

**ENTREPRENEURIAL ECOSYSTEMS IN TECHNOLOGY TRANSFER:  
A CASE STUDY ON SUCCESSFUL INNOVATION  
COMMERCIALIZATION****Kruger N.A.\***

**Abstract:** This study aimed to explore the factors leading to the successful commercialisation of innovations generated through technology transfer and its connection to an entrepreneurial ecosystem. Using a post-positivist research paradigm, the study applied a qualitative case study on university technology transfers with proven track records. Findings showed that technology transfer must be integrated throughout the university, motivated professors and inventors, and have support from networks, mentorship, and private funding. The university should incentivise innovation and align its goals with the entrepreneurial ecosystem. Recommendations include integrating innovation commercialisation with the surrounding entrepreneurial ecosystem and treating innovators as owners of their research. Following these suggestions will increase the number of successful innovations and sectoral specialisation in the local entrepreneurial ecosystem.

**Key-words:** Business Strategy, Entrepreneurial ecosystem(s), Startup(s), Technology transfer

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**Introduction**

The “entrepreneurial ecosystem” refers to a community of entrepreneurs and supportive structures, often within a specific region, that collaborates to provide resources and advantages for establishing, sustaining, and growing high-potential new ventures (Spigel, 2017; Spigel and Harrison, 2018). It encompasses the interactions among entrepreneurs, firms, and their surrounding environment (Nieuwenhuizen et al., 2023). The factors agreed upon as relevant to Entrepreneurial Ecosystems are diverse and interrelated. According to Groth et al. (2015), access to “risk capital and investment capital” is crucial for the success of new ventures. As Isenberg (2016) noted, universities and research sites also play a key role in the ecosystem by providing access to “entrepreneurial knowledge and training opportunities.” Croce (2017) highlights the importance of “entrepreneurial communities and a supportive culture” in the ecosystem. O’Brien et al. (2019) emphasise the significance of “venture-friendly markets and local demand” in the success of new ventures. As Zhang and Roelfsema (2020) pointed out, government policies and support are critical for an entrepreneurial ecosystem.

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Agu-Igwe and Ochinanwata (2021) stress the role of “support organisations and intermediaries such as mentors, advisors, incubators, and accelerators” in the ecosystem. Chang and Lai (2021) argue that the availability of “worker talent and human capital” is essential for the success of new ventures.

Madzikanda, et al. (2021) emphasise the significance of “professional resources and services, established businesses” in the ecosystem. Motoyama et al. (2021) stress the importance of “formal and informal networks” in the success of new ventures. Economic clusters, physical infrastructure, and “long-term entrepreneur-driven leadership,” as pointed out by Nicholls-Nixon et al. (2021), are also important components of an entrepreneurial ecosystem.

Pittz et al., (2021) highlight the importance of “inclusivity at all levels” in the success of an entrepreneurial ecosystem. Scheidgen (2021) emphasises the significance of “inclusive engagement and events to engage entrepreneurs” in the ecosystem. Schmutzler et al. (2021) stress the importance of “success stories” in the ecosystem. Senaratne et al. (2021) argue that “economic clusters, physical infrastructure, and long-term entrepreneur-driven leaderships” are important components of an entrepreneurial ecosystem. Webb (2021) emphasises the importance of “formal and informal networks” in the success of new ventures. However, it is vital to remember that an entrepreneurial environment also depends on commercialising discoveries created through technology transfer. Universities and research facilities are essential players in technology transfer and commercialising new ideas processes. Companies frequently come up with these concepts and can offer the funding for research and development needed to implement them. Universities can also give entrepreneurs the instruction and training they need to acquire the knowledge and abilities to commercialise these discoveries successfully.

Despite a general understanding and agreement on which factors shape and determine the dynamics of an entrepreneurial ecosystem, their nature is highly heterogeneous (Zhang and Roelfsema, 2020). This heterogeneity stems from the varying magnitude of the impact of the same ecosystem components (Spigel and Harrison, 2018; Mason and Brown, 2014; Spigel, 2017). The diversity arises from the unique political, economic, social, technological, legal, and environmental features that distinguish nations and regions, ultimately influencing their manifestation (Bruns et al., 2017; Webb, 2021). This heterogeneous nature makes it impossible to generalise the needed interventions, and the context must be well understood to enact interventions within a particular entrepreneurial ecosystem effectively.

The influence of universities on forming entrepreneurial ecosystems and commercialising innovations cannot be overstated (Klofsten et al., 2019). Universities play a crucial role in facilitating technology transfer and innovation commercialisation, acting as intermediaries between research and development activities and the market. However, this issue was not addressed in the previous version of the “Introduction”. Universities provide a critical link between creating and disseminating knowledge, technology transfer, and successful

commercialisation of innovations. The entrepreneurial ecosystem provides the enabling environment for such commercialisation.

Entrepreneurial ecosystems form organically through the various interactions between the active agents within a particular ecosystem, driven by the economic interests of individual economic agents (Madzikanda et al., 2021). This manifests as businesses seeking out relevant products, services, or resources that they require from other actors within their domain or point of entry into the entrepreneurial ecosystem, enabling them to maximise profitability (Schmutzler et al., 2021). Over time, these interactions become routine, and stability is established within an ecosystem. Once established, they can continue to grow and develop both in terms of their complexity and scope and promote more complex cooperative interactions (Agu-Igwe and Ochinawata, 2021). These interactions are, however, still highly complex, needing to account for not only the productive capabilities of agents and the market demand for their products but also the far more complex motivations and motives of each agent relative to each other.

This study aims to explore the factors leading to the successful commercialisation of innovations generated through technology transfer and its connection to an entrepreneurial ecosystem.

### **Literature Review**

Despite the heterogeneity of entrepreneurial ecosystems, there is a unanimous agreement in the research on entrepreneurial ecosystems that universities play a crucial role in entrepreneurial ecosystems (Schmutzler et al., 2021). How universities engage with entrepreneurial ecosystems is multifaceted (Isenberg, 2016), providing training to potential employees (Groth et al., 2015), fostering innovation through research and development (Croce, 2017), and serving as a mediator between government and industry (O'Brien et al., 2019). However, this study will focus on the interaction of universities with the intellectual property they generate and its commercialisation.

Universities generate intellectual property from various sources, including multi-disciplinary problem-solving, inter-faculty staff research, and student innovations to indigenous problems (Motoyama et al., 2021). Technology transfer offices are established to act as intermediaries between the academic and business worlds to bring these innovations to market (Nicholls-Nixon et al., 2021). These offices handle the patenting, licensing, and commercialisation of the university's intellectual property, freeing the university to focus on its core strengths of research and knowledge advancement (Senaratne et al., 2021). The technology transfer offices play a crucial role in safeguarding and commercialising valuable technologies, maximising the impact of public research funding for the betterment of society (Chang and Lai, 2021). The offices are responsible for organising, managing, and exploiting the university's intellectual property for commercial purposes and serve as the university's agents (Pittz et al., 2021).

However, bringing research and business together is not a simple mandate. Establishing a business from an innovative idea or product requires work of two highly coupled kinds (Madzikanda et al., 2021). The first is “knowledge work”, recognising opportunity and creating and refining a credible narrative that will attract the necessary resources. The second is recruiting the necessary resources: intellectual property, money, management, equipment, and space to foster innovation in a business (Kabir, 2019; Thomas, 2007). In this manner technology transfer is a management function, it does not produce the raw components that will be commercialised, however, it does transform them through planning organising, leading, and controlling the process of commercialisation.

Furthermore, commercialising any idea is a challenging process, and getting a project to the point where it can seek funding requires between 1000 and 2000 hours, with efficiency driven by the transaction costs involved in such activities (Petersen et al., 2019; Thomas, 2007). To emphasise this point, despite the immense potential of universities to produce intellectual property and thereby connect to industry within the entrepreneurial ecosystems context, there is significant fallout along the value chain, and only 0.1% or 0.2% of the disclosures will meet with commercial success sufficient to generate six to seven figure royalties to the university (Thomas, 2007 Lund et al., 2020 ). Additionally, more than 99% of the value eventually comes from less than 1% of the technology, usually embodied in one or two licenses (Thomas, 2007). The nature of successful technology transfer is such that almost all the revenue, all the public benefit, and all the economic development stem from a small number of deals many years after they were initially done (Thomas, 2007; Stiglitz, 2019). Given the low rate of successful commercialisation, the argument for technology transfer intervention must be made clear. Firstly, according to Cunningham et al. (2020) the contribution of technology transfer offices goes beyond revenue generation and can be seen in public benefit, economic development, faculty service, faculty reward for inventive activity, industry interaction, and revenue generation.

The success of technology transfer from universities to commercial entities in an entrepreneurial ecosystem has been widely studied and found to be primarily influenced by several factors such as the efforts of the university, the quantity and quality of research activity (Groth et al., 2015; Isenberg, 2016), the age and capability of the technology transfer office (Croce, 2017; O’Brien, et al., 2019), the type of research being conducted (Zhang and Roelfsema, 2020), the geographical location of the university (Agu Igwe and Ochinanwata, 2021), and the level of investment in technology transfer offices (Chang and Lai, 2021; Madzikanda et al. 2021). These findings indicate the importance of considering a comprehensive approach in analysing technology transfer activities and their contribution to entrepreneurial ecosystems. A higher quantity and quality of research, a well-established technology transfer office with a strong network, research with practical applications, a location in a technology-dense area, and investment in the technology transfer office increase the likelihood of successful technology transfer (Motoyama

et al., 2021; Nicholls-Nixon et al., 2021; Pittz et al., 2021; Scheidgen, 2021; Schmutzler et al., 2021; Senaratne et al., 2021; Webb, 2021). Consequently, for a university to play a more active role in the entrepreneurial ecosystems it is adjacent to, it requires that the university in question apply itself more actively and improve its managerial capacities. However, the means by which this can be done while accounting for entrepreneurial ecosystem considerations requires understanding what makes technology transfer offices successful.

### **Research Methodology**

This study aims to identify the key factors and conditions that contribute to the successful commercialisation of technology transfer projects. To answer this question, the functions, actions, and structures of effective technology transfer offices are analysed here qualitatively. The study employs a qualitative case study approach and analyses secondary data obtained from various government and non-governmental websites. Given the social nature of technology transfer and entrepreneurial ecosystems, a post-positivist research paradigm was adopted. The data was analysed using thematic analysis, a method that entails searching data sets to identify, analyse, and report consistent patterns. According to Braun and Clarke (2006), thematic analysis can be used as a standalone method or as a foundational tool for other qualitative research methods. The principles of thematic analysis include coding data, searching for and refining themes, and reporting findings. The flexibility of thematic analysis allows for the interpretation of data during the process of selecting specific codes and constructing themes. The study's findings were obtained by applying the principles of thematic analysis to the data obtained from the case study. Maree (2021) also highlights that the thematic analysis approach used in this study involves both description and interpretation of the data.

The sample is as follows. The universities selected for the sample were KU Leuven, established in 1973 with around 8 projects funded annually, Delft University founded in 1902 with approximately 12 projects funded per year, Trondheim University established in 2003 with approximately 4 projects funded each year, Uppsala University established in 2008 with about 4 funded projects per year, and Bremen University established in 1985 with 2 funded projects per annum. Also included in the sample were Michigan Institute of Technology established in 1961 with 15-25 funded projects per year, and University of Cape Town established in 2008 with 2-5 funded projects annually. The information was collected from various internet sources such as the official websites of the universities and technology transfer offices (Bremen, 2022; Delft Enterprises, 2022; Gredemark, 2022; KU Leuven, 2022; Leuven MindGate, 2022; Life Science Research Partners, 2022; UCT, 2022a, 2022b; TU Delft, 2022a, 2022b, 2022c; YES!Delft, 2022; MIT, 2022; RoboHouse, 2022).

The relevant documents (reports and information sites) were obtained from these universities and were prepared for analysis using Atlas.ti version 22, a software specifically designed for qualitative data analysis. The software was chosen for its

ability to create network diagrams and facilitate data visualisation, resulting in a structured approach to identify themes.

The research process followed a set of steps, as outlined by Caulfield (2019). These steps involved copying the selected source documents into the software, coding the content, aggregating quotes that grounded the codes, compiling the codes into code groups (themes) related to the research question, reviewing the themes to ensure they are representative of the data and useful for analysis, defining and naming the themes, and finally, writing the analysis and preparing the report from the themes, using quotes to better understand the most pertinent content and emphasise the significance of the themes generated.

### Research Results

The thematic analysis conducted in the study aimed to identify the key factors that contribute to successful technology transfer. The following codes were identified as critical components of a successful technology transfer process relevant to the concept of technology transfer's role in entrepreneurial ecosystems: Mentorship, Education, Accelerator, Academically specialising in a particular field, Entrepreneurial orientation, Entrepreneurial ecosystem, funding (government, national, staged, start-up, and support), Idea competitions, Incubator, Infrastructure, Integrated Technology Transfer Offices, Intellectual Property Policy, Key Takeaways, Management Interventions, Multiple Campuses and Faculties, Networking, Niche, Originating Research Unit Contribution, Research kickback, Research to Technology Transfer to Entrepreneurial Ecosystem, Research to Marketplace, Royalty Structure, Specialization, Strategically positioned near industry, Team, Technology Transfer Activities, Technology Transfer Composition, Technology Transfer Motivation, and University Share. These codes were analysed and distilled into themes that helped answer the central research question.

The critical components of successful technology transfer can be grouped into four main themes: entrepreneurial ecosystem infrastructure, funding, technology transfer, and equity distribution. The entrepreneurial ecosystem infrastructure theme includes mentorship, education, and networking codes. The funding theme includes government and national funding, start-up funding, and royalty structure. Codes related to the technology transfer process, such as research to marketplace and technology transfer composition, are grouped under the technology transfer theme. Lastly, research kickback is grouped under equity distribution, reflecting the fair allocation of benefits. This approach helps simplify understanding the complex interplay of various components in the technology transfer process, allowing for better analysis and decision-making. These themes are discussed as follows.

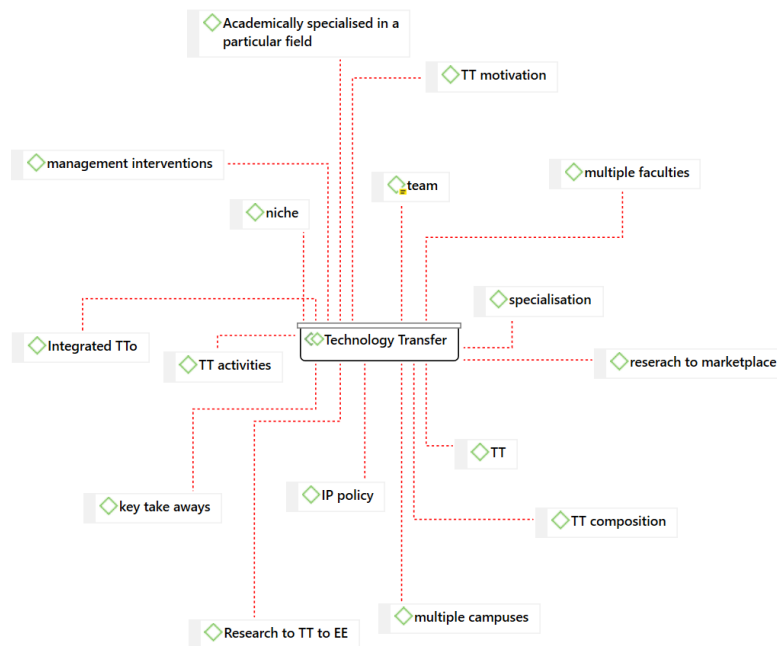
#### ***Theme 1: Technology transfer***

Technology Transfer, Shown in Figure 1 with its accompanying codes, was identified as the first central theme in this study. The universities under examination demonstrate a commitment to technology transfer through their established infrastructures for pursuing it. technology transfer offices must effectively engage in

a real-world context, transfer research findings to the broader society, and promote cooperation and dialogue with key stakeholders. However, the extent of commercial engagement, the efficacy of technology transfer offices, the motivations for technology transfer within universities, and the available support and funding structures vary among the cases. Nonetheless, commonalities were found in successful commercialisation, including mentorship, education, networking, intellectual property policies, specialisation within an industry, technology transfer integration throughout the university, and traditional management interventions.

Where universities concentrate technology transfer efforts in a single niche or discipline, they accelerate innovation and attract industry attention, aiding in the establishment and expansion of funding networks. RoboHouse and YES!Delft, both from Delft University, serve as examples of how intellectual property protection, education, funding, and networking can foster commercialisation. YES!Delft offers support on intellectual property, access to mentors and investors, and facilitates the transformation of entrepreneurial potential into successful tech start-ups. A capitalistic funding structure encourages start-ups to negotiate with investors, and YES!Delft integrates the ecosystem elements of education, finance, technical development, and expertise. The success of technology transfer offices within a university context is contingent on the trust and equity between researchers and the technology transfer offices. UU Innovation addresses these concerns through communicated intent and free, confidential support. However, the university's revenue structure greatly affects researcher participation in technology transfer. In some cases, the business is treated as private with the researcher paying for assistance, while in others, such as MIT, the university takes care of everything but with the researchers as employees.

For technology transfer to be effective, it must permeate the entire university structure and remain sensitive to faculty contexts. technology transfer offices must also develop a local network to establish a permanent bridge between academic research groups, start-ups, venture capitalists, and consultancies to promote entrepreneurship culture. The examples of Delft University and KU Leuven illustrate this, with access to over 200 and 60% of businesses in their areas, respectively.

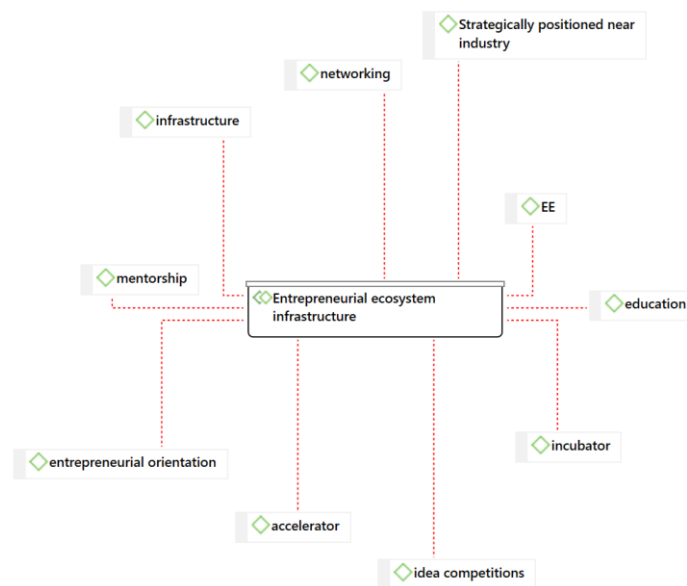


**Figure 1: Technology transfer**

***Theme 2: Entrepreneurial ecosystem infrastructure***

Entrepreneurial ecosystem infrastructure, shown in Figure 2. with its accompanying codes, encompasses the core components necessary for the transition from technology transfer to entrepreneurial ecosystems. The components identified in the thematic analysis align with key elements of entrepreneurial ecosystems, including tangible elements like science parks, incubators, accelerators, and proximity to business centers, as well as intangible elements such as education, mentorship, networking, idea competitions, and entrepreneurial mindset. The themes and sub-themes emerged from commonalities among the technology transfer offices and serve as crucial considerations in technology transfer. A successful technology transfer requires a balance of personal and business factors and effective networking at multiple levels, including marketing, mentorship, and equity pursuits. Universities play a vital role in the research process but must also offer support through incubators, accelerators, and technology transfer partnerships to commercialise their findings. This theme highlights the importance of considering entrepreneurial ecosystem elements in technology transfer contexts.

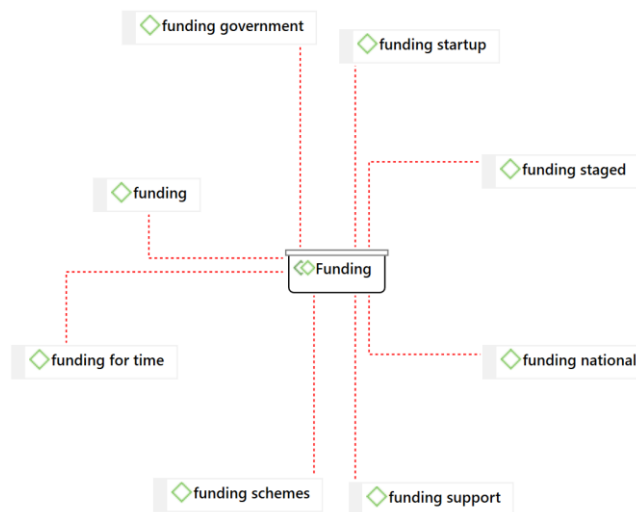




**Figure 2: Entrepreneurial ecosystem infrastructure**

***Theme 3: Funding***

The third theme, Funding a minor, but important theme, is shown in Figure 3. with its accompanying codes. Funding is intrinsically tied to ownership. Since universities must find innovative ways of financing their activities. Funding is primarily oriented towards gathering financial resources. However, if the intellectual property is pursued, it can also be a powerful means of bringing technical expertise or potent business partners into business. It should be a goal of technology transfer to build up the relationships between the university and funding bodies. These funding initiatives can come from government schemes or private sources. Whether financing is extended from either of these two sources, they must still qualify for that financing before it is extended. In this regard, funding can be applied institutionally through the university, technology transfer offices or the researcher. What should also be noted is that funding isn't a once-off procedure and that financing in the latter stages is often only made available if certain prerequisites are met. Funding must be applied during research, development, start-up, and business growth and development. During each of these stages, it is likely that different funding sources will need to be pursued. Funds are numerous; some are generated through regional and national governments, and some are sector-specific. What is noted as vital is a discretionary fund held by the technology transfer offices to pursue those commercialisation projects deemed worthwhile.



**Figure 3: Funding**

#### **Theme 4: Equity distribution**

The final theme, equity, shown in Figure 4. with its accompanying codes, is considered a minor, but important theme. How equity was distributed between the various technology transfer offices, researchers, and universities varied substantially. From the outset, there are two primary perspectives regarding royalties, or rather, philosophies of ownership of intellectual property. In one camp, the inventor/researcher is seen as the owner, and in the other, the university is seen as the owner. Both have their own benefits and disadvantages. With ownership comes responsibility. If the university owns the intellectual property and all the responsibility to drive an idea to market falls to them, however, it is more likely that they will seek to rent out the rights to a particular patent to a third party instead of taking any real business claim, this is the model of MIT. On the other end of the spectrum is full ownership of intellectual property by the researcher. In Northern European universities, this model is more common. In the latter case, the researcher has to fund and run the project. As they use university resources or engage university technology transfer offices, they cede equity to the university through the technology transfer offices.

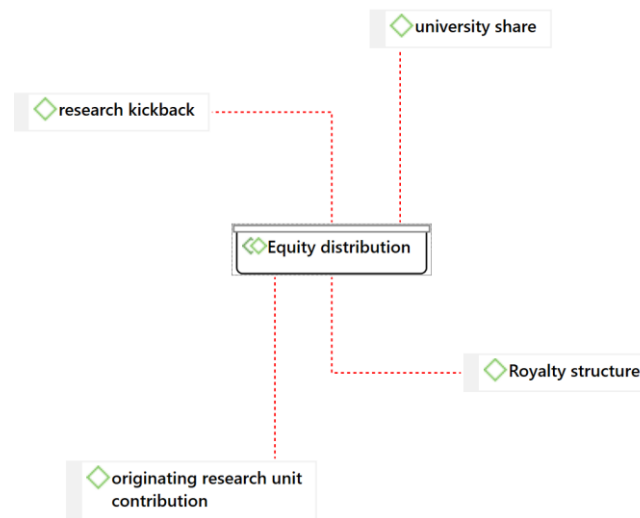


Figure 4: Equity distribution

## Discussion

The study identifies four central themes related to technology transfer and entrepreneurial ecosystems: technology transfer, entrepreneurial ecosystem infrastructure, funding, and equity. Successful technology transfer requires a balance of personal and business factors, effective networking at multiple levels, and consideration of entrepreneurial ecosystem elements. The study's findings on the importance of effective technology transfer, engaging with key stakeholders, and promoting cooperation and dialogue align with previous research in the field. Grimaldi et al. (2011) emphasise the role of universities in shaping incentives and opportunities for entrepreneurs, and Rasmussen and Borch (2010) highlight the importance of mentorship, education, networking, intellectual property policies, specialisation, and traditional management interventions in promoting successful technology transfer. The study also identifies the critical role of funding and equity distribution, consistent with previous research emphasising the availability of capital in creating and sustaining successful entrepreneurial ecosystems (Stam and Elfring, 2008).

Moreover, the study emphasises the importance of universities' commitment to technology transfer and their infrastructure in promoting effective technology transfer. The findings align with previous research highlighting the need for universities to provide mentorship, education, networking, and intellectual property policies and specialise within an industry. This also includes traditional management interventions to support commercialisation (Rasmussen and Borch, 2010). The study's call for universities to identify innovative financing mechanisms and build relationships with funding bodies is consistent with previous research that

emphasises the critical role of government policies and the availability of capital in creating and sustaining successful entrepreneurial ecosystems (Acs et al., 2008). The study's findings on effective technology transfer, the importance of universities' commitment to technology transfer, their infrastructure, innovative financing mechanisms, and relationships with funding bodies align with previous research in the field. Incorporating these factors into the design and implementation of entrepreneurial ecosystems can promote successful technology transfer and commercialisation.

### **Conclusion**

For technology transfer to be effective, it is essential to consider the core facilities available to entrepreneurs and the surrounding factors that impact their success. This includes internal and regional network access, mentorship, funding, and institutional integration. The technology transfer process must form a cohesive model within the entrepreneurial ecosystem, including funding bodies and specialised programs that bring together experienced industry leaders and executives. Early identification and matching of high-potential projects with the right entrepreneur are crucial for successful ventures. Additionally, universities should foster a drive towards commercialisation but not hinder researchers' efforts by retaining all equity.

Research, technology transfer, and entrepreneurial ecosystems are interlinked and driven by the benefit to all stakeholders. Institutional funding can make the institution a stakeholder as well. The purpose of technology transfer is not just funding, but a holistic support system that enables cooperation and specialisation among various parties. The core value of technology transfer lies in connecting business management and practical challenges with solutions at the ground level. Technology transfer offices play a crucial role in providing funding and networking opportunities for stakeholders and can be more effective with access to discretionary funds.

For technology transfer to be successful, there are a few key elements required:

1. University-wide support.
2. Access to public and private funding.
3. Freedom for researchers to buy and sell equity as they see fit.
4. Dedicated technology transfer office's function.
5. Integration into a larger network.
6. Mentorship programs.

Research has shown that integrating technology transfer offices throughout the university structure, motivating professors and inventors to drive their projects, and providing supporting networks and private funding are crucial for technology transfer to work. An equity model can facilitate buy-in from skilled businesspeople. Mentorship programs provide training opportunities and accelerate the development of entrepreneurial expertise, increasing the chances of success.

Technology transfer success is dependent on the interplay of all these factors. All innovation transfer agents should first focus on regional development to build

community, trust, and resilience in the network. Accelerators and incubators with specific industry focus can better attract support and funding to generate spin-offs. The strategic goals should align with these considerations for optimal outcomes.

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## EKOSYSTEMY PRZEDSIĘBIORCZOŚCI W TRANSFERZE TECHNOLOGII: STUDIUM PRZYPADKU UDANEJ KOMERCJALIZACJI INNOWACJI

**Streszczenie:** Niniejsze opracowanie miało na celu zbadanie czynników prowadzących do udanej komercjalizacji innowacji powstałych w wyniku transferu technologii i ich powiązania z ekosystemem przedsiębiorczości. Wykorzystując postpozytywistyczny paradygmat badawczy, w badaniu zastosowano jakościowe studium przypadku dotyczące transferów technologii uniwersyteckich o udokumentowanych wynikach. Wyniki te wykazały, że transfer technologii musi być zintegrowany na całym uniwersytecie, motywować profesorów i wynalazców oraz mieć wsparcie ze strony sieci, mentoringu i finansowania prywatnego. Uczelnia powinna zachęcać do innowacji i dostosowywać swoje cele do ekosystemu przedsiębiorczości. Zalecenia obejmują integrację komercjalizacji innowacji z otaczającym ekosystemem przedsiębiorczości i traktowanie innowatorów jako właścicieli swoich badań. Zastosowanie się do tych sugestii zwiększy liczbę udanych innowacji i specjalizację sektorową w lokalnym ekosystemie przedsiębiorczości.

**Słowa kluczowe:** Strategia biznesowa, Ekosystem(y) przedsiębiorczości, Startup(y), Transfer Technologii

## 技术转让中的创业生态系统：成功创新商业化的案例研究。

**摘要：**本研究旨在探讨导致通过技术转让产生的创新成功商业化的因素及其与创业生态系统的联系。该研究使用后实证主义研究范式，对具有可靠记录的大学技术转让进行定性案例研究。调查结果表明，技术转让必须整合到整个大学，激励教授和发明家，并得到网络、指导和私人资金的支持。大学应该激励创新，并使其目标与创业生态系统保持一致。建议包括将创新商业化与周围的创业生态系统相结合，并将创新者视为其研究的所有者。遵循这些建议将增加当地创业生态系统中成功创新和部门专业化的数量。

**关键词：**商业战略、创业生态系统、初创企业、技术转让