zriadenie STPs by nemalo byť všeliekom na štrukturálne problémy, pretože nesprávne pripravená koncepcia STPs neprináša pozitívne efekty. Aj preto sú najväčšou prekážkou nejasné podmienky monitorovania STPs a chýbajúca dlhodobá systematická stratégia monitorovania a nepretržitej prevádzky v budúcnosti. K dôležitým bariéram patrí nedostatočná a meniace sa podmienky fungovania štátnej podpory, financovanie výskumu a nejasné hodnotenie výskumných infraštruktúr. Na druhej strane medzi najmenej významné bariéry patrí časový manažment, nedostatočná spolupráca medzi výskumnými inštitúciami a zastaraná alebo chýbajúca infraštruktúra pre špecializovaný výskum. To vyvoláva otázky, ako napr: Ako možno motivovať a stimulovať STPs, aby sa viac zapájali do podnikateľských aktivít a využívali ich na vlastný rozvoj?"

V neposlednom rade chceme dosiahnuť to, aby táto dizertačná práca mohla mať aj praktické implikácie pre všetkých aktérov Triple helix modelu, ale najmä pre tvorcov politík. Najdôležitejším praktickým prínosom dizertačnej práce je využiteľnosť výsledkov uskutočneného dotazníkového prieskumu pri tvorbe a navrhovaní inovačných politík a strategických cieľov zameraných na podporu vysokých škôl, podporu posilňovania spolupráce so súkromným sektorom. Pri tvorbe politík a napĺňaní cieľov stanovených Európskou komisiou pre krajiny EÚ je mimoriadne dôležité vyhnúť sa nevhodne implementovaným investičným projektom. Pretože, ak sú investície do infraštruktúry STPs zbytočné, ak nezvyšujú inovačnú výkonnosť krajín prostredníctvom UBC, sú to tzv. katedrály v púšti vedy, výskumu a inovácií (Massey, Quintas a Wield, 2003). Analytický prístup, akým je vyhodnotenie uskutočneného dotazníkového prieskumu a odporúčania, ktoré sú súčasťou dizertačnej práce, môžu vlády využiť ako spätnú väzbu pre lepšie nastavenie politík, strategické plánovanie a budúce nastavenie aktivít spolupráce so súkromným sektorom, ako aj ďalšie plánovanie budúcich procesov spolupráce. Pre jednotlivé STPs môžu byť užitočné informácie z dotazníkového prieskumu, v ktorom môžu vidieť názory ostatných subjektov na jednotlivé témy. Výsledky by mohli byť zaujímavé aj pre súkromný sektor, keďže vieme poskytnúť informácie o aktivitách a službách, ktoré jednotlivé STPs realizujú s cieľom nadviazať spoluprácu. Dizertačná práca bude verejne dostupná a sprístupnená príslušným rezortom a respondentom, s ktorými sme viedli rozhovory a dotazníkový prieskum, ako aj samotným STPs, univerzitám a súkromnému sektoru, ktoré prejavili záujem o zaslanie výsledkov nášho výskumu.

Tento výskum nebol bez empirických a metodologických obmedzení. Údaje použité vo výskume boli získané prostredníctvom dotazníkového prieskumu, ktorý mal prierezový charakter. V závere môžeme konštatovať, že v našom výskume ostáva ešte veľa nevyriešených výskumných otázok a smerov, ktorým sme sa z rôznych dôvodov (časových, administratívnych, kapacitných) nevenovali. Keďže niektoré výsledky výskumu boli založené na subjektívnom hodnotení respondentov (napr. podpora vlády, prekážky a pod.), bolo by pre respondentov náročné reflektovať hodnotenia založené na objektívnej pravdivosti. Pre dôkladnejšie preskúmanie vyvoja spolupráce v STPs by sme v budúcnosti chceli preskúmať kvantitatívne údaje na ročnej báze (počet spolupracujúcich firiem a ich špecializácia, počet startupov a spin-offov, spoločné projekty a granty, spoločné projekty so študentmi atď). Domnievame sa, že v období o 2 až 5 rokov budú tieto údaje oveľa dostupnejšie vzhľadom na nezávislejšie riadenie a monitorovanie STPs z vlastnej iniciatívy a zyvšujúcej sa potreby pokroku. V budúcnosti preto odporúčame výskum rozšíriť o kvantitívne údaje pre dôkladnejšie preskúmanie, ako UBC ovplyvňuje úspešnosť STPs, ako aj ich hospodárske výsledky v čase.

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APPENDICES

Appendix 1 List of contacted university STPs and added respondents (managers) to the interviews in selected countries

Appendix 2 Questionnaire survey