


EXPLORING THE APPROACHES TOWARDS SUPPORT OF ACADEMIC ENTREPRENEURSHIP: EVIDENCE FROM AN EMERGING MARKET

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Abstract. Over the past three decades, an exponentially growing body on elements and actors of the concept of an entrepreneurial university has emerged. Compared to its western European counterparts, however, the idea of the third role of the university has only recently been implemented in Central and Eastern European countries, and thus both research and entrepreneurial practice grapple with empirical results. In this paper, we attempt to fill this gap while adopting a case study approach to examine the issue of what resources a prominent technical university operating in the emerging market of the Czech Republic transfers to academic ventures to utilise and commercialise university research results. Within a survey, nine academic founders and two university representatives were interviewed to assess the role of university resources in facilitating academic entrepreneurship. Our research results suggest that creating infrastructure to foster the third role of universities in an emerging market is a complex and long-term issue. Formal institutions embedded in the intra-university organisational structure, such as knowledge transfer offices and entrepreneurial centres, need to be equipped with sufficient resources and competences. Skilled people with their own network of contacts to intra-university departments and external environment represented by regional incubators, venture capital providers, business angel associations, and experienced entrepreneurs should be involved in the process of creating and increasing capacity. Furthermore, the upcoming agenda should undoubtedly acknowledge the significant role of entrepreneurship education with a focus on talent recognition and entrepreneurship training to impact the entrepreneurial intentions of researchers and students. Overall, we also conclude that the motivation of academics to commercialise their inventions could be positively affected by the applied concepts of assessing their performance. Finally, this study shows that measures at all management levels have to be adopted to create a vital organisational culture that will be in alignment with the vision of entrepreneurial university. The novelty of this paper is twofold. First, the study provides a useful methodological concept of data collection as the multi-level approach was applied for studying the phenomenon of entrepreneurial university. Furthermore, the research findings have valuable implications for university authorities, as well as national and local policy makers, in creating growth programmes and supporting the entrepreneurial mindset.

Keywords: knowledge economy, academic entrepreneurship, university start-up, university spin-off, knowledge transfer, technology transfer, emerging market, innovation, development.

JEL Classification: I23, O31, O32.

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1. Introduction

Since the early 1980s, there has been a fundamental shift in the perception of the mission of universities. They are no longer expected to be solely responsible for human capital education and basic research, the results of which are predominantly published in the form of academic

research papers (Odei & Novak, 2023; Hrivnák et al., 2023; Lee & Lee, 2020). Increasingly, the third role of universities in the context of technological and economic development is being emphasised. As noted by Bonaccorsi et al. (2022), the third mission mainly refers to patenting of academic research, patent licencing to an industrial partner, transferring the results of scientific and technological research to the market, and academic entrepreneurship. In other words, universities and other higher educational institutions should not only play a prominent role in education, knowledge generation, and protection of novel technologies. More recently, licencing and exploiting these technologies through established university industrial partners or academic entrepreneurial ventures (start-ups and spin-offs), and building a significant role in national and regional innovation systems, have been interpreted as the final goal of commercialising university research (Ortín-Ángel & Vendrell-Herrero, 2010; Świadek et al., 2022; Dzikowski, 2022). This situation is the obvious result of growing awareness of the prominent role of the young entrepreneurs (Balcerzak et al., 2023; Skalická et al., 2023), as entrepreneurial intentions are widely understood as an indispensable source of economic growth and development (Sabary & Kljunikov, 2023; Sabary et al., 2023; Diaz Tautiva et al., 2023). Recently, more suitable concepts of the third role have been discussed, namely a sustainable entrepreneurial university reflecting the dual logics of being economically responsible and being socially responsible (Cai & Ahmad, 2023; Lattu & Cai, 2020).

Academic entrepreneurship is commonly defined as an institutional transfer of intellectual property to a new entrepreneurial venture for the purpose of exploiting it (Pazos et al., 2012; Beckman & Cherwitz, 2009; Burg et al., 2008). The terms spin-off and start-up are most often used in connection with academic entrepreneurship. While academic start-ups are commonly defined as a whole set of firms established by students and academics, university spin-offs are only a subset of all start-ups created. Thus, as noted by Colombo and Piva (2008), new ventures originating from academic institutions do not represent a homogeneous group. Spin-offs typically differ from start-ups in that, while the former exploit intellectual property or patented inventions received through a formal transfer (e.g., a licence), the latter category exists without a formal transfer of IP. In this case, the key inventors who are a part of the founding team have tacit knowledge that cannot be licenced or exploited in cooperation with a third party. Setting up a new start-up firm seems to be the most appropriate way how to commercially exploit this knowledge (Pedro et al., 2019; Rasmussen & Wright, 2015; Colombo & Piva, 2008).

Universities are applying various instruments to foster academic entrepreneurship. Hrivnák et al. (2023) provide an analysis of the most prominent evolutionary stage-based models of academic spin-off support. Based on a comprehensive review of the literature, the authors identified, e.g., “earlier stage models” focused on supporting the creation of a spin-off within the university and “classical stage models” that emphasise the role of the university in the pre and post-establishing of a spin-off firm. Parmentola and Ferretti (2018) proposed a theoretical framework to better understand academic spin-off development in southern Italy. The framework combines two perspectives, the stages of spin-off creation and factors determining development of a spin-off. The authors present a series of approaches that can be verified in further studies. De Cleyn and Braet (2010) aimed at providing an overview of the main models in the spin-off research, such as evolution models. The authors conclude

that these models are inadequate because they do not capture the real-life situation. Hence, a new integrative model was proposed in the paper that incorporates the dynamically changing nature of academic spin-off evolution and the major peripheral aspects. Gübeli and Doloreux (2005) were concerned with the process by which a university spin-off is established and formed. The main characteristics of academic firms generated by this process were analysed as well as how the networking with the parent organisation and the local ecosystem during this process has been facilitated.

In this context, assessing resources that are relevant in terms of promoting academic entrepreneurship is essential as without financial, personal, and material support high-quality research outputs with commercialisation potential can hardly be expected (Odei & Novak, 2023; Duong, 2023). Lee and Lee (2020) distinguish between personal resources related to HR and institutional resources related to the university. Considerable research has been conducted on institutional resources, since universities or their affiliated entrepreneurship centres are traditionally providers of education, training, networking programmes and facilities such as university incubators and science parks to support young entrepreneurial projects (Hrivnák et al., 2023; Neves & Franco, 2018; Burg et al., 2008).

With a significant time lag behind their West European counterparts, universities in Central and Eastern Europe (CEE) have just recently reinterpreted their role and started implementing the third mission to become more entrepreneurial orientated and to contribute to the development of local entrepreneurial ecosystems and societies. Specifically, they learn what measures and approaches might be effective taking into account the specific institutional context (Hrivnák et al., 2023; Nowiński et al., 2019).

An integral understanding of the determinants of creating academic start-ups and spin-offs in CEE is still in its infancy. Therefore, this study aims to explore the issue of *how university resources contribute to the dynamics of academic start-ups and spin-offs creation in the context of one of the most prominent technical universities in the Czech Republic*. More specifically, based on a survey among academic founders and university representatives, we seek to broaden our understanding of relevant university resources that contribute to the creation of academic ventures and propose measures that higher education institutions operating in the emerging market of Czechia could adopt to encourage an entrepreneurial mindset.

To the best of our knowledge, there is a lack of studies that have examined knowledge transfer practices adopted by universities in the CEE region, educational, scientific, and entrepreneurial profiles of academic founders operating here, as well as their perceptions the university resources and the local start-up ecosystem should play in creating academic ventures. Therefore, this study connects theoretical knowledge about how to promote academic ventures to empirical evidence on practical attitudes applied by a higher education institution operating in an emerging market. Although this article presents an in-depth analysis of a specific example, we believe it has valuable implications at both the local and international level, as advancing the concept of entrepreneurial universities is at the forefront of EU and national government policy. Therefore, transferring our research findings that address the practices and challenges of building an entrepreneurial university could be valuable in creating local growth programmes and supporting the entrepreneurial mindset in other ecosystems and environments.

The remainder of this paper is organised as follows. Section 2 reviews the literature on the creation of university start-ups and spin-offs. The following section presents the data and methods. Finally, key findings of the empirical study as well as limitations are provided and discussed.

2. Review of literature

Multiple studies have confirmed that universities and other higher educational institutions play an important role in the development of regional and national entrepreneurial ecosystems that strengthen competitiveness and economic growth (Lee & Lee, 2020; van Stijn et al., 2018; Rasmussen & Wright, 2015). First, universities are a prominent provider of highly trained and educated workforce (Hassan et al., 2021; Doanh Duong, 2024; Wach & Bilan, 2023) and thus contribute significantly to a suitable environment for the development of the knowledge-based economy (Bonaccorsi et al., 2022; Civera et al., 2020; Bigos & Milka, 2024). Second, universities perform generic and applied research activities with a significant impact on society while sharing and disseminating it through scientific partnerships (van Stijn et al., 2018; Lockett et al., 2003; Meseri & Maital, 2001). Beyond the licencing of intellectual property rights to well-established companies, there is an increasing effort to transfer knowledge through creating university start-ups and spin-offs (Brantnell & Baraldi, 2022; Lee & Lee, 2020; Burg et al., 2008). Recently, more attention has been drawn to the issue of how to transform the concept of entrepreneurial university to take responsibility for sustainable development (Cai & Ahmad, 2023). Universities are expected to take on new roles and responsibilities with respect to the climate and ecological crisis. There is a general agreement that universities should incorporate high-impact education about the climate and ecological crisis into their educational programmes, as university graduates have a disproportionate influence on political and economic development (Dyke & Monbiot, 2024).

The vast majority of research on academic entrepreneurship emphasises the importance of the institutional framework as a prerequisite for successful knowledge transfer (Kuczewska & Tomaszewski, 2022). In this context, Etzkowitz (2017) provides empirical evidence on how the classic model of Humboldtian university can be transformed into a Triple Helix of university-industry-government interactions while analysing MIT and Stanford as the most prominent examples of entrepreneurial universities and emphasises how this model can contribute to a knowledge-based regional development that has become increasingly common in the US and globally.

Similarly to MIT and Stanford, other universities in the US and their west European counterparts have established institutional infrastructure including, inter alia, knowledge or technology transfer offices (KTOs, TTOs) over the period of the last 30 years. These intra-university units together with entrepreneurship centres are in charge of identifying promising university research, assess the protection potential of inventions, promote their commercialisation, and provide educational activities, training, and events to promote the protection of IPR and facilitate opportunities for cooperation between scientists and entrepreneurs (Brantnell & Baraldi, 2022; Civera et al., 2020; Ismail et al., 2010).

Burg et al. (2008, p. 125) studied spin-off creation at a Dutch university and distinguish “two fundamentally different phases” in creating capacity for academic entrepreneurship. Within the first stage, an infrastructure for start-up and spin-off creation must be established. This infrastructure is mainly represented by an interlinked network of investors, managers, and advisors, which in the following stage aims to support academic entrepreneurs in their activities in various forms, such as targeted education and networking with industry, capital providers, and other external stakeholders. The authors conclude that in order to promote academic entrepreneurship, universities should design and implement measures that will raise awareness of the opportunities offered by entrepreneurship, screen entrepreneurial ideas within programmes aimed at both students and academic staff, and provide access to the right mix of entrepreneurial skills, resources, and collaborative networks. Equally important is the formation of an organisational culture within the university that will create a motivating environment for founders. Finally, clear rules must be defined that regulate the process of creating start-ups and spin-offs. Ismail et al. (2010) analysed the process of decision making on commercialisation of patents through creating spin-offs at a Scottish university. A theoretical framework was developed highlighting the importance of institutional factors such as origin of sources of R&D funding, availability of financing for the different stages of the life cycle of spin-offs, and existence of strong networks with external investors. Furthermore, the authors noted that the university TTO should have entrepreneurial competency, i.e., its staff should be able to recognise opportunities, have skills in legal aspects of patents and patenting, and have good links with individual university departments and funding providers. Build on qualitative evidence, Siegel et al. (2003) focused on assessing the impact of organisational practices on the performance of TTOs. The following organisational factors were identified as essential to translate the idea of entrepreneurial university into practice: an attractive reward system for TTOs, effective staffing practices, which consist mainly of hiring the right mixture of scientists, lawyers, marketing experts, and entrepreneurs, and “boundary spanning” skills of TTO managers to be able to close effective alliances between researchers and firms.

Developing and fostering a climate of academic entrepreneurship requires a wide range of resources. Van Stijn et al. (2018) interviewed 36 representatives of clean-tech start-ups, universities, and representatives of accelerators and incubators in the Boston area, Massachusetts, USA, to explore the concept of university-start-up interaction (USUI) as a source of knowledge spillover and innovation. The authors identified 14 practices used and concluded that in terms of USUI intangible resources are the most important. Other resources that university transfer to start-ups are predominantly related to organisation and product development, while resources for market development are, despite their undeniable importance for the success of start-ups, rather undersized. USUI are also suitable to strengthen the position of universities in educational programmes focused on entrepreneurship.

Given the resources-based context, Lee and Lee (2020) contributed to the discussion by analysing panel data from 92 Korean universities for the period 2012 and 2018. The research conducted suggests that while faculty start-ups are significantly positively affected by faculty labour costs and public research funds received from both central and local governments, student start-ups benefit mainly from a well-developed university infrastructure represented by TTOs, start-up clubs, and start-up funding.

Rasmussen and Wright (2015) adopted a demand-side perspective to answer the question of how universities can design incentives to promote academic entrepreneurship. In their paper, three entrepreneurial competencies are emphasised: opportunity development competency (i.e., the ability to identify opportunities and transform them into a viable business concept), championing competency (i.e., the ability to define the venture and bring together a right mix of HR), and resource acquisition competency (i.e., the ability to secure and integrate external and internal resources to develop entrepreneurship). The authors also defined different levels within the university in terms of spin-off activity and subsequently discussed their role in the competency development of spin-offs. For the policies and infrastructure that support spin-offs, the central university level is responsible. TTOs that are typically closely related to the central level deal with the issue of how to manage and enhance the value of university-owned IP or, to be more specific, how to commercialise research results through formal spin-offs and how to provide them with external funding and other forms of support. There are, however, broad discussions on whether TTOs are the right tool to assist spin-offs in their expansion stage beyond the initial establishment (Rasmussen & Wright, 2015; Meseri & Maital, 2001). According to Rasmussen and Wright (2015) lower levels are more important in promoting entrepreneurial competencies of academic ventures, as these are closer to where their activity takes place. Therefore, the interaction of individual departments, research groups and laboratories, individual researchers, and students seems to be essential from the perspective of creating a viable ecosystem.

Lockett et al. (2003) surveyed technology transfer officers at 57 UK universities to examine strategies used to support university spin-offs. The authors distinguish between more and less successful universities in terms of commercialisation of their activities and conclude that those that are more active have better strategies towards the spinning out academic firms and implementing external (surrogate) entrepreneurs and have developed well-functioning networks with external organisations from which the spin-offs can benefit. Furthermore, in the case of more successful universities, the role of TTOs was identified as much more important in terms of recognising commercial potential of inventions.

Odei and Novak (2023) analysed the determinants of the spin-off activity in the UK while using data for 164 universities. The authors conclude that there is a positive and statistically significant relationship between funding, patent, and rewards; thus, all these elements represent an important driver of establishing spin-offs. To be more specific, a reward model should be implemented that will motivate employees to deliver more excellent work results, and access to sufficient funds can improve the ability of universities to apply for patents and acquire and receive proper protection of research outputs.

The issue of spin-off formation is well documented in the case of US, UK, and West European universities that have a long tradition in knowledge transfer. Research in the CEE countries is somewhat neglected, which is reflected in the relative lack of empirical evidence. Recently, however, there has been a spate of interest in academic entrepreneurship and spin-off models in this fast-developing region. Hrivnák et al. (2023) conducted a comparison of spin-off models implemented in Catalonia, which is considered a knowledge hub with a long tradition, and South Moravia, where the university entrepreneurial ecosystem has only recently been established. The research outputs suggest that universities operating in immature

markets begin with an adoption of successful spin-off models developed either by their domestic or foreign peers. Over the years, these models have been adjusted to reflect changing university policies, definitions of spin-off firms, perceptions of the academic community, and incentives to support academic entrepreneurship. Another stream of research deals with the issue of whether entrepreneurial education in universities increases the entrepreneurial intentions of students. Nowiński et al. (2019) focused on studying this relationship within Visegrád countries (Czech Republic, Hungary, Poland, and Slovakia), representing a subset of the CEE region. The results show that Poland is the only country in which a direct relationship between entrepreneurial education at universities and entrepreneurial intentions was confirmed. Furthermore, the study shows that entrepreneurial education could support entrepreneurial intentions of university students if entrepreneurial self-efficacy related to searching, planning, and organising activities mediate the impact of entrepreneurial education on intentions. Finally, the research findings suggest that female university students benefit more than males from entrepreneurship education.

3. Methodology

To gather comprehensive data related to the determinants of academic start-up and spin-off creation and implementation of an infrastructure to support academic entrepreneurship at a university of technology in Czechia, the multi-case theory-building approach (Eisenhardt, 2021; Eisenhardt & Graebner, 2007), was adopted. The focus of theory-building research based on cases is on the question of “how do things happen” (Gehman et al., 2018, p. 287). Therefore, multiple case studies are a tool that allows researchers to shed light on the issue of whether an arising finding is “simply idiosyncratic to a single case or consistently replicated by several cases” (Eisenhardt & Graebner, 2007, p. 27). We also draw on the definitions and procedures proposed by Yin (2009, 1992), who understands a case study as comprehensive empirical descriptions of observed cases focussing on a specific phenomenon based on multiple data sources.

We chose Brno University of Technology (hereinafter referred to as BUT or the University) for our research because this institution represents a research university with a long tradition operating in the specific institutional context of CEE. Van Burg et al. (2008) suggest that technical universities are generally predestined when it comes to academic entrepreneurship research because of their focus on natural sciences and technology; these disciplines contribute disproportionately to the emergence of start-up and spin-off firms.

South Moravia, the region in which BUT operates, is a region that underwent an extensive economic transformation after 1990, consisting of a transition from a centrally planned economy to an entrepreneurial ecosystem showing nowadays good performance in terms of innovation (Hrivnák et al., 2023). Recently, South Moravia can be characterised as an innovation hub with a vibrant start-up scene, including a number of public and private higher education institutions supplying the region with talents.

In total, eight university start-ups and one spin-off were selected in consultation with the University Knowledge Transfer Office (KTO) and the Entrepreneurship Centre (hereafter also referred to as Contribute) representing our set of cases. In our research, the objective is to

bring together rich, comprehensive, and systemic qualitative data on academic start-ups and spin-offs, in order to gain new insights about the subjects of observation and agents under study. In accordance with Steffensen et al. (2000), the following selecting criteria were applied: (1) the firm had been in existence for at least one year at the time of data-gathering; (2) selected cases cover as many departments and scientific areas as possible as it may be assumed that at least a part of attitudes toward academic entrepreneurship and perceptions of barriers varies depending on the scientific area or faculty; (3) individual cases vary in terms of size as measured by the number of hired workforce and/or funds raised. Additionally, two interviews were carried out with representatives of the KTO and Contribute; both intra-university institutes represent a tool to support the innovation and entrepreneurial ecosystem at the BUT.

Similarly to Wakkee et al. (2019) and Rasmussen and Wright (2015), we employed a multi-level approach to gain understanding on the challenges faced by young entrepreneurial firms, and thus uncover how a higher educational institution uses resources to foster academic entrepreneurship. Two types of actors and their interactions were investigated to gain a more holistic view. In-depth semi-structured on-site interviews were carried out in the first half of 2023 with 9 academic founders and 2 BUT managers involved in commercialisation support. Academic entrepreneurs and KTO managers represent our key informants, whose attitudes can be helpful in understanding the phenomenon under study (Patton, 1990). The average duration of the interview was 48 minutes.

Two kinds of interview scheme were used: one for the founders, and one for the university representatives. The structure of the interviews was as follows. First, the entrepreneurs were asked to give a short introduction to their professional background and factors that motivate and demotivate them to start an academic firm. KTO and Contribute representatives were asked to introduce their main activities taking place in terms of university-start-ups and spin-offs interaction. Second, the interviewees were asked to characterise the knowledge (product or technology) which has been commercialised with focus on the opportunity recognition and the decision to commercialise the product by setting up a start-up. This interview section aimed to derive an insight into the role of the university (KTO, Contribute, and faculties) in facilitating technology transfer. The last set of questions focused on a more in-depth understanding of the role of the entrepreneurial ecosystem in facilitating academic entrepreneurship in the region. In accordance with Gehman et al. (2018) and Ismail et al. (2010), before and after interviews we additionally used more varied data sources about observed cases (e.g., spin-offs Web sites, the University Web site, social networks, etc.).

An answer sheet was developed to record the data. During interviews, the focus was on active listening and situational enquiry to gain as much interpretative knowledge as possible (Gläser & Laudel, 2009). In a follow-up stage, the interviews were transcribed and once more verified with the respondents to achieve as much accuracy as possible. Furthermore, secondary data was collected both respondents and other sources, such as intra-firm documents, press articles, and the Internet.

We use content analysis to treat and interpret the collected data. The open-coding process was applied to break down the data analytically. Relevant codes were identified to capture the main ideas or concepts found in the data (Eisenhardt, 2021; Eisenhardt & Graebner, 2007; Corbin & Strauss, 1990), hence organising the data for a follow-up analysis. Emerging research results were discussed with the founders, KTO, and Contribute representatives dur-

ing the process of data analysis to validate our findings and increase their reliability. Finally, our research outputs were compared with existing theories and concepts (see also van Stijn et al., 2018).

4. Research findings

4.1. Brief characteristics of the university and knowledge transfer practices

The BUT is one of the best established technical universities in the Czech Republic, with a number of students placing this institution among the largest educational institutions in the country. The overall institutional ranking published by Scimago places BUT among the best ranked universities in the region.

Table 1 shows some basic characteristics of the university surveyed and its performance indicators in terms of the emergence of knowledge transfer. This takes place mainly in the form of licencing technologies and software to established companies. To date (January 2024), BUT participated in the establishment of seven spin-off firms, and more than 10 ideas were transformed into start-ups with the label "BUT start-up". In terms of definitions, a spin-off is considered a firm that transforms technological inventions and intellectual property into tangible product services. BUT distinguishes between "true" and "untrue" spin-offs. In the case of "true" spin-offs, the university takes a share of the equity in an entrepreneurial firm, while in the case of "untrue" spin-offs, the university is not a shareholder; therefore, the firm has only licenced university technology. Unlike spin-offs, university start-ups are only tied to a know-how developed at the university (not to intellectual property) and the university generally does not dispose of an equity stake. These definitions are consistent with, e.g., van Stijn et al. (2018).

Table 1. Basic characteristics of BUT, knowledge transfer and performance indicators (source: own compilation)

Year of university establishment	1899
Number of students	18,137 (2021)
Academic staff	1,619 (2021)
Number of faculties	8
Technology and software licencing	93 (2017–2021)
Number of spin-offs/start-ups	1 true spin-off; 6 untrue-spin-offs more than 10 ideas transformed into start-ups with the label "BUT start-up"
Institutional support of entrepreneurship:	
KTO	<ul style="list-style-type: none"> ▪ Intra-university legislative framework ▪ Knowledge management/audit ▪ Organisational support of knowledge transfer ▪ Transparent information support
Contribute Initiative	<ul style="list-style-type: none"> ▪ An entrepreneurial centre ▪ Idea development and implementation ▪ Incubation and acceleration ▪ Business counselling and cooperation ▪ Personal development and training

Individual faculties and institutes are largely autonomous in designing their own instruments to support academic entrepreneurship. This means that they have their own infrastructure, including human resources. Currently, faculty and rectorate knowledge transfer coordinators coexist. According to one of the interviewees (who is later identified as R11), the advantage of the autonomous approach lies in the possibility to develop formal and informal networks that are narrowly disciplinary. However, according to R11, a strong degree of decentralisation is “not an ideal situation, as effective know-how requires a certain degree of centralisation due to the need for specific resources”.

Two institutional elements have been established at the central level of the university: the KTO and Contribute. Each of these supporting elements provides a different type of service, which is tailored towards both scientists and students, and which aims at creating a highly efficient ecosystem, increasing the attractiveness of academic entrepreneurship.

The Contribute represents an entrepreneurship centre and is coordinated by the Faculty of Business and Management which is well equipped with human resources with expertise in training and personal development in the field of entrepreneurship. It complements the university infrastructure with a mix of tools to create a culture of an “entrepreneurial university” (R11). More than 90% of the demand for services comes from students, whereas academics make up the vast minority of the client base.

The KTO is fully integrated into the organisational structure of the central level represented by the Rectorate. Its purpose is to reflect the rapidly changing needs of the university to facilitate the commercialisation of research and generate external funds. Regarding this, it reflects developments from many other countries such as the US, UK, and Israel. The KTO takes care of searching and managing the results of creative activities, supports researchers in analysing the commercial potential of intellectual property, and provides undergraduate students and academic staff with education and advice on issues how to manage and protect intellectual property. In contrast to Contribute, the client base of KTO consists mainly of researchers who have know-how and are seeking to commercialise it either in the form of selling a licence or establishing a spin-off firm. It is in the case of the latter that the cooperation of both intra-university elements of entrepreneurship support plays an important role.

Van Stijn et al. (2018) identified three mechanisms by which knowledge created at universities can be transferred and used: education, direct support for new ventures, and university-industry interaction. We used this concept to categorise the institutional practices provided by the Contribute and KTO. In total, eight practices were identified to support the entrepreneurial university concept. Figure 1 shows a more detailed description of each activity. There is no evidence of providing a wider spectrum of services described in previous research (Hrivnák et al., 2023; van Stijn et al., 2018). In this context, practices such as the evaluation of novelty of technology, the identification of application areas, support for prototype development and testing, and screening of potential supply chains should be mentioned in particular. Interviews with university representatives indicate that the “immaturity of knowledge transfer infrastructure combined with resource constraints” (R11) are barriers that should be addressed in future strategies to promote the third role of the university.

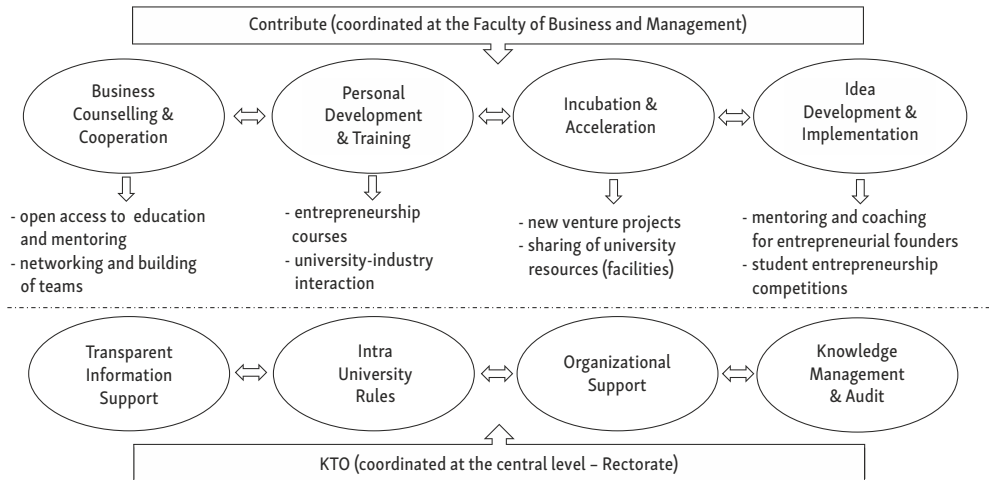


Figure 1. Mechanisms of knowledge utilisation and transfer (source: own compilation)

4.2. Academic entrepreneurs, their motivations and demotivating factors

The first question served to cluster the interviewees in terms of their gender, age category, academic and professional background, and position. Table 2 contains a summary of essential information.

Our sample covers both female and male academic entrepreneurs and two university representatives. It can be further categorised in terms of age (less mature versus more mature academics), graduation (MA versus PhD), expertise, as well as experience in research, entrepreneurship, and knowledge transfer. A larger part of respondents are profiled in basic and applied research as PhD students or postdocs and have been working both at university centres of excellence and enterprise. A minority of interviewees became academic founders during their studies and their current entrepreneurship is rooted in student projects. Both university representatives involved in the survey have extensive experience in creating intra-university legislative rules and programmes to support knowledge transfer and entrepreneurship and have actively participated in the standardisation of conditions for cooperation with industrial partners.

Bearing in mind that industry experience is essential because it supports the exploitation of research results and gained knowledge (Ismail et al., 2010), we formulate the second question as follows: *How would you describe your academic and entrepreneurial experience, as well as your experience in transferring knowledge created in academia into industrial practice?* Table 3 gives details of the research findings resulting from the coding and categorisation within the content analysis.

First, six respondents have in-depth expertise in the academic research context, which is usually related to a position as a researcher at a university centre of excellence and, in some cases, involvement in research projects with external financing at the level of the home faculty. Next, our results suggest that the experience of students with student projects is an important source of entrepreneurial ideas, similarly to participation in research projects

with external funding. Third, in some cases, the respondents emphasised the importance of prior experience in transferring knowledge into industrial practice, either within contractual research projects (e.g., development of materials in collaboration with companies) or in the form of establishing a start-up or spin-off firm.

Table 2. Respondents and their professional background (source: own compilation)

Respondent No	Gender Age category Faculty	Academic back-ground	Position held and experience in entrepreneurial and academia	Experience in transferring knowledge and industrial ties	Date and duration of interviews
R1	Male 21–30 Civil Engineering	Graduate degree – MA	Co-founder of a spin-off (CEO) in the area of material engineering (development and production of plastic panels). Co-founder of a student project.	Zero ties to the industry before setting-up the spin-off firm	June 14 2023 45 minutes
R2	Male 31–40 Material Engineering	Graduate degree – PhD	Co-founder of a spin-off (CEO) focused on development and production of ballistic protection against armour-piercing projectiles. Researcher in a university centre of excellence.	Links to the industry are mainly from prior research projects	June 16 2023 53 minutes
R3	Female 21–30 Chemical Engineering	Graduate degree – MA	Founder of a spin-off (CEO) focused on development of products for cosmetic purposes. Researcher (PhD student) at the Faculty of Chemical Engineering.	Minimal ties to the industry before the start of the project	June 19 2023 47 minutes
R4	Female 21–30 Visual Arts	Graduate degree – MA	Co-founder of a spin-off (CEO) focused on design and production of slow-fashion apparel and accessories. Previous experience in designing and defending student projects.	Minimal to zero ties to the industry before setting-up the spin-off firm	June 19 2023 52 minutes
R5	Male 31–40 Biotechnology Engineering	Graduate degree – PhD	Co-founder of a spin-off (CEO) focused on research, development, and production of functional natural materials from fungal mycelium and waste from the agricultural and wood processing industries. Researcher at the National Academy of sciences.	Links to the industry are mainly from prior research projects	June 20 2023 53 minutes

End of Table 2

Res-pondent No	Gender Age category Faculty	Academic back-ground	Position held and experience in entrepreneurial and academia	Experience in transferring knowledge and industrial ties	Date and duration of interviews
R6	Male 21–30 Business and Economics	Graduate degree – MA	Co-founder of a spin-off (CEO) focused on design and production of slow-fashion apparel. Founder of a student project.	Zero ties to the industry before setting-up the spin-off firm	June 21 2023 49 minutes
R7	Male 31–40 Business Informatics	Graduate degree – PhD	Co-founder of a spin-off (CEO) focused on designing an application for event management (for iPhones). Founder of a student project.	Links to the industry are mainly from previous entrepreneurial projects	June 26 2023 44 minutes
R8	Male 31–40 Material Engineering	Graduate degree – PhD	Co-founder of a spin-off (CEO) focused on designing and producing cutting-edge devices in the area of microscopy. Researcher in a university centre of excellence.	Rich ties to the industry mainly from prior both entrepreneurial and research projects	June 29 2023 47 minutes
R9	Male 21–30 Electrical Engineering	Graduate degree – PhD	Development of devices for educational purposes in the area of electrical engineering. Researcher (PhD) student at the Faculty of Electrical Engineering and Communication.	Rich ties to the industry mainly from prior both entrepreneurial and research projects	June 29 2023 48 minutes
R10	Male 41–50	Graduate degree – PhD, professor-ship	Extensive experience in promoting knowledge transfer (KTO manager), initiator of innovation and entrepreneurial centre (<i>Contribute</i>)	Rich experience in transferring knowledge (mentoring and advice)	June 15 2023 52 minutes
R11	Male 51–60	Graduate degree – PhD, habilitated	Initiator of innovation and entrepreneurial ecosystem (<i>Contribute</i>)	Rich experience in entrepreneurship (mentoring and advice), ties to the industry mainly from prior practice	June 16 2023 41 minutes

Table 3. Assessing entrepreneurial experience and transferring knowledge from academia to an entrepreneurial firm (source: own compilation)

Code 1	Code 2	Code 3
Experience in research	Entrepreneurial and student projects	Experience in transferring knowledge
n: 6	n: 9	n: 3
R2: At the faculty level, I have experience in participating in R&D projects in the field of materials engineering, where I have gained experience in the application of developed materials in collaboration with practice.	R1: During my studies, I founded a student project ("Plastic Christal"), which was the initial impetus to start my own start-up. I also received a lot of support from my family background, since my parents are entrepreneurs.	R2: I have gained experience in the application of knowledge to corporate practice in cooperation with companies. Within the current R&D project, material is being developed and tested on specific products developed in collaboration with companies.
R5: After studying science, I founded a start-up. At the same time, I have been involved in many R&D projects at the Academy of Sciences.	R3: Already in secondary school I knew that I wanted to pursue cosmetics in my professional life, and so the idea for my own business matured. I started developing this idea during my PhD studies.	For this purpose, a start-up was founded, of which I am the CEO.
R8: During my PhD studies I participated in R&D projects with external funding (Technology Agency). My current entrepreneurial project was developed as part of this applied research project. Later I held the position of project manager at the Central European Institute of Technology.	R7: The business idea was born during my studies. The creation of the first company was related to the development of iPhone applications, which were in demand by domestic companies. The follow-up project was originally related to the development of a product for a conference. The response was very positive, and a corporation expressed interest in collaborating on the product development. The project was subsequently developed with the support of CzechInvest and an accelerator programme in N.Y.C. The current project is therefore a spin-off of the original business.	R8: At the university's centre of excellence, I headed the science and research support department, where I gained experience in knowledge transfer and setting up spin-offs. Subsequently, I used this experience to set up my own spin-off firm.
R9: The business idea was conceived in the framework of an Interreg project that provided funding for the development of electronics for educational purposes. The product attracted the interest of primary and secondary schools.		

Note: *n* refers to the number of valid responses related to the individual codes.

In order to better understand the profiles of academic founders, we also asked *what factors motivate young entrepreneurs to start a spin-off and, conversely, what demotivates them*.

In terms of motivation, three main factors are repeatedly highlighted, and only three respondents first cite "desire to get rich". One of the founders (R2) said: "I believe in the idea of the project and I am convinced that it will be a jackpot." The other entrepreneur (R6) emphasised that "money represents freedom" for him and that's why he does business. He is "definitely not risk averse" and interprets "investing his further work on the spin-off with

uncertain outcomes as a great opportunity". The third respondent is also mainly financially motivated, but at the same time is aware that "the start-up does not generate positive cash flow for most of its life cycle and cashing out is mainly the matter of a successful exit".

Three investors (R3, R7, and R8) were mainly driven to market their inventions by the "desire to see their products exploited by a spin-off or start-up". R3 said: "The very first motivation for me is to realise my philosophy of life through my own start-up. In this context, I am driven by the support of the community of people who tested the first products in the pre-seed stage and showed great interest in them." R8 commented on the question about motivation as follows: "I am motivated by the desire to make the result of my work tangible and useful to other people. I am not satisfied with the idea that the result of my work will only be an academic paper."

The last category of motivation is represented by the "desire to gain recognition and contribute to the development of society". For example, R1 reported that academic entrepreneurship has allowed him to "grow up significantly faster compared to his peers" who were only employed with studying. Gaining the respect of customers, parents, and other members of their community was "quite important" and led the entrepreneurial team to decide to give back to society by "participating in university events where examples of good practice are presented to other young entrepreneurial candidates". R6 said that his aim is to achieve "a positive footprint" through entrepreneurship, which provides "a wonderful opportunity to contribute to the development of society". Furthermore, R9 noted that he is "concerned about the declining level of education" in the country and his business project aims to "make a positive contribution".

When it comes to factors that demotivate starting an entrepreneurial academic firm, respondents most often mention fear of giving up their academic career, too many challenges, and risk and uncertainty. R8 commented on the problem of loss of academic career prospects: "An academic, wanting to be entrepreneurial, reduces his time at university and establishes a start-up, thus entering into great uncertainty. However, evaluation in academia is based on the number of academic papers in the most influential scholarly journals. Despite many proclamations, the application of knowledge in industrial practice in the form of establishing start-ups and spin-offs is not evaluated. Hence, setting up an entrepreneurial firm is very expensive and risky (opportunity costs are high), and for most scientists, entrepreneurship remains an adventure." Interviewees R9 and R10 have repeatedly indicated that the administrative burden resulting from internal regulations and their too often ambiguous interpretation results in situations in which "those in charge are afraid to make decisions". Even more serious is the lack of methodological procedures for sharing results between partners and the lack of know-how in relation to the valuation of IP outputs being commercialised.

In summary, financial uncertainty and the loss of growth prospects in the academic career represent the main factors that discourage academics from starting their own firms. R8 points out that the system is clearly failing in the evaluation of academic staff, which is "a great shame, because building a start-up is a tremendous experience in terms of human resource development that would move the education system forward".

4.3. Product, technology and market assessment

In a follow-up set of questions, our aim was to get acquainted with *the specific knowledge (product, technology) that is being commercialised and the perceived level of product innovation*.

The product portfolio briefly described in Table 4 covers technologies in the field of materials engineering ($n: 3$), sustainable apparel development ($n: 2$), cosmetics ($n: 1$), IT ($n: 1$), electron microscopy ($n: 1$) and product development for educational purposes ($n: 1$).

Table 4. Product and technology (source: own compilation)

Code 1
Product and technology
n: 9
R1: We have developed an innovative plastic recycling technology. The product is represented by <u>plastic plates</u> , which have a wide application in interior architecture.
R2: The product is represented by a <u>unique material that can be optimised depending on the customer's needs</u> . This is followed by the development of the product itself.
R3: The product is a <u>cosmetic based on natural substances with proven efficacy</u> . The emphasis is placed on the efficacy of the products, the origin of the raw materials, and the environmental friendliness of the packaging.
R4: We develop <u>tailored garments made from sustainable materials with timeless designs</u> . Our vision is to build a wardrobe for the target customer. Currently, the emphasis is also on the B2B segment, i.e., cooperation with companies that want to focus on sustainability.
R5: We develop <u>100% natural materials</u> from fungal mycelium and waste from the agricultural and wood processing industries, which are widely used in the <u>production of packaging</u> .
R6: Our product is <u>double-sided T-shirts</u> . At the beginning, the idea was to develop a product that would be technologically simple and, at the same time, possible to promote via social networks. Later, the idea of <u>sustainability</u> (material, reversibility), <u>the concept of slow fashion</u> , <u>environmental friendliness</u> , and maybe the concept of ESG (local production) were added. The product is sustainable and will not end up in the trash immediately, which is the main message to customers. Products can be tailored to customer needs.
R7: We have developed an <u>IT tool for event management</u> in the form of an iPhone application.
R8: We have developed a <u>device that integrates atomic force techniques with an electron microscope</u> .
R9: Our product is represented by a <u>complete package of hardware and software</u> (teaching aids), which is further complemented by a teacher training offer. This is a subscription service.

Note: n refers to the number of valid responses related to the individual codes.

Particularly in the case of university spin-offs, it is expected that IPRs will play a prominent role (Ismail et al., 2010). Therefore, we asked our respondents to answer the question of *whether the product or technology is protected by IPRs*. Somewhat surprisingly, only two projects can declare that their products or technologies are protected. In one case, a trademark was successfully registered at the EU level; in the other case, the product is protected by a patent. In terms of the development of academic entrepreneurship at the BUT, it is essential to reflect the statement announced by R8: "We have patent protection. However, we sought to obtain patent protection for the product after the spin-off company was established. The

university does not have the know-how to determine the fair value of the patent, which is an essential shortcoming in terms of the university's competencies." Other respondents are considering some form of IPR, e.g., patenting a technology, utility model, or trademark. These considerations are partly related to the preparation for international expansion. It is also worth noting that any considerations on IPR are initiated by the founder, and hence the KTO played zero or minor role in the whole process. However, there is an expectation on the part of those considering some form of IPR protection that the KTO will provide support in the patent or trademark application process.

We also addressed the issue of the *perceived level of innovation of the product or technology being commercialised*. The results of the content analysis suggest that the interviewees see the added value for customers on three levels. These are represented by the unique features of the product, the sustainability, and the tailor-made attitude. Uniqueness most often refers to the materials developed (e.g., durability, biodegradability, or unique utility features). Young entrepreneurs have recognised the opportunities for their inventions in the form of sustainable solutions. This ranges from proclamations to market the business idea to sustainable materials and timeless design. According to a respondent (R1), "Customers are likely to buy our products because they are perceived as a way to save this planet". R3 focused on the niche market of the biohacking community and said that "the added value for the customer is determined by the values (philosophy) of her firm, which lies in minimalism and feeling good about yourself". Two other respondents emphasised that they are identified with the concept of slow fashion and the principles of ESG: "The customer should be aware of where the materials come from and that the work is fairly priced" (R4). Sustainability is also associated with the timelessness of the product solution (R6) and the use of recycled materials and their biodegradability (R5).

The question of what the target market should be had been addressed during the product development stage. Some entrepreneurs have recognised that they would serve a fast-growing market, which is obviously in line with a general definition of start-ups. This can be illustrated by the statements in Table 5. R1 said: "The local market with sustainable materials is 3 to 4 years behind the well-developed EU countries. However, we are now riding a wave of rapidly growing customer interest." R3 acknowledges that customers in the B2C market are becoming more environmentally conscious. "They are increasingly aware of their body's needs and demand evidence of product efficiency. I see great potential for growth in these areas." A comprehensive approach to the perceived global opportunities represented by sustainability can be documented in the statement of R8: "Looking towards the future, we have chosen three main areas related to global sustainability. Something that we all feel, science, and our industry need to step in. So, we did a workshop on what our company can do to help sustainability and reduce emissions. From that we started looking at solar cells, batteries, semiconductor components, or sustainable materials. All of this can be improved with our product."

Table 5. Market assessment (source: own compilation)

Code 1	Code 2
Target market identified	Fast growing market
n: 4	n: 3
R3: When the start-up was founded, there was a clear idea of who the customer would be. However, in reality, it was a surprise that 1/3 of the customers were men. Apparently, the unisex strategy worked well, suggesting that the added value of the product is minimalism.	R1: The market in the Czech Republic is 3 to 4 years behind developed western markets in the field of sustainable materials. However, we are now riding a wave of rapidly growing customer interest.
R4: When we founded the start-up, we knew that the target group would be people who are involved in slow fashion and sustainability and who also want to support local producers. In terms of age and gender, the target group is not clearly defined.	R3: Increasingly, customers are becoming more environmentally conscious, thinking about their bodies, and demanding proof of product performance. I see great potential for growth in these aspects.
	R7: The market for the product existed at the time the company was founded. However, at the time of entry, investors were aware that it was saturated. We proved otherwise: 50% of our customers are first-time users.
R8: The biggest piece of work was and still is, to show the world how the combination of technologies that underpin our product is good and indispensable. From the beginning, we have worked along two lines. The first was in device development, and the second was in discovery – learning what the customer needed and what our device could be used for. We were constantly going around and building a network of salespeople, partners, and distributors.	R8: Looking toward the future, we have chosen three main areas related to global sustainability. We all feel science and microscopy need to step in. So, we did a workshop on what our company can do to help sustainability and reduce emissions. From there we started to look at solar cells, batteries, semiconductor components, or sustainable materials. All of this can be improved with our product.

Note: *n* refers to the number of valid responses related to the individual codes.

4.4. Role of university resources and the local start-up ecosystem

In this part of the study, we focused on the issue of *how both the university and the local ecosystem are assessed in terms of supporting academic entrepreneurship*.

First, we asked the question: *What role did the university or faculty play in the decision to create your spinoff / start-up firm?*

Our results show that the recognition of the commercial potential of the knowledge and the decision to set up a spin-off were solely a matter of the interviewed entrepreneurs. They all commented that the university was not involved in decision making regarding these essential issues, as the intra-university infrastructure is not capable enough in helping them exploit their knowledge by establishing a new entrepreneurial firm.

Next, we focused on the issue of *how our respondents perceive the role that the university or faculty has been playing in promoting academic entrepreneurship*. The survey results indicate that there are many weaknesses in terms of intra-university entrepreneurial incentives (Table 6). Four respondents consider declarations on entrepreneurial support to be rather

formal, far away from everyday reality. As R2 put it: "The University should finally move from formal declarations to real support. ... It does not offer much to founders apart from administrative burdens and non-transparent processes." Some even express their doubts about whether spin-off and start-up support is a real priority and call for a change of mindset at the level of the management of institutes, faculties, and the Rectorate; "I would appreciate more respect for entrepreneurial activities" (R3). According to interviewees, organisation development should be strongly focused in the following areas: (1) patent application processing (R2); (2) removing bureaucratic burdens (R2); (3) promoting internal grant schemes (R9); (4) enhanced advisory services, e.g., in the areas of valuation, marketing, and IPR (R9); and (5) a more targeted networking with industry (R9). According to (R5), strengthening the position of KTO and Contribute could be a way to "create a more motivational environment".

There is a lot of support for the notion that "a widespread atmosphere of mistrust" massively hinders the application of more vibrant measures to support academic start-ups. This mistrust manifests itself both at the level of the organisational structure and towards the founders of the start-ups themselves. R2, R8, and R9 agree that no one within the existing structure wants to take responsibility for his decisions, with the result that rather no decisions are made. R8 gives a summary of everyday practice ("The KTO is paralysed by fear of its own decisions") and at the same time formulates proposals on how to change this: (1) changing the atmosphere to promote trust ("Founders should not be perceived as someone who misuses or even steals university know-how"); (2) adjusting some intra-university guidelines to simplify the process of setting up spin-offs ("At the moment setting up a firm is a very complex and non-transparent process, which is ridiculously time-consuming"); and (3) a significant extension of the know-how at the level of the KTO ("Acquiring new competences is highly desirable, particularly in the area of patent valuation. At the moment, those in charge are afraid of being accused of selling a licence to someone below cost. As a result, the existence of a university-owned patent is an impediment to the establishment of spin-off firms. ... Fear of this kind of failure paralyses the whole system and contributes to the creation of a grey zone, i.e. a leakage of resources outside the university. Ironically, any effort to leave the grey zone raises suspicion"). According to R9, the atmosphere of mistrust is fostered by "rigid hierarchies", which manifests itself in a lack of interest in ideas coming from lower levels of management: This anti-entrepreneurial attitude allows ideas to die too often."

We also identified that the existing intra-university model used to assess academics is burdened by a lack of incentives to become an entrepreneur as the main indicators used for measuring academic staff performance consist in the number of research papers published in high-ranked academic journals and the number of projects with external funding. Researchers are also expected to deliver lectures, supervise the thesis, and lead a team of PhD students and postdocs. Hence, academic staff is employed with multiple responsibilities, and in combination with the fact that transfer of knowledge is not adequately reflected in the evaluation system, the commercialisation of research results encounters a lack of interest. R8 believes that, in particular, the assessment of academic staff in the position of PhD students and postdocs should be adjusted to better appreciate the transfer of knowledge into industrial practice: "There is an untapped space within the motivational system to encourage entrepreneurship."

Table 6. Assessing the role the university plays in promoting academic entrepreneurship (source: own compilation)

Codes	n	R2	R3	R5	R8	R9	Examples
Support is only formally declared	4	x	x		x	x	The university should finally move from formal declarations to real support. (R2)
Anti-business mindset of many university managers and mistrust towards founders	4	x	x		x	x	There is a high level of mistrust towards founders, who are often perceived as wanting to steal university know-how. (R2)
Bureaucratic burdens and non-transparent processes	3	x			x	x	The process of negotiating the establishment of a spin-off firm at the university level is unreasonably complex and nontransparent (R8)
Reluctance to make decisions	3	x			x	x	The KTO is paralysed by fear of its own decisions. This must definitely be changed. (R8)
Academic staff assessment	2			x	x		People in academia are evaluated by the number of academic articles they have published successfully. (R5)
More respect for entrepreneurial activities desirable	1		x				I would appreciate more respect for entrepreneurial activities. (R3)
More efforts in promoting academic entrepreneurship at the central and decentral level required	1			x			In my opinion, the KTO and the faculties should strengthen their positions in creating a motivational environment. (R5)
A lack of real support/incentives	1					x	There are neither resources (e.g. grant schemes) nor consultancy available. (R9)
A lack of competences	1				x		The KTO should acquire new competences, for example, in the area of patent valuation. (R8)

Note: *n* refers to the number of valid responses related to the individual codes

We subsequently asked the respondents to indicate specific areas in which *the university and individual faculties should increase efforts to promote academic entrepreneurship*.

Three interrelated areas are mentioned most frequently, which respondents believe should be given attention at the level of the BUT in particular: (1) talent identification and investment in the right people (R1, R3, R4, R5, R6, R7, R8, R9); (2) more targeted education in the area of entrepreneurship (R3, R5, R6, R7); and (3) promoting student competitions (R1, R3, R4, R7). For more details, see Table 7.

There is a strong belief that systematic identification of them and work with talents deserve much more attention, especially at the level of individual faculties. For example, R1 suggests that "There are few students within each cohort who want to be entrepreneurs. However, it is necessary to actively reach out to this group and continue to work with them." Regarding this, R1 recommends more activity at the level of faculties and student organisations. In terms of investing in talents, interviewees emphasise the need for university-wide curriculum development aimed at the acquisition of entrepreneurial and technological skills

Table 7. Assessing areas, the university should increase efforts to promote academic entrepreneurship (source: own compilation)

Codes	n	R1	R2	R3	R4	R5	R6	R7	R8	R9	R11	Examples
Talent identification and investment in the right people	8	x		x	x	x	x	x	x	x		Identifying talents and developing their skills is the most prominent role of universities in promoting knowledge transfer. (R8)
More targeted education	4			x		x	x	x				In general, there are few courses established within the curricula for students who want to become an entrepreneur. (R7)
Student competitions	5	x		x	x	x		x				I recommend developing student competitions focused on entrepreneurship. Young entrepreneurs should receive feedback from investors and industry. (R3)
Promoting examples of good practice	3	x		x			x					The participation of practitioners in teaching should be increased. I can see a lack of people at the university who are successful founders or angel investors and who are able to link theory and practice. (R6)
Promoting KTO and Contribute	2					x				x		Information flows are totally inadequate. During my studies, I did not know that there was a regional business incubator (JIC) or that it was possible to enrol in entrepreneurship-orientated courses. (R9)
Networking across faculties	2				x		x					Networking of students of entrepreneurship with students of technology engineering would really help. (R6)
Opening up opportunities	2				x	x						The university gave us the opportunity to participate in the development of university promotional materials. This is a unique opportunity to let our business grow. (R4)
Access to resources	2		x								x	The university should establish a fund to support projects with a long repayment period in an attempt to simulate the lack of local investors. (R11)

Note: n refers to the number of valid responses related to the individual codes.

and competencies. R5 further highlighted this: “I consider more targeted education (marketing, branding, finance, patent procedure) and providing examples of good practice from successful and unsuccessful founders to be very effective. Talents need to be systematically trained in knowledge transfer. KTO and Contribute should primarily care of education and networking within and outside the university.” According to R7, the universities in the Czech Republic have in response to external challenges to change their attitude, i.e., start training future entrepreneurs and reduce the number of graduates trained for the government and corporations. Implementing examples of good practice could be a very desirable direction for the development of current curricula. R1, a successful founder, adds the following comment: “The University often invites us to seminars with students whose main mission is to convey our experience as founders and to show that there is nothing to be afraid of. In these seminars, we demonstrate that it is possible to start a business while studying. Students need someone to ask how to get started but often do not know where to look for a partner. Successful people are usually not available to students. The university should organise events with business to pass on experiences. Live input is often more powerful than podcasts and other forms of virtual presentations.” This statement is consistent with the views of other respondents, who also recommend more networking efforts with the local start-up scene and investors. The entrepreneurial mindset could spread across students and academic staff by implementing more practical courses with successful founders and investors and organising student competitions, because this is “the first opportunity for a young entrepreneur to get feedback” (R3), “a unique networking opportunity with industry” (R5), and “a chance to make your presence known” (R4). Other instruments include the assignment of bachelor and master theses in partnership with local start-up industries or even the establishment of student start-ups in partnership with local investors. R8 supports this in particular: “Let students set up a real start-up, allowing them to generate knowledge and experience with high added value.”

The issue of support in the form of both financial and material resources is also a subject of extensive discussion. R3 proposes the introduction of a transparent system that would show which resources (e.g., laboratory equipment) the university owns and is open to share under predefined conditions. The result would be a win-win situation for both parties involved and a reduction in the “grey zone” in the use of university resources. Some respondents would welcome more targeted grant schemes, which are currently unavailable at the university level. This stems from the funding system of public universities in the country and a very limited amount of financial resources that could potentially be used for this purpose (R10, R11). Attracting local investors supplying “the right funds” into university ecosystem could be a proper solution, however, both university representatives also noted that this is a challenge, because the local segment of business angels and venture capitalists is unfortunately rather underdeveloped both in terms of the number of investors and the amount of capital available.

The last thematic area concerned the *evaluation of the local start-up ecosystem*. The regional leader in fostering the local entrepreneurial ecosystem mainly focused on support and stimulation of the establishment of high-potential start-ups is represented by the *South Moravian Innovation Centre* (JIC).

Table 8 shows that the interviewees unanimously describe the JIC as a very well-functioning element of the entrepreneurial ecosystem, which is perceived as one of the best incuba-

tors in the CEE region due to its high-quality human resources and wide range of services. Five founders took advantage of mentoring and training courses aimed, in particular, at elaborating a business plan (R1: "I attended management courses on how to identify a market opportunity, how to write a business plan, how to develop a product, and how to contact capital providers"), verifying the technical feasibility of a product (R3: "At JIC, I attended a 10-hour mentoring and MVP validation seminar"), knowledge transfer (R5: "I am currently taking a certificate course on technology transfer to gain knowledge of how academics should start a business based on a technology or product being the result of inventive activity at a university"), raising capital (R6: "We obtained general information about external funding and contacts with angel investors from our industry") and taking benefits of mentoring programmes (R8: "We have been through various JIC programmes and have had several mentors since we started the business. We learnt how to prepare a business plan and how to attract investors. The JIC has also helped us with matters such as setting up ownership relations, financial plans, and building a business network.").

The parameters of the existing regional spin-off support system should be improved in several aspects. For example, there is a strong belief that a closer cooperation between the JIC and the university in promoting programmes for entrepreneurs is desirable. This is evidenced by R5, who reports that "Students usually do not know that the JIC even exists".

Table 8. Assessing the role of the regional start-up ecosystem (source: own compilation)

Codes	n	R1	R2	R4	R5	R6	R7	R8	Examples
The regional business incubator (JIC) is doing its best	7	x	x	x	x	x	x	x	The ecosystem in our region is fantastic thanks to JIC, which represents one of the best incubators in CEE (R8)
Closer cooperation between JIC and university desirable	1				x				There is insufficient communication between the JIC and the university. Students usually do not know that the JIC exists. (R5)
Extension of grant schemes needed	1				x				It is necessary to establish calls issued to cover the costs of branding, marketing, or developing a business plan. There is also no support to get production off the ground. There is also a need to establish subsidy schemes that are related to the institution of patent attorney. (R5)
Grant schemes are not always user-friendly	1				x				The established grand scheme needs to be simplified to become user-friendly. (R5)
Little courage to support pre-seed and seed investments	1				x				Incubators and universities should be more involved in funding the pre-seed and seed stages of a start-up development to seek answers to the question: Is the product possible?' (R5)

Note: n refers to the number of valid responses related to the individual codes.

Some interviewees also believe that established grant schemes should be simplified to become user-friendly because in their current form it is difficult for a young entrepreneur to gain orientation across all calls for grant applications, which are announced at the university, regional or national level. According to R5, R7, and R11, more fundamental innovations of existing grant schemes should be addressed. For example, there is a need to establish grant schemes that will be designed for embryonic stages (R5). "In contrast to Anglo-Saxon countries, start-ups in the Czech Republic come to the market with a relatively finished product. In my opinion public institutions should be more involved in funding the early stages of development in order to seek answers to the question Is the product possible? This will certainly support more projects that are doomed to fail, but it will also encourage people to want to innovate and not be afraid of failure. In this respect, I have little courage to make decisions." Other proposals aim to establish grant schemes to finance the costs of branding, marketing, getting production off the ground, or legal services, which are, e.g., related to the institution of patent attorney. R7 also tackled the issue of support intended for start-ups that have surpassed the seed stage: "Business incubators and innovation centres provide support that is designed for start-ups in their nascent stage and focused on the question of how to start a business. However, there is a vacuum of incentives for start-ups in the follow-up stages." For example, the issue of how start-ups should respond to a dramatically changing environment is systematically neglected, and this should be addressed in further education courses designed for more mature founders. "Universities and business incubators are required here to make appropriate offers here."

5. Discussion

Taking into account the main research findings, this paper contributes to the growing body of research that addresses the importance of institutional settings in fostering academic entrepreneurship in emerging markets, as the capacity of the university ecosystem significantly affects the emergence and success of start-ups and spin-offs (see, e.g., Brantnell & Baraldi, 2022; Civera et al., 2020; Lee & Lee, 2020).

First, our results reveal that the University has built a basic infrastructure consisting of a KTO and an entrepreneurship centre (*Contribute*). The current model is to some extent decentralised, as individual faculties and institutes are autonomous in applying their own tools to support entrepreneurship. On the one hand, this is in line with the literature emphasising the importance of lower management levels because these are closer to individual researchers and research groups, which makes them much more sensitive in recognising their entrepreneurial potential and needs (Rasmussen & Wright, 2015); on the other hand, however, decentralisation does not necessarily increase the performance of the whole system if none of its elements have sufficient resources. In the case of the BUT, we identified a significant lack of resources, which causes both the higher and lower management levels to appear not to perform their role of knowledge transfer promoters. This can be evidenced by, e.g., a very narrow spectrum of services provided than reported in the prior literature examining strategies used by successful universities in terms of commercialisation (Odei & Novak, 2023; Hrivnák et al., 2023; van Stijn et al., 2018). To address this drawback, the University should

implement more targeted support in the following areas: entrepreneurial courses, training in IPR protection, mentoring, counseling, and guidance of academic founders, introducing internal grant schemes, and strengthening network ties with industry, investors, as these tools have a significant positive impact on entrepreneurial activity (Hrivnák et al., 2023; Neves & Franco, 2018; Burg et al., 2008). Therefore, our results suggest that to induce the volume of academic firms in an emerging market, a significant development of HR capacities is required, in particular. KTOs and entrepreneurial centres must address challenges in recruiting and maintaining staff with entrepreneurial and legal skills, excellent networks to individual university departments, local industry, and external capital providers (Burg et al., 2008). All of these measures are challenging in terms of internal and external financial resources. Prior research has, however, shown that, from the perspective of governments and other public bodies, this is an efficient use of public funds (Odei & Novak, 2023).

Next, the BUT case suggests that the organisational culture within universities might be a serious impediment to developing the idea of an entrepreneurial university. Regarding this, there are two fundamentally different perspectives, which are first represented by establishing a formal infrastructure to support academic spin-offs and start-ups and second creating a vital organisational culture that will be in alignment with the vision of entrepreneurial institution. If there is a widespread atmosphere of mistrust towards academic founders and decision makers within the university organisational structure, and the support declared by the university officers is perceived only as formal, even the best intentions to build up infrastructure cannot motivate both the researchers and students to commercialise their ideas. Our conclusions on this issue are similar to the findings of Hrivnák et al. (2023), who studied conditions of spin-off creation at two other universities in the region. The authors also documented that academics with spin-off ambitions have to face negative reactions from colleagues and faculty leadership, and often they are perceived as someone who wants to steal from the university. In this regard, Burg et al. (2008, p. 123) recommend introducing “norms and exemplars” that will be shared at all organisational levels and will represent real incentives for young founders. Similarly, Nowiński et al. (2019) call for introducing an entrepreneurship-friendly atmosphere at universities.

Third, administrative burdens, rigid hierarchies, and non-transparent processes strongly demotivate students and academics in their consideration to create a university spin-off or start-up firm. Internal regulations and processes are perceived as overly complicated, and the responsibilities of decision-makers are often unclear. In this aspect, we support Neves and Franco (2018) in their argument that lowering the degree of formalisation and centralisation would create a more favourable climate for academic entrepreneurship.

Fourth, our findings show that the applied concept of assessing academic performance does not form sustainable incentives to participate in the transfer of knowledge resulting from inventions. In general, it can be said that researchers are overloaded with many duties, as they are expected to be excellent lecturers, supervisors of undergraduate and graduate thesis, and if they are in the position of associate professors, and professors, they should also overtake the position of team leaders of PhD research groups. The main criteria considered for career advancement are the number of external research grants received and the volume of articles published in high-ranked international research journals. Despite official proclama-

tions about the importance of the third role of the university, this is not adequately reflected in the form of academic staff evaluation criteria. Results in the form of contractual research with firms or spinning out a new start-up seem to be marginalised. Therefore, we believe that our study will contribute to discussions on the importance of parameters for assessing academic staff in immature ecosystems (Hrivnák et al., 2023; Neves & Franco, 2018).

Finally, our results on regional entrepreneurial ecosystem signify that conditions for academic spin-offs and start-ups should be developed in two main directions. Our first recommendation aims to more closely link the university infrastructure with elements of the external ecosystem that support entrepreneurship in the region. This could lead to a more efficient use of public resources, more specifically not duplicating but complementing services of the two bodies being in charge of supporting start-ups. Furthermore, a narrower cooperation between universities and incubators could alleviate the belief of many academics and students that little is done to promote the role of the regional infrastructure. Our second recommendation is more focused on a rather fundamental innovation of existing funding schemes, which are expected to cover a wider range of needs with respect to the life-cycle stage of the spin-off or start-up firm. Regarding this, our findings are consistent with Hrivnák et al. (2023), Rasmussen and Wright (2015), and Lockett et al. (2003), who emphasise the role of accessible finance covering a broader spectrum of innovative ventures.

6. Conclusions

This article adopts a survey-based approach to explore the issue of how university resources contribute to the creation of university spin-offs and start-ups in the conditions of a prominent technical university in the Czech Republic, South Moravia. We interviewed nine academic founders and two university representatives to assess the institutional and regional infrastructure that supports knowledge transfer, specify the services provided to academics and students, and identify perceived drawbacks related to the current form of institutional incentives. Our findings reveal the motivation of academic founders, as well as perceived barriers that must be addressed in upcoming strategies to promote the third role of the University.

The results of the research have a number of implications for theory and practice. We document that the building of infrastructure is a complex and long-term issue in immature ecosystems. Formal institutions embedded in the intra-university organisational structure need to be equipped with sufficient resources and competences. The development of the university-affiliated KTO and Entrepreneurial Centre (Contribute) is one approach how to facilitate academic entrepreneurship, although establishing an own incubator might be an alternative strategy. Clear and entrepreneurial-friendly university rules have to be adopted to regulate the process of creating start-ups and spin-offs. Universities should attract skilled people with their own network of contacts to intra-university departments and external environment represented by regional incubators, venture capital providers, business angel associations, and experienced entrepreneurs. Furthermore, the university agenda should undoubtedly acknowledge the significant role of entrepreneurship education with a focus on talent recognition and entrepreneurship training to impact the entrepreneurial intentions of researchers and students. Measures at all management levels are needed to change informal

institutions; the ultimate goal of creating an entrepreneurial university must be made believable for all internal and external stakeholders. Finally, our results reveal that the motivation of academics to commercialise their inventions could be positively affected by the applied concepts of assessing their performance.

Even though this study provides empirical evidence and implications for academic ventures, several limitations have to be emphasised. The first limitation concerns the fact that our sample is relatively small and related to a single technical university operating in the Czech Republic. This limits the generalisability of our results to other universities and research fields. This limitation may even be more serious to universities operating abroad in a different institutional context. Next, we surveyed academic founders and university representatives to propose directions, how university infrastructure should develop, and what resources are likely to boost the volume of university ventures. However, the perspectives of other stakeholders are not reflected in our investigation.

Further research might usefully seek to examine spin-off practices at other universities and in other CEE countries. This would generate data material unavailable so far to conduct comparative studies with US, UK, and more developed European counterparts. Future research can also test additional issues, e.g., how universities do facilitate their participation at academic ventures, how do they deal with the distribution of equity stakes, what exit strategies do they follow, or how different stakeholders interpret factors that might stand behind the success and failure stories of university spin-offs and start-ups? More stakeholders, such as angel investors, venture capital funds, or business incubators and accelerators, should be surveyed.

Moreover, there is a lack of empirical evidence on whether and, where appropriate, how universities in CEE countries transform their concepts of entrepreneurial university more toward models reflecting various elements of sustainability. Therefore, an essential issue that deserves the attention of researchers is what strategies are or should be implemented to redefine the third role of universities, e.g., in regard to educational and training programmes how these promote economic, social, and environmental transformation of the society.

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Competing interests

The authors have no competing interests to declare.

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