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Study of the Technology Transfer Ecosystem of BULGARIA

Prepared by Bulgarian Association for
Transfer of Technology and Innovation (BATTI)
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KTU 1955 KARADENIZ TECHNICAL UNIVERSITY
CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS
BATTI
UNIVERSITAS GALATIENSIS

Comprehensive Study of the Technology Transfer Ecosystem

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1 Introduction

This report presents a comprehensive analysis of the technology transfer (TT) ecosystems in Greece, Bulgaria, Türkiye, and Romania, conducted by four leading institutions specializing in innovation and technology commercialization. These institutions include the Centre for Research and Technology Hellas (CERTH) in Greece, the Bulgarian Association for Transfer of Technology and Innovation (BATTI) in Bulgaria, Karadeniz Technical University Technology Transfer Application and Research Center (KTU TTC) in Türkiye, and the "Dunărea de Jos" University of Galați (UDJG) in Romania.

The study is part of the broader "Technology Transfer and Innovation Network for the Black Sea Basin" (T3N-BSB) project (https://t3nbsb.net/), which is funded under the Black Sea Basin Cross-Border Cooperation Program for the 2021-2027 period. T3N-BSB aims to develop sustainable transnational networks and platforms to facilitate the exchange of best practices and knowledge on leveraging innovative technological advancements. With a budget of €498,120.00, the project fosters stronger collaboration among academia, industry, and policymakers, ensuring technology transfer processes are more effective across borders. By enhancing institutional capacities and interconnectivity, T3N-BSB seeks to create a robust ecosystem that supports economic growth through innovation and research commercialization in the Black Sea region.

■ Importance of the Study

In today's knowledge-driven economy, the ability to efficiently transfer technology from research institutions to industry is crucial for driving innovation, economic growth, and competitiveness. This is especially relevant for countries like Bulgaria, where efforts to enhance the technology transfer ecosystem are necessary to harness the potential of scientific research and innovation. A comprehensive study of Bulgaria's technology transfer ecosystem is essential for identifying the gaps, challenges, and opportunities for improvement.

Despite progress in recent years, Bulgaria's technology transfer ecosystem remains underdeveloped compared to leading European and global counterparts. The lack of detailed research specifically focused on the Bulgarian context has left stakeholders without a clear roadmap for improving the system. While various reports provide insights into general European practices, few have specifically addressed the unique challenges faced by Bulgarian academic institutions, businesses, and policymakers.

■ Existing Challenges

The technology transfer ecosystem in Bulgaria faces several key challenges, which hinder the successful commercialization of research and innovation. One of the most significant issues is the *disconnect between academic research and industry needs*. While Bulgarian universities and research institutions produce high-quality research, much of it remains underutilized because it is not sufficiently aligned with market demands or the needs of local industries. This results in innovations that often stay within the academic sphere and fail to be commercialized or scaled.

Bulgaria faces difficulties in *scaling innovations beyond the initial stages* of development. Startups and spin-offs, which are crucial for turning research into market-ready products and services, struggle with a lack of funding, mentorship, and access to international markets. This creates a bottleneck where promising technologies are developed but fail to achieve

commercial success. There is also a need for stronger policy frameworks and governmental support. Although there are national initiatives aimed at fostering innovation, these are often fragmented or underfunded, making it difficult for innovators to navigate the system or secure the necessary support for commercialization.

Methodology

To provide a comprehensive analysis of the Bulgarian technology transfer ecosystem, this study will employ a mixed-methods approach. Desk research will be conducted. Also known as secondary research it involves the collection and analysis of existing data and information from a variety of published sources. In this study, desk research will include reviewing academic literature, government reports, policy documents, industry publications, and existing case studies relevant to technology transfer in Bulgaria and internationally. This approach helps provide context, identify trends, and compare Bulgaria's technology transfer ecosystem with global best practices. Desk research allows for a cost-effective and efficient means of gathering foundational knowledge and supporting the primary data collection methods.

Coverage

This study will focus on the key sectors involved in Bulgaria's technology transfer ecosystem: *academic, industrial, and governmental*. Specifically, the study will examine how universities and research institutions interact with industry to move innovations from research and development to commercialization. The study will also evaluate the role of government policies, funding programs, and regulatory frameworks in shaping the ecosystem.

Geographically, the study will concentrate on Bulgaria, though it will draw comparisons with other countries in the European Union and beyond. This comparative approach will help identify best practices that can be adopted in Bulgaria, while also highlighting areas where the country's ecosystem diverges from more established systems.

The sectors covered will include research-intensive industries such as information and communication technology (ICT), biotechnology, energy, and advanced manufacturing.

Limitations

Although this study aims to provide a comprehensive overview, it will not cover informal technology transfer mechanisms, such as knowledge sharing through consulting or collaborations that do not involve intellectual property. The focus will be on formal processes, such as patents, licenses, and spin-offs, as these are the most measurable and comparable aspects of the ecosystem.

Another limitation is the potential lack of available data in some areas. While efforts will be made to gather data from all relevant stakeholders, some institutions may not have comprehensive records on technology transfer activities, which could limit the depth of analysis in certain areas.

Practical Implications

The practical implications of this study are significant for various stakeholders involved in Bulgaria's technology transfer ecosystem. For **policymakers**, the study will provide evidence-based recommendations on how to improve regulatory frameworks, increase funding for innovation, and foster stronger collaborations between academia and industry. For **technology transfer offices (TTOs)** and **university administrators**, the findings will offer insights into best practices for managing intellectual property, supporting researchers, and

building partnerships with industry.

For **industrial partners** and **investors**, the study will highlight opportunities for engaging with academic institutions to access cutting-edge research and innovation. Finally, **researchers** will benefit from an improved understanding of the commercialization process, helping them align their work more closely with industry needs and enhancing the societal impact of their research.

2 Historical Context & Current State

2.1 Overview

- The development of Bulgaria's technology transfer ecosystem has been shaped by historical events, government policies, and global trends. From the early days of isolated academic research to the more structured and internationally integrated system seen today, the ecosystem has evolved through key milestones and institutional developments.

- Initial Efforts in Technology Transfer

The early stages of technology transfer in Bulgaria can be traced back to the socialist era, when state-driven industrialization fostered collaborations between research institutions and state-owned enterprises. During this period, innovation was heavily controlled by the state, and scientific discoveries were often geared toward supporting national economic goals. However, these early collaborations lacked the formal structures and market-driven incentives that are characteristic of modern technology transfer ecosystems.

After the political changes of 1989 and the transition to a market economy, Bulgaria began to slowly adopt more open and market-driven approaches to innovation. The government introduced new policies aimed at promoting research and development (R&D) and fostering collaboration between universities and the private sector. This laid the groundwork for the establishment of foundational research institutions, with universities increasingly being encouraged to engage in collaborative research with industry to meet the needs of the emerging private sector. (Terziev, The legacy for the beginning of the market economy transition in bulgaria, 15 Sep 2019)

- Creation of the First Technology Transfer Offices (TTOs)

The establishment of the first Technology Transfer Offices (TTOs) in Bulgaria was a pivotal step in formalizing the process of moving innovations from academic research to the marketplace. This marked the beginning of institutionalized support for innovation commercialization, intellectual property (IP) management, and university-industry collaborations.

- Background and Need for TTOs

In the early 2000s, Bulgaria was undergoing significant economic and structural transformations. The transition from a centrally planned economy to a market-oriented one in the 1990s had opened up new opportunities for research and innovation, but the mechanisms to support the commercialization of academic research were still underdeveloped. Universities and research institutions, particularly the Bulgarian Academy of Sciences (BAS) and Sofia University, were producing valuable research but lacked the formal infrastructure to translate those discoveries into marketable products or services.

At this time, Bulgarian researchers faced multiple challenges:

- **Limited Knowledge of IP**: Researchers had little understanding of how to protect their intellectual property or manage patents.
- **Weak University-Industry Collaboration**: There was a significant disconnect between academia and industry, with few channels for collaboration or partnership.
- **Lack of Commercialization Expertise**: Academic institutions did not have the necessary expertise in technology commercialization, business development, market analysis and other areas.

- Establishment of the First TTOs

The first TTOs in Bulgaria were created in the mid 2000s, with leading research institutions taking the initiative. These offices were designed to manage the commercialization of research, including intellectual property protection, licensing, and fostering spin-offs or startups based on academic inventions. (Zhelev, 01 Jan 2014)

- **(BAS)**: BAS, the leading research institution in the country, established one of the first TTOs in Bulgaria. Given BAS's large research output across various fields such as biotechnology, materials science, and information technology, there was an urgent need to create a dedicated office for handling IP and commercialization. The TTO at BAS was tasked with identifying potential innovations with commercial value, protecting those through patents, and seeking industrial partners or licensing opportunities to bring those innovations to market. (Sciences, n.d.)
- **Sofia University**: As the largest university in Bulgaria, Sofia University played a central role in setting up one of the country's earliest TTOs. Sofia University's TTO focused on supporting academic staff and researchers in navigating the complex processes of IP protection, market analysis, and partnership development. The office also encouraged students and faculty to think about the commercial potential of their research, providing training in entrepreneurship and innovation management. (University, n.d.)
- **Technical University of Sofia**: The Technical University of Sofia also launched a TTO to bridge the gap between its engineering research output and industry applications. This office worked closely with the engineering, ICT, and electronics sectors, helping to forge partnerships with local and international companies. (Technical University Sofia, n.d.)

- Role and Initial Impact of TTOs

The primary role of these early TTOs was to serve as intermediaries between researchers and the commercial sector. Their responsibilities included:

- **Managing Intellectual Property (IP)**: TTOs helped researchers identify patentable inventions, navigate the patent application process, and secure protection for their intellectual property. This included drafting patent applications, negotiating licensing agreements, and managing IP portfolios.
- **Facilitating Industry Collaborations**: TTOs were instrumental in establishing relationships between universities and industry partners. They acted as matchmakers, connecting companies looking for innovative solutions with academic research projects that had commercial potential.
- **Supporting Startups and Spin-offs**: A key part of the TTOs' mission was to assist in the creation of spin-offs and startups based on academic research.
- **Technology Licensing**: TTOs negotiated licensing agreements between academic institutions and businesses, ensuring that intellectual property was transferred under favorable terms that would benefit both the university and the commercial partner.

- Challenges Faced by Early TTOs

While the creation of TTOs represented a significant step forward, these offices faced several challenges during their early years:

- **Lack of Expertise**: Many of the first TTOs were established with limited staff who had little experience in managing technology transfer or IP commercialization. Training and professional development in these areas were needed.
- **Limited Resources**: Most TTOs struggled with a lack of financial resources, making it difficult to invest in market research, patent applications, or business development services.
- **Weak Industry Ties**: In the early 2000s, there was still limited awareness within Bulgarian industry about the potential of academic research. TTOs had to invest

significant effort into building trust and relationships with businesses, many of which had not previously engaged in R&D collaborations with universities.

- Initial Impact on the Ecosystem

Despite these challenges, the establishment of TTOs had a noticeable impact on Bulgaria's innovation ecosystem:

- **Increase in Patent Activity**: With the support of TTOs, Bulgarian universities and research institutions saw an increase in patent filings. Researchers became more aware of the importance of IP protection, and institutions began to build patent portfolios.
- **First Commercialization Successes**: Early TTOs were instrumental in facilitating some of the first technology transfer success stories, such as the licensing of biomedical innovations from BAS and the creation of several spin-off companies in the ICT and engineering sectors.
- **Building Industry-University Bridges**: By providing a formal structure for technology transfer, TTOs helped to slowly bridge the gap between academia and industry. While the initial impact was modest, these offices laid the groundwork for deeper collaborations that would come in the following years.

- Impact of TTOs

  - Influence of Global Best Practices

The influence of global best practices has played a crucial role in shaping the development of technology transfer offices (TTOs) in Bulgaria. The formation of the country's first TTOs was driven by the desire to emulate successful models from more established innovation ecosystems, particularly those in the United States and Western Europe. In these regions, TTOs have proven to be key drivers of innovation, acting as intermediaries between academic research and industry by facilitating the commercialization of research outputs.

In the United States, the passage of the *Bayh-Dole Act* in 1980 was a turning point that allowed universities to retain ownership of intellectual property (IP) resulting from federally funded research. This policy led to a surge in the creation of TTOs at major universities, which became instrumental in patenting, licensing, and creating startups based on university research. Bulgarian institutions, recognizing the success of these U.S. models, began to adopt similar structures, aiming to foster a culture of innovation and entrepreneurship within academia. However, replicating this model presented challenges, as Bulgaria's IP laws and research funding structures were not as mature, necessitating adaptations to fit the local context.

In Western Europe, the technology transfer ecosystem had also evolved, with many European TTOs offering valuable insights into how to navigate the complex intellectual property landscape of the European Union (EU). Following Bulgaria's accession to the EU in 2007, Bulgarian TTOs were able to draw on these European experiences, particularly in understanding how to protect and commercialize intellectual property across multiple jurisdictions. Countries such as Germany, the United Kingdom, and the Netherlands had well-established TTOs that were seen as models for how universities could engage with industry, manage IP, and support spin-offs. These institutions provided Bulgaria with frameworks for structuring TTOs and developing best practices in IP management, licensing, and research commercialization.

In particular, *Horizon 2020* and its successor, *Horizon Europe*, provided opportunities for Bulgarian TTOs to participate in transnational projects, where they could learn from more experienced European institutions. These EU programs also highlighted the importance of aligning national IP frameworks with EU standards, encouraging Bulgarian institutions to modernize their IP policies and enhance their technology transfer capabilities. Through collaborative research and development (R&D) projects and partnerships with Western European institutions, Bulgarian TTOs were able to gain exposure to effective technology transfer methodologies, such as Proof-of-Concept (PoC) funding, IP valuation techniques, and licensing strategies.

Global best practices also emphasized the importance of building ecosystems around TTOs, incorporating *incubators*, *accelerators*, and *innovation hubs* to support the growth of startups emerging from academic research. In leading innovation ecosystems, these supportive structures provided entrepreneurs with access to mentorship, investment, and industry partnerships. Bulgarian TTOs, influenced by these practices, began exploring ways to establish similar ecosystems, although resource constraints and underdeveloped venture capital markets have made progress slow. Nonetheless, this exposure to global practices has highlighted the importance of integrating TTOs into broader innovation ecosystems, connecting academic institutions with government, industry, and financial sectors.

In addition to IP management and commercialization, global best practices stress the importance of fostering a culture of *entrepreneurship* and *innovation* within research institutions. Many successful TTOs in the U.S. and Europe have implemented comprehensive training and mentorship programs to help researchers and students develop the skills necessary to commercialize their innovations. Bulgarian institutions have begun to incorporate these elements, although more resources and institutional support are needed to fully integrate entrepreneurial education into academic curricula.

Moreover, global best practices have emphasized the need for transparent and fair IP revenue-sharing policies to incentivize researchers to engage in commercialization activities. Bulgarian universities have slowly started adopting similar frameworks, but more robust systems are required to ensure researchers are motivated to participate in the technology transfer process and that institutions can benefit from commercial successes. (Mirchev)

- Key Support from the European Union and Government

The expansion of Bulgaria's TTO network in the late 2000s and early 2010s was supported by both national and international initiatives: (Stoyanova, 01 Jun 2018)

- **EU Funding and Horizon 2020**: European Union programs, particularly Horizon 2020, provided significant funding for research and innovation activities in Bulgaria, allowing universities to invest in strengthening their TTOs.
- **National Government Programs**: The Bulgarian government, through its **National Innovation Strategy** and **Operational Program "Innovation and Competitiveness" (2014-2020)**, provided financial support for R&D activities and incentivized technology transfer through various grants and policy reforms.

- Key Milestones

Several key milestones have marked the development of Bulgaria's technology transfer ecosystem, reflecting its growing sophistication and integration with global trends. These milestones were critical in understanding how the country's innovation landscape evolved and became increasingly efficient in translating academic research into commercial products and services.

- First Intellectual Property Legislation Reform (1990s)

In the early 1990s, shortly after Bulgaria transitioned from a socialist economy to a market-oriented one, the country undertook significant reforms to its **intellectual property (IP) laws**. This reform process was vital in aligning Bulgaria's legal framework with international IP standards, particularly as the country sought to integrate into the global economy and eventually join the European Union (which it did in 2007). The revisions aimed to provide a clear and robust legal basis for the protection of inventions, innovations, and intellectual creations, which had been inadequately protected under the previous socialist system.

One of the key pieces of legislation introduced during this period was the *Law on Patents and Utility Model Registration*, which was first enacted in 1993. This law strengthened patent protection by extending the duration of patents, clarifying the rights of inventors, and ensuring the legal enforceability of patents in court. This enabled Bulgarian researchers, universities, and businesses to secure exclusive rights over their technological innovations, providing a legal framework to protect their intellectual work from unauthorized use.

In addition to the patent law, Bulgaria also adopted the *Law on Trademarks and Geographical Indications* in 1999, which provided clearer regulations on brand protection and the geographical identification of products. These reforms were pivotal in allowing Bulgarian companies to protect their brands and products on both domestic and international markets, which was critical as the country opened up to global trade and foreign investment.

Another key development in Bulgaria's IP reform was the ratification of international treaties that integrated the country into the global intellectual property system. Bulgaria became a signatory to the *Paris Convention for the Protection of Industrial Property* and the *Patent Cooperation Treaty*, which facilitated international patent filing and protection for Bulgarian inventors and researchers. Additionally, Bulgaria acceded to the *World Intellectual Property Organization (WIPO)* in 1975, but the 1990s reforms strengthened its cooperation with this body, ensuring compliance with international IP norms.

These IP reforms not only empowered Bulgarian innovators to protect their ideas, but they also played a crucial role in fostering technology transfer and commercialization. By clarifying the legal environment surrounding patents and licensing, the reforms made it easier for research institutions and companies to engage in technology transfer activities. They provided the legal certainty needed for businesses to invest in research and development (R&D) with the confidence that their innovations would be legally protected. This, in turn, laid the foundation for future partnerships between academia and industry, enabling Bulgaria to gradually build an innovation-driven economy.

The reform of IP laws in the 1990s also prepared Bulgaria for its eventual membership in the European Union, where strong IP protection is a cornerstone of the single market. These legislative changes helped ensure that Bulgarian businesses and researchers could participate fully in the European and international innovation ecosystems, contributing to the country's economic modernization.

- First National Innovation Strategy (2004)

A significant advancement in Bulgaria's efforts to stimulate innovation came with the launch of the **National Innovation Strategy in 2004**. This strategy represented the first comprehensive government initiative aimed at boosting research and development (R&D) and facilitating technology transfer between academia and industry. By providing a structured approach to funding, policy support, and collaborative mechanisms, the strategy played a pivotal role in formalizing technology transfer activities within the country's institutions. It laid the groundwork for fostering closer connections between scientific research and the business sector, encouraging innovation-driven economic growth.

At the heart of this initiative was the establishment of a dedicated fund aimed at promoting scientific research and development projects, with the goal of enhancing the competitiveness of Bulgarian enterprises. The fund's direct objectives included encouraging cooperation between the scientific community and businesses, aiming to translate academic research into practical, commercially viable products, processes, and services. This collaborative approach sought to foster a culture of innovation and entrepreneurship, helping businesses adopt cutting-edge technologies to improve their operations.

One of the main goals of the fund was to support R&D projects that led to the creation of new or improved products and services, thereby increasing the technological level of Bulgarian enterprises. These projects focused on enhancing economic efficiency, improving innovative potential, and raising the technological standards within industries. By doing so, the fund also aimed to stimulate private investment in R&D, recognizing that increased private sector engagement was key to sustaining innovation and driving economic growth.

In addition to promoting innovation, the fund also had specific targets aimed at boosting the production capacity of enterprises. It focused on increasing the volume of production, improving the quality of goods and services, and reducing the resources required for production processes. This emphasis on efficiency not only improved the competitiveness of Bulgarian businesses in both domestic and international markets, but also encouraged investment in companies that demonstrated strong innovative potential.

By facilitating greater collaboration between science and business, the National Innovation Strategy helped transform Bulgaria's innovation landscape, positioning the country to become more competitive in the global economy. The strategy encouraged enterprises to embrace R&D as a key driver of growth and sustainability, while ensuring that academic institutions played a central role in fostering technological advancements. This strategic alignment between science, industry, and government became a cornerstone of Bulgaria's push towards a more knowledge-based economy.

- First Successful Technology Commercialization (2006)

The first major milestone in the commercialization of academic research in Bulgaria occurred in 2006 when the **Bulgarian Academy of Sciences (BAS)** successfully began licensing various technologies developed by its research teams. This marked a turning point for the country, as it highlighted Bulgaria's potential to transform scientific research into marketable products and services. The move by BAS demonstrated the ability of academic institutions to collaborate with industry, fostering a knowledge-based economy.

Prior to 2006, Bulgaria's academic research had remained largely within the academic sphere, with limited practical application or commercial potential being realized. The BAS, being one

of the country's most prominent research institutions, decided to focus on technology transfer, a process that bridges the gap between academic innovation and industrial application. Through licensing agreements, BAS made its research accessible to commercial enterprises, allowing for the development and production of cutting-edge technologies.

The success was driven by a dedicated team of scientists working on innovative technologies, and their work found applications in various industries, including energy, biotechnology, and information technology. One of the notable achievements from this period was the licensing of energy-efficient solutions, which contributed to advancements in Bulgaria's energy sector. Additionally, the commercialization efforts helped BAS and other research institutions secure much-needed funding, thus enabling further research and development.

This landmark event set the stage for future collaborations between Bulgarian academia and industries, enhancing the country's reputation in scientific innovation and technology transfer. The BAS continued to build on this success, establishing Bulgaria as a player in the international arena of technology commercialization. (Ivanova, 30 Sep 2008)

- Tech Parks Culture Development

The development of key technology parks in Bulgaria has played a pivotal role in the growth of the country's innovation and technology transfer ecosystem. These parks have become central hubs for research, development, and commercialization, supporting startups and fostering collaboration between academic institutions, the industry and the private sector.

Sofia Tech Park

Sofia Tech Park is Bulgaria's first dedicated science and technology hub, launched in 2015 to boost innovation in critical sectors such as information and communication technology (ICT), biotechnology, and green energy. It has quickly established itself as a focal point for the country's technology transfer activities, facilitating collaboration between academia, industry, and government. Offering state-of-the-art infrastructure, laboratories, and incubation space, the park provides an ideal environment for startups and researchers to develop innovative products and services.

The park's main goal is to serve as a prestigious hub for global, regional, and national researchers, fostering a knowledge-based economy in Bulgaria and the Balkan region. Sofia Tech Park focuses on enhancing the competitiveness of both science and entrepreneurship by improving the exchange of knowledge between academic circles and the business community, supporting startups, and commercializing scientific research.

The tech park consists of several interconnected units:

- The Incubator: This space is dedicated to supporting startups by providing modern office spaces, conference rooms, relaxation areas, and sports facilities. Startups also receive valuable consultations on administrative, marketing, and financial issues through educational programs, conferences, and thematic forums.
- Laboratory Complex: One of the park's main elements, the complex hosts 11 high-tech labs, established with the help of leading Bulgarian academic

institutions like Sofia University, Technical University of Sofia, and Medical University of Sofia. These labs offer opportunities for scientific research and collaboration with private companies.
- Experimentarium: A museum center showcasing innovation and technology, featuring Bulgaria's first interactive children's center, "TechnoMagicLand."
- Innovation Forum "John Atanasoff": A multifunctional event venue hosting conferences and seminars to foster dialogue between the scientific and business communities.
- Petascale Supercomputer (PetaSC Bulgaria): This supercomputing initiative supports advanced scientific research and industrial applications, positioning Bulgaria at the forefront of European high-performance computing.

The establishment of Sofia Tech Park has had a significant impact on the local economy by attracting international projects, strengthening collaborations between academic and industrial sectors, and fostering a supportive ecosystem for technological innovation and entrepreneurship. (Sofia Tech Park, n.d.)

- Varna Tech Park

Varna Tech Park - Black Sea High-tech Park (BSHTPV) was established in 2016 with a focus on maritime technology, logistics, and renewable energy due to Varna's strategic location as a major Black Sea port. The Tech Park is a thriving hub that provides an ideal environment for small and medium-sized enterprises (SMEs) to grow and innovate. Located in Varna, the park offers businesses access to cutting-edge technology, specialized services, and global markets. The center fosters collaboration between research institutes, high-tech companies, investors, and local businesses, all aimed at boosting sustainable and competitive development.

The infrastructure at BSHTPV includes modern offices, laboratories, study rooms, and recreational areas, creating a dynamic space for research and innovation. The park brings together academia, local authorities, national research bodies, and the private sector to facilitate knowledge exchange and innovation in priority areas such as Black Sea resource utilization, environmental protection, climate change, renewable energy, and public health improvements. (Varna Tech Park, n.d.)

Varna Tech Park operates in three key sectors:

- Research, Innovations, and Technologies - promoting breakthroughs across various industries.
- High-Technology Environmental Solutions - focusing on green and eco-friendly innovations.
- Conference Center - serving as a meeting point for collaboration and knowledge sharing.

This high-tech park plays a crucial role in improving the local economy by fostering high-tech products and services. It attracts both international investments and supports the development of local innovative enterprises, contributing to the overall competitiveness of SMEs in the region.

The park also has a significant environmental impact by promoting the use of renewable energy and reducing carbon emissions. In addition, it enhances the well-being of the population through technologies aimed at climate change adaptation and

public health, such as early warning systems for natural disasters and pollution monitoring.

Varna Tech Park creates opportunities for talented young professionals, offering them a space to innovate and grow within Bulgaria while contributing to job creation and the region's overall economic development.

- Plovdiv Tech Park

Plovdiv Tech Park is Bulgaria's first privately funded entrepreneurial technology park, established to support innovation, research, and high-tech entrepreneurship. Officially renamed Plovdiv Tech Park AD in 2019, the park's mission is to provide a unique environment where businesses, especially startups, can thrive. It offers essential services like high-tech training, shared workspaces, and business incubation programs. The park is also involved in projects aimed at enhancing research and technological capacity.

With a rich legacy dating back to its origins as the "Laser Technology Factory" in the 1980s, the complex initially focused on laser equipment production. Over the years, it evolved into a hub for optoelectronics, laser technologies, and cutting-edge innovations. Plovdiv Tech Park continues this tradition, now offering an ideal platform for companies to develop innovative products and services, aided by its strategic partnerships, including collaboration with the Indian Institute of Hardware Technology (IIHT) since 2016.

Located just 20 minutes from Plovdiv's city center and international airport, the park benefits from excellent infrastructure, making it an attractive location for foreign businesses entering the Bulgarian market. It provides access to the country's largest industrial area, Trakia, and supports companies in education, consulting, research, logistics, and high-tech services.

Plovdiv, known for its vibrant entrepreneurial culture, is an ideal location for startups, with a high density of investors and mentors. Plovdiv Tech Park helps businesses harness this unique ecosystem, providing not only physical space but also an innovation-friendly atmosphere that drives research and development.

Plovdiv Tech Park is positioned as a key player in fostering technological growth in Bulgaria, offering opportunities for both local and international businesses to innovate and expand. (Optela, n.d.)

- EU Horizon 2020 Participation (2014-2020)

Bulgaria's participation in the European Union's **Horizon 2020** funding program represented a major step in the internationalization of its technology transfer activities. Through Horizon 2020, Bulgarian research institutions and universities gained access to substantial funding and became part of larger European research projects. This enabled Bulgarian TTOs to learn from best practices in leading European countries and helped integrate Bulgarian innovations into international networks. Several research institutions benefited from this program, accelerating the commercialization of their technologies and fostering cross-border collaborations.

- Notable Cases and Examples

Several successful technology transfer cases have shaped the evolution of Bulgaria's ecosystem. These examples highlight how Bulgarian institutions and companies have navigated the challenges of commercialization and leveraged international opportunities to bring their innovations to market.

- Sirma Group

One of Bulgaria's most prominent success stories is the **Sirma Group**, a leading technology company specializing in software development and artificial intelligence. The company originated from academic research collaborations in the late 1990s, when a group of researchers from the Bulgarian Academy of Sciences and Sofia University worked together on projects related to AI and computer science. Sirma Group became a prime example of how Bulgarian research could be transformed into a successful, globally competitive business.

Sirma Group's most well-known product, **Ontotext**, is a semantic technology that has been used in various industries, including publishing, financial services, and healthcare. The company's successful commercialization efforts have had a ripple effect on Bulgaria's technology transfer ecosystem, inspiring other researchers and entrepreneurs to pursue commercialization paths. (Sirma Group, n.d.)

- Biovet

Biovet, a biotechnology company based in Peshtera, is another notable example of successful technology transfer in Bulgaria. Originally established as a research initiative in veterinary medicine, Biovet has become one of the leading manufacturers of animal health products and vaccines in Southeast Europe. The company's success can be attributed to its strong collaborations with Bulgarian research institutions, including the Bulgarian Academy of Sciences.

Over the years, Biovet has expanded its operations internationally, securing partnerships with global pharmaceutical companies. The company's growth from a small research-based initiative to an international player highlights the importance of effective technology transfer and commercialization support in scaling Bulgarian innovations. (Biovet, n.d.)

- LaunchHub Ventures and Eleven Ventures

LaunchHub Ventures and **Eleven Ventures** are two examples of leading venture capital firms that have played a pivotal role in supporting early-stage technology startups in Bulgaria. These firms have provided funding and mentorship to numerous university spin-offs and research-based startups, helping to scale innovations and bring them to market. Their investments have helped strengthen the overall technology transfer ecosystem by providing crucial financial and business development support to companies emerging from academic institutions. (Eleven Ventures, n.d.) (LaunchHub Ventures, n.d.)

Institutionalization of Technology Transfer in Bulgaria

The process of institutionalizing technology transfer in Bulgaria has been marked by significant developments in establishing formal structures, processes, and frameworks aimed at facilitating innovation commercialization. Beginning in the early 2000s, as Bulgaria aligned its policies with European Union standards, the government and academic institutions recognized the need for a structured approach to managing intellectual property (IP) and fostering collaboration between research institutions and industry.

The establishment of **Technology Transfer Offices (TTOs)** at major research universities and institutions like the **Bulgarian Academy of Sciences (BAS)** was a critical step in this institutionalization. Initially, TTOs were created to manage the increasing volume of research outputs that had potential commercial value, providing a dedicated body to handle intellectual property rights, patent filings, and licensing agreements. Over time, these offices evolved, becoming more professionalized with specialized staff trained in IP management, technology commercialization, and legal aspects of licensing.

In parallel, the **standardization of procedures** for technology transfer became a priority. Guidelines were developed to ensure that research institutions followed consistent processes in managing IP, negotiating licensing agreements, and engaging with industrial partners. As Bulgaria integrated into the EU, it became subject to EU-wide regulations concerning research, development, and innovation, further solidifying the framework for technology transfer activities.

An important aspect of this institutionalization was the **internationalization of technology transfer activities**. Participation in EU-funded programs like **Horizon 2020** allowed Bulgarian institutions to engage in collaborative research with European counterparts, exposing them to advanced technology transfer practices and giving them access to larger innovation networks. These partnerships helped Bulgarian universities adopt more efficient IP management strategies and strengthened their ability to commercialize research on a global scale. Moreover, the Bulgarian government supported this transition by implementing national strategies that aligned with EU innovation goals, further institutionalizing technology transfer processes. (Terziev, Offset implementation impact on technology transfer in bulgaria, 27 Dec 2017)

Influence of Global Trends on Bulgaria's Technology Transfer Ecosystem

Bulgaria's technology transfer ecosystem has been shaped by several global trends that have influenced both the strategic direction and the operational mechanisms of technology transfer activities in the country. The **rise of the knowledge economy**, characterized by the growing importance of intangible assets such as innovation, research, and intellectual property (IP), played a significant role in Bulgaria’s shift towards building a knowledge-based innovation infrastructure. As global economies began prioritizing the commercialization of research, Bulgarian institutions and the government recognized the importance of aligning with this trend to boost national competitiveness.

The integration of Bulgaria into the European Union in 2007 had a profound impact on its technology transfer ecosystem. Bulgaria gained access to EU funding programs such as **Horizon 2020**, which promoted cross-border research collaboration and shared best practices in innovation management. These collaborations exposed Bulgarian research institutions to more mature technology transfer systems in Western Europe, facilitating knowledge exchange and technology dissemination. Furthermore, participation in these international research consortia helped Bulgarian institutions improve their **IP management practices**.

Another global trend that significantly influenced Bulgaria's ecosystem was the growing importance of **intellectual property (IP) management**. As innovations became a primary driver of economic growth worldwide, effective IP management became crucial for countries aiming to compete in the global market. Bulgaria began adopting more sophisticated IP policies in line with **European Patent Office (EPO)** standards, and TTOs became the primary actors in managing the protection and commercialization of research outputs. Global trends in **open innovation** also started influencing Bulgaria's research landscape, with universities becoming more open to collaborative research and joint ventures with both domestic and international companies.

The growing global emphasis on **sustainability** and **green technologies** also had a notable effect on Bulgaria's technology transfer ecosystem. EU regulations and funding priorities started focusing heavily on sustainability, prompting Bulgarian research institutions and startups to explore innovative solutions in renewable energy, sustainable agriculture, and environmental technologies. These global trends fostered the development of new technology transfer opportunities in sectors that are crucial to addressing global challenges such as climate change.

- Emergence of New Stakeholders in Bulgaria's Technology Transfer Landscape

The Bulgarian technology transfer landscape has seen the entry of new stakeholders, which has significantly impacted the commercialization of research and the development of innovative startups. Among these new players, **venture capitalists (VCs)**, **private equity firms**, and **multinational corporations** have emerged as key drivers of growth and innovation.

In the early 2010s, Bulgaria experienced a surge in entrepreneurial activity, leading to the establishment of several **venture capital funds** aimed at supporting startups and early-stage companies. Leading firms began investing in tech-driven startups, providing not only capital but also access to mentorship, business development expertise, and networks. These venture capital firms have played a crucial role in scaling innovations from Bulgarian research institutions, particularly in the ICT, AI, and fintech sectors.

The involvement of **private equity firms** has also expanded, with an increasing focus on financing more established companies in sectors like biotechnology, renewable energy, and advanced manufacturing. These firms bring strategic investments that help Bulgarian companies expand internationally and bring new technologies to the global market. Their participation has led to a more mature investment ecosystem in Bulgaria, helping to bridge the gap between academic research and commercial success.

Another significant development has been the **entry of multinational corporations** into Bulgaria's innovation landscape. Big companies have partnered with Bulgarian universities and research institutions on collaborative R&D projects, particularly in emerging areas like artificial intelligence, cloud computing, and cybersecurity. These partnerships provide Bulgarian researchers access to cutting-edge technologies and global markets, while multinational corporations benefit from the local talent pool and research capabilities.

Furthermore, **business incubators and accelerators** have grown in prominence, offering structured programs that provide startups with resources such as workspace, mentorship, and funding. Programs like **Sofia Tech Park's incubator** and the **American University in Bulgaria's accelerator** have become vital for supporting early-stage companies in navigating the complexities of technology commercialization and scaling their operations.

- Graphical Representation of the development of Bulgaria's Technology Transfer Ecosystem

- Pre-1990s: Early Efforts in Technology Transfer

  - **Socialist Era**: State-driven industrialization fosters collaborations between research institutions and state-owned enterprises, with innovation efforts focused on national economic goals. However, these collaborations lacked the formalized, market-driven processes seen in modern technology transfer systems.

- 1990s: Transition to a Market Economy

  - **1991-1993**: Following the political changes of 1989, Bulgaria transitions to a market-oriented economy. This shift paves the way for more open and market-driven innovation practices.
  - **1993**: Initial reforms to Bulgaria's **Intellectual Property (IP) laws** align the country with international standards, creating the foundation for future technology transfer activities. (Terziev, The legacy for the beginning of the market economy transition in bulgaria, 15 Sep 2019)

- 2000s: Creation and Early Development of TTOs

  - **Early 2000s**: Bulgaria begins establishing its first **Technology Transfer Offices (TTOs)** at leading research institutions like the Bulgarian Academy of Sciences (BAS) and Sofia University. These offices are responsible for managing intellectual property, licensing agreements, and creating spin-offs based on academic research.
    - **BAS TTO**: Focuses on managing IP in fields such as biotechnology, materials science, and IT.
    - **Sofia University TTO**: Helps researchers with IP protection, market analysis, and innovation management.
    - **Technical University of Sofia TTO**: Bridges the gap between engineering research and industry applications.
  - **2004**: Bulgaria introduces its first **National Innovation Strategy**, aimed at boosting R&D and fostering collaboration between academia and industry.

- Mid-2000s: Early Commercialization Successes

  - **2006**: The **Bulgarian Academy of Sciences (BAS)** achieves one of Bulgaria's first major technology commercialization successes by licensing research innovations to external partners. (Sciences, n.d.)

- 2010s: Expansion of Tech Parks and Innovation Hubs

  - **2015**: **Sofia Tech Park** is established as Bulgaria's first science and technology park, focusing on ICT, biotechnology, and green energy. It becomes a central hub for collaboration between academia, industry, and startups.
  - **2016**: **Varna Tech Park** launches, emphasizing maritime technology, logistics, and renewable energy, leveraging Varna's strategic location on the Black Sea.
  - **2016**: **Plovdiv Tech Park** is established, becoming Bulgaria's first privately funded entrepreneurial tech park, offering high-tech training, shared workspaces, and support for startups.

- Late 2010s: Increased Global Integration

- **2017**: **Sofia Tech Park** partners with **IBM**, promoting research in cloud computing and AI, marking a milestone in Bulgaria's international technology collaborations.
- **2018-2020**: Bulgaria continues to integrate into the European innovation landscape through participation in EU-funded programs like **Horizon 2020**, supporting cross-border research collaborations.

- 2020s: Institutionalization and Emergence of New Stakeholders

  2020-2021: Growth in the involvement of **venture capital firms** like **LaunchHub Ventures** and **Eleven Ventures**, supporting the commercialization of research and early-stage startups.

2.2 Existing Studies

Strategic evaluation of the technology transfer and IPR protection systems of Bulgaria, Croatia and Romania and recommendations for their enhancement
Authors Bole, D., Galabova, L., Haley, C., Kokorotsikos, P., Matanovac , R., Rizzuto, C., Taylor, S., Vladut, G., Zambelli, M.
Editors Kaymaktchiyski, S., Battiston, A., Jiménez, V. M.

(Strategic evaluation of the technology transfer and IPR protection systems of Bulgaria, Croatia and Romania and recommendations for their enhancement, 2024)

The technology transfer (TT) ecosystem in Bulgaria has evolved significantly in recent years, particularly within academic and research institutions, aiming to enhance collaboration between academia and industry, intellectual property (IP) management, and the commercialization of research. Multiple studies and initiatives have provided insights into the country's TT ecosystem, outlining both achievements and challenges. (1)

1. Overview of the Bulgarian Technology Transfer Ecosystem

Bulgaria's TT ecosystem has been developed with the goal of promoting innovation and research commercialization. It includes a range of stakeholders: research institutions, universities, government bodies, and specialized organizations. These actors collaborate to foster the transfer of know-how and technologies from the research sector to industry, thereby supporting economic growth and technological development.

Key players in Bulgaria's TT ecosystem include the Bulgarian Academy of Sciences (BAS), the Joint Innovation Centre (JIC), Sofia Tech Park, the GIS-Transfer Centre (GIS-TC), and universities such as Sofia University and the Medical University of Plovdiv. The ecosystem also incorporates Centres of Competence (CoCs) and Centres of Excellence (CoEs), established to consolidate national research and innovation (R&I) resources.

- Key Objectives

  - **Enhancing collaboration** between academic institutions and industry.
  - **Supporting intellectual property protection** and commercialization.
  - **Facilitating the creation of spin-offs** from research institutions.
  - **Attracting international collaborations** and investment to the Bulgarian R&I sector.

- 2. Key Institutions and Their Role in Technology Transfer

  - 2.1 Bulgarian Academy of Sciences (BAS) and the Joint Innovation Centre (JIC)

    BAS is one of the most influential research institutions in Bulgaria, and it plays a crucial role in the country's TT ecosystem. The JIC at BAS provides technology transfer services such as IP protection, brokerage services, and commercialization support. JIC operates the CONNECT platform, which facilitates partnerships between researchers and businesses, offering services like IP management, research collaborations, and access to commercialization opportunities.

    A significant challenge for BAS and its associated TT offices is the limited availability of specialized TT professionals. Many researchers in BAS manage their own commercialization processes, which leads to inefficiencies and missed opportunities. Despite these challenges, BAS remains one of the most active institutions in Bulgaria for patenting inventions. According to recent studies, BAS has also been involved in creating several spin-off companies, a key method of transferring research from academia to industry.

  - 2.2 GIS-Transfer Centre Foundation (GIS-TC)

    The GIS-Transfer Centre Foundation, a network coordinating the national technology transfer ecosystem, is pivotal in transferring competitive research products and know-how between academia and industry. It consists of 31 member entities, including major TTOs and research organizations across Bulgaria. GIS-TC supports IP management, business development, and international collaboration, particularly through partnerships with global networks like the German-based STEINBEIS Foundation.

    GIS-TC has also been responsible for fostering innovation through its work with small and medium-sized enterprises (SMEs), helping to facilitate the transfer of new technologies to the market. As a result of its initiatives, GIS-TC has enabled the formation of several spin-offs and supported various joint projects between research institutions and businesses, creating an essential link in the Bulgarian innovation ecosystem.

  - 2.3 Sofia Tech Park

    Sofia Tech Park serves as a national hub for innovation, start-ups, and technology transfer. It was created to strengthen Bulgaria's research infrastructure and facilitate the growth of early-stage technologies. Sofia Tech Park plays a central role in developing and managing relationships between academia and industry, providing resources like research laboratories and business incubators that support start-ups and foster technology commercialization.

    Sofia Tech Park's role in the TT ecosystem has been particularly significant in bridging the gap between academia and industry. It has become a focal point for technology-driven entrepreneurship, facilitating numerous start-up ventures and providing a platform for innovative research to reach commercial markets. However, studies show that the park's full potential is still not entirely realized due to challenges such as underutilization of its facilities and insufficient integration with Bulgaria's wider innovation ecosystem.

  - 2.4 Centers of Competence (CoCs) and Centers of Excellence (CoEs)

The establishment of CoCs and CoEs in Bulgaria between 2019 and 2023 marked a major development in the country's technology transfer infrastructure. These centers were created as part of efforts to consolidate national R&I resources and bridge the gap between research and industry. CoCs and CoEs focus on specific areas of research and innovation, often in high-tech sectors such as ICT, robotics, and healthcare, and they work closely with universities and research institutions to translate scientific research into marketable products and services.

However, several studies have pointed out key challenges faced by these centers, including the reliance on part-time or seconded staff, limited resources, and fragmented efforts. Despite their potential to drive regional innovation, many CoCs and CoEs struggle with sustainability issues due to a lack of long-term funding and human capital.

3. Key Findings from Studies on Technology Transfer

3.1 Fragmentation and Lack of Coordination

Many studies have identified the fragmentation of Bulgaria's TT ecosystem as a significant challenge. The existence of multiple TT entities, including over 30 TTOs, has led to a lack of coordination, with many of these offices operating at subscale and being more project-oriented rather than focusing on core TT activities. The absence of a centralized national TT strategy has further complicated efforts to streamline technology transfer across institutions.

3.2 Low Academia-Industry Collaboration

Despite improvements in recent years, collaboration between academic institutions and industry remains low in Bulgaria. Many researchers continue to engage in TT activities independently, without leveraging institutional support, due to insufficient incentives and unclear institutional policies. The absence of robust mechanisms for evaluating the commercial potential of research has also been a barrier to more effective collaboration with industry.

3.3 IP Management and Spin-Off Creation

IP management remains a central feature of Bulgaria's TT ecosystem, with institutions like BAS and Sofia University actively engaging in patenting activities. However, studies highlight the lack of sufficient funding and resources for the protection and commercialization of IP, particularly within universities and research institutes. As a result, the creation of spin-offs, while an important method of technology transfer, has not yet reached its full potential.

The regulatory environment, particularly laws related to the establishment of spin-off companies from research institutions, has also been cited as a barrier. Many academic institutions are hesitant to create spin-offs due to legal uncertainties surrounding public funding legislation.

3.4 Brain Drain and Human Capital

One of the most significant issues affecting Bulgaria's TT ecosystem is the persistent brain drain of qualified researchers and TT professionals. Studies indicate that a lack of incentives, combined with inadequate funding and job insecurity, has led to a steady outflow of talent.

This issue is particularly pronounced in CoCs and CoEs, where many staff members work on a part-time basis or are seconded from other institutions.

- 4. Common Methods, Tools, and Workflows in the Technology Transfer Ecosystem
  - 4.1 Collaborative Research and Contract Research

Collaborative research remains one of the primary methods of technology transfer in Bulgaria. Institutions like BAS and GIS-TC frequently engage in joint research projects with industry partners. These collaborations are often funded through national and international grants, including EU programs like Horizon Europe. Through such collaborations, companies gain access to cutting-edge research, while research institutions benefit from industrial insights and commercialization opportunities.

  - 4.2 Spin-Offs and Start-Ups

Spin-off creation is a critical method for transferring technologies from academic institutions to the marketplace. GIS-TC has supported the creation of several spin-offs from BAS, while Sofia Tech Park has incubated numerous start-up companies in the tech sector. Spin-offs allow for direct commercialization of research and often focus on high-tech industries such as robotics, AI, and biotechnology.

  - 4.3 IP Management and Licensing

Managing and licensing intellectual property is a core function of TTOs in Bulgaria. These offices assist researchers in securing patents, navigating the legal aspects of IP protection, and finding industrial partners to license technologies. Licensing agreements between universities and companies provide a critical revenue stream for research institutions while allowing businesses to leverage innovative technologies developed in academic settings.

- 5. Conclusion: Results and Future Directions

Despite significant progress, including the creation of key TT institutions and increased academia-industry collaboration, the ecosystem remains fragmented, with several challenges to address. These include the need for better coordination among TT offices, more sustainable funding mechanisms, and enhanced support for human capital development.

Moving forward, it will be essential for Bulgaria to build on the success of initiatives like Sofia Tech Park and the CoCs/CoEs while addressing the structural issues that hinder long-term sustainability. Improved policy coordination, the implementation of a coherent national TT strategy, and a focus on attracting and retaining human capital will be crucial for creating a robust and dynamic TT ecosystem capable of driving innovation and economic growth.

3 PESTEL Analysis of the Technology Transfer Ecosystem

3.1 Political Factors

Political factors play a crucial role in shaping the development and implementation of technology transfer (TT) strategies. The Bulgarian government has made considerable efforts to strengthen the system, particularly through initiatives like the establishment of *Centers of Competence (CoCs)* and *Centers of Excellence (CoEs)*. These centers aim to enhance collaboration between academia, industry, and government bodies, fostering an environment where research can be more easily commercialized. However, despite these positive steps, the policy landscape remains fragmented, limiting the full potential of technology transfer.

One of the major challenges is the lack of coordination between different ministries and agencies involved in research and innovation (R&I). The need for a more integrated and cohesive approach has long been recognized, but achieving such coordination has been difficult. To address this, the government introduced the *Law on Research and Innovation* in May 2023, which is expected to enhance the synchronization of policies across ministries, improving the overall R&I framework. This law is seen as a critical step toward establishing clearer guidelines for research funding, intellectual property (IP) protection, and technology transfer, all of which are essential for improving Bulgaria's innovation ecosystem.

Another key development in the political landscape is the *Recovery and Resilience Plan (RRP)*, which includes specific reforms and financial support aimed at strengthening the country's technology transfer and R&I capabilities. While the RRP provides a much-needed boost in funding, its long-term effectiveness depends heavily on the proper execution and oversight of these initiatives. Ensuring that the allocated resources are directed to projects with high innovation potential is essential for the success of the plan. The creation of transparent and efficient mechanisms for evaluating and managing projects under the RRP is crucial in this context.

One of the most significant barriers to effective technology transfer in Bulgaria has been the lack of systematic, national-level public funding for basic research and IP protection. While targeted funds have been established, the absence of a sustained financial commitment to research from the state has hindered long-term innovation performance. Without reliable funding for fundamental research, universities and research institutions struggle to build a strong foundation for technology transfer activities, such as licensing and spin-offs.

The fragmented regulatory framework has also presented challenges for the commercialization of scientific research. One notable regulatory obstacle has been the restriction on researchers and investors holding equity in startups formed around their innovations. This limitation discourages researchers from engaging in entrepreneurial activities, as they are unable to directly benefit from the commercialization of their discoveries. The proposed changes to these regulatory frameworks are critical to fostering a more vibrant entrepreneurial ecosystem where academic researchers can actively participate in the creation of technology-driven startups.

In addition to policy and regulatory reforms, other political factors influencing Bulgaria's TT ecosystem include the country's integration into European research and innovation programs. Bulgaria’s participation in the *Horizon Europe* program and other EU initiatives has been vital for connecting Bulgarian researchers with international partners, providing access to European funding, and promoting the exchange of knowledge and technologies across borders. The alignment of national policies with EU standards remains an ongoing effort, but

it is crucial for Bulgaria to fully leverage these opportunities for technology transfer and innovation.

3.2 Economic Factors

The economic environment in Bulgaria plays a critical role in shaping the technology transfer (TT) ecosystem, particularly with regard to funding availability. One of the major challenges faced by public research institutions is the lack of systematic and sustainable funding dedicated to intellectual property (IP) protection and commercialization activities. Without consistent financial resources to support these key aspects of the technology transfer process, many innovations emerging from academic research struggle to reach the market. This issue is compounded by the fact that public institutions often rely heavily on short-term project funding, which does not provide the long-term stability needed for building a robust TT infrastructure.

In contrast, the private sector, particularly the venture capital (VC) industry, has shown signs of growth, especially in fields such as information and communications technology (ICT) and digital startups. Bulgaria's ICT sector has become one of the most dynamic areas for innovation and commercialization, attracting both domestic and international investment. However, these sectors remain largely outside the state's IP ecosystem, meaning that the innovations within them are often disconnected from public research institutions and their potential contributions to broader scientific advancements. This gap between public research and private sector commercialization limits the overall effectiveness of the TT ecosystem.

Despite targeted reforms and financial support from European Union (EU) initiatives such as the *Operational Programmes (OP)* and the *Recovery and Resilience Plan (RRP)*, financial inefficiencies and overlaps in TT funding remain a significant issue. These inefficiencies can lead to the misallocation of resources, with some areas of innovation receiving disproportionate attention, while others—often those with high potential for technological advancement—are overlooked. The lack of a coordinated, overarching strategy for funding allocation exacerbates this problem, preventing Bulgaria's TT ecosystem from reaching its full potential.

To address these economic barriers, several proposals have been put forward, including the creation of a dedicated *Technology Transfer Venture Capital (VC)* fund. A VC fund specifically designed to support technology transfer would provide much-needed financial backing for the commercialization of innovations developed within academic and public research institutions. This type of fund would encourage private sector investment in early-stage technologies, helping bridge the gap between research and market-ready products. The fund could also support high-risk, high-reward ventures that are often overlooked by traditional investors, thereby fostering a more diverse and dynamic innovation landscape.

In addition to the VC fund, the introduction of *Proof-of-Concept (PoC)* grants has been identified as a key mechanism for improving the technology transfer process in Bulgaria. PoC grants provide researchers with the financial resources needed to validate the commercial potential of their innovations, helping to de-risk early-stage projects and making them more attractive to private investors. By supporting these initial stages of commercialization, PoC

grants can accelerate the development of market-ready technologies and increase the likelihood of successful technology transfer outcomes.

The combination of a well-structured VC fund and PoC grants could significantly enhance Bulgaria's TT performance by creating a more supportive financial ecosystem for innovation. These mechanisms would help ensure that promising technologies receive the necessary funding to advance from research and development (R&D) to commercialization. Moreover, they would promote greater integration between public research institutions and private sector investors, fostering a collaborative environment that encourages the commercialization of scientific discoveries across a range of industries.

3.3 Social Factors

Social factors, particularly attitudes towards innovation and the education level of the workforce, play a pivotal role in shaping Bulgaria's technology transfer (TT) ecosystem. Despite growing collaboration between academia and industry in recent years, the level of public research commercialization remains relatively low. This limitation is largely influenced by several social dynamics, including the widespread issue of *brain drain*, where highly skilled researchers and technology transfer professionals leave the country in search of better opportunities abroad. This migration of talent weakens the national innovation ecosystem, as the country loses key individuals who are essential for driving scientific advancements and facilitating the commercialization of research.

One of the core challenges in Bulgaria's TT landscape is the insufficient incentives for public researchers to commercialize their innovations. Within many academic institutions, there are few structured rewards or recognition systems that encourage researchers to move beyond pure research and engage in entrepreneurial or commercial activities. This lack of incentives often results in researchers bypassing institutional technology transfer offices (TTOs) and seeking direct collaboration with the private sector. As a result, the technology transfer process becomes fragmented, leading to a disconnect between universities and research institutes and the broader commercialization ecosystem. This fragmentation limits the potential benefits that could be gained from organized institutional technology transfer, including revenue generation, intellectual property (IP) protection, and broader societal impacts.

Addressing the *brain drain* issue and creating better incentives for researchers are critical to overcoming these challenges. One potential solution involves fostering a more supportive environment for researchers who wish to engage in commercialization activities. Providing researchers with opportunities to hold equity in startups or offering financial rewards for successful commercialization efforts could create the necessary motivation to keep talented individuals within the country and actively engaged in the technology transfer process. In addition, developing a clearer pathway for academic entrepreneurs, including mentorship programs, incubators, and accelerators specifically designed for academic researchers, could help retain talent and improve commercialization outcomes.

Despite these challenges, there are positive trends that bode well for the future of Bulgaria's TT ecosystem. The increasing emphasis on *STEM (Science, Technology, Engineering, and*

Mathematics) education is helping to build a more technically proficient workforce capable of driving innovation. This shift towards STEM fields is accompanied by a growing awareness of sustainability, which is encouraging research and development in areas such as clean energy, environmental protection, and green technologies. The integration of sustainability into research agendas aligns with global trends and opens new avenues for technology transfer, particularly in fields where Bulgarian researchers can make significant contributions.

However, while these educational and environmental trends are promising, they must be supported by cultural shifts in research attitudes and industrial cooperation. Traditionally, research in Bulgaria has been focused more on academic achievements than on practical applications, a mindset that needs to evolve to encourage more industry-oriented research. Building a more collaborative environment that integrates academia, industry, and public research systems is essential. This requires not only government intervention but also a change in how research institutions view their role in society. Universities and research centers need to prioritize their contributions to economic development and societal well-being through technology transfer.

To achieve this cultural shift, the Bulgarian government can play a central role by promoting policies that encourage closer cooperation between public research institutions and the private sector. Initiatives such as joint research programs, co-funded projects, and public-private partnerships can help bridge the gap between academic research and industry needs. Moreover, fostering stronger connections between universities, industry, and investors through events such as innovation fairs, conferences, and networking platforms can create a more dynamic innovation ecosystem. These efforts would not only improve the commercialization of research but also strengthen Bulgaria's position in the global innovation landscape.

3.4 Technological Factors

The technological landscape in Bulgaria is steadily evolving, presenting both opportunities and challenges for the country's technology transfer (TT) ecosystem. On one hand, Bulgaria has seen notable advances in fields such as artificial intelligence (AI), information and communication technology (ICT), and digital platforms, all of which provide fertile ground for technology transfer initiatives. However, despite these technological advancements, many Bulgarian research institutions struggle to scale up their commercialization efforts due to infrastructural and human capital limitations.

A major challenge faced by Bulgarian research institutions is the lack of adequate infrastructure to support technology transfer. Many public research organizations lack state-of-the-art facilities, advanced equipment, and specialized technology platforms that are crucial for developing and commercializing cutting-edge innovations. Without access to the latest technological tools, researchers are often unable to fully explore the commercial potential of their discoveries. This gap in infrastructure makes it difficult for institutions to compete with global research centers that are better equipped to bring innovations to market.

Human capital also remains a significant bottleneck in the technology transfer process. While there is an increasing focus on STEM education in Bulgaria, the country still lacks a sufficient

number of highly specialized professionals who possess the technical and entrepreneurial skills necessary to navigate the complex process of commercializing research. This issue is particularly pronounced within *Technology Transfer Offices (TTOs)*, which play a critical role in bridging the gap between academia and industry. In many cases, TTOs in Bulgarian universities and research institutes are under-resourced and project-oriented, with limited staff dedicated to core TT activities such as patenting, licensing, and startup formation. This scarcity of resources and expertise hampers their ability to systematically engage in the commercialization process, leading to missed opportunities for technology transfer.

Moreover, while Bulgaria's growing digital and ICT sectors present a significant opportunity for technology transfer, this focus on ICT often overshadows other high-potential technological areas. The ICT sector has become a dynamic driver of innovation in Bulgaria, with startups and enterprises leveraging the country's strong technical education base and favorable business environment. However, other critical fields, such as biotechnology, green technologies, and materials science, remain underdeveloped in terms of both research and commercialization. Without targeted investments and institutional support in these areas, Bulgaria risks falling behind in sectors that are increasingly important on the global stage.

Biotechnology, for example, offers immense potential for technology transfer, particularly in the fields of pharmaceuticals, agriculture, and environmental sustainability. However, the sector in Bulgaria remains relatively small, with few dedicated research centers and limited collaboration between academia and industry. Similarly, green technologies, which are essential for addressing climate change and sustainability challenges, have not received the level of investment necessary to unlock their full potential. The lack of focus on materials science, another high-impact area, further limits Bulgaria's ability to compete in industries that rely on advanced materials, such as aerospace, automotive, and electronics.

To fully capitalize on the technological opportunities available, Bulgaria must strengthen its institutional support for technology transfer, particularly in underdeveloped sectors. This requires strategic investments in research infrastructure, including modern laboratories, innovation hubs, and technology incubators that can provide the necessary environment for scientific and technological advancements. Additionally, expanding the capacity of TTOs through training, resources, and personnel is essential to enhancing their ability to identify, protect, and commercialize innovations across a range of disciplines.

Investments in education and training are equally important for building the human capital necessary to drive technology transfer. By fostering a culture of entrepreneurship within universities and research institutions, Bulgaria can encourage more researchers to engage in commercialization activities. Programs that provide entrepreneurial training, mentorship, and funding for early-stage researchers can help bridge the gap between scientific discovery and market application. Furthermore, greater collaboration between universities, industry, and government can facilitate the development of cross-sector partnerships that drive innovation and commercialization.

3.5 Environmental Factors

Bulgaria's technology transfer (TT) ecosystem is increasingly shaped by the global emphasis on green technologies and sustainability. As climate change and environmental degradation become central concerns, the demand for innovation that addresses ecological challenges—such as clean energy, sustainable agricultural practices, and resource efficiency—is on the rise. This shift presents an opportunity for Bulgaria to integrate green technologies into its TT framework, but the country has yet to fully capitalize on this potential.

Despite the growing importance of sustainability, Bulgaria's technology transfer ecosystem lacks a coherent and focused approach to the promotion and development of green technologies. Many of the country's existing TT initiatives have concentrated on more traditional sectors like ICT, while green innovation, including renewable energy technologies, sustainable agriculture, and waste management systems, has not received the same level of attention. Without dedicated support and investment, the development of green technologies remains fragmented and underfunded, limiting Bulgaria's ability to contribute to broader ecological goals, both nationally and within the European Union.

One of the key areas where Bulgaria's TT system could make significant strides is in *clean energy technologies*. The country has considerable potential in renewable energy sources such as solar, wind, and hydroelectric power. However, the commercialization of these technologies has been slow, largely due to insufficient infrastructure, a lack of coordinated investment, and weak linkages between research institutions and the energy sector. To fully leverage its renewable energy potential, Bulgaria must strengthen its TT mechanisms, fostering closer collaboration between academia, industry, and government bodies to ensure that research on clean energy solutions can be effectively translated into commercial products and services.

In addition to clean energy, *sustainable agriculture* is another critical area where technology transfer can play a transformative role. Agriculture remains a vital part of Bulgaria's economy, and innovations in sustainable farming practices, water management, and crop productivity could significantly enhance the sector's environmental and economic sustainability. However, there is a lack of focused TT efforts to promote the commercialization of sustainable agricultural technologies. This represents a missed opportunity for Bulgaria to align with the European Union's *Farm to Fork Strategy*, which emphasizes the need for innovation in agriculture to meet the EU's goals for sustainable food systems and carbon neutrality.

The Bulgarian government's alignment with broader European Union environmental goals, such as the *European Green Deal*, necessitates a more strategic approach to green technology transfer. The EU's target of achieving carbon neutrality by 2050 puts pressure on member states to innovate in areas such as renewable energy, circular economy practices, and carbon capture technologies. For Bulgaria to contribute meaningfully to these objectives, public and private investments in sustainable innovation are essential. At present, there is insufficient financial support directed toward green research and development (R&D), particularly in the early stages of technology commercialization, where Proof-of-Concept (PoC) grants and venture capital (VC) funding are most needed.

To foster a more sustainable TT ecosystem, Bulgaria must develop policies and funding mechanisms that specifically target green technologies. This could include establishing a *Green Technology Innovation Fund*, which would provide financial support for R&D in renewable energy, energy storage, smart grid technologies, and sustainable agriculture. By

providing incentives for public and private sector collaboration, such a fund could accelerate the development and commercialization of environmentally friendly technologies. Moreover, creating *public-private partnerships* (PPPs) in green innovation could drive the transfer of academic research into marketable solutions, particularly in sectors like clean energy and sustainable agriculture, where private sector expertise is essential for scaling innovations.

Additionally, fostering an *eco-entrepreneurial culture* is critical for promoting green technology transfer. Encouraging researchers to engage in the commercialization of sustainable technologies requires both financial incentives and a supportive regulatory environment. Initiatives such as *green startup incubators* and *accelerators* can help nurture early-stage eco-innovators by providing mentorship, access to investment, and connections with industry partners. These programs would help bridge the gap between academic research and industrial application, ensuring that Bulgaria remains competitive in the growing global market for green technologies.

3.6 Legal Factors

Legal factors, particularly those concerning intellectual property rights (IPR) and patent laws, are critical to the effective development of Bulgaria's technology transfer (TT) ecosystem. The legal framework surrounding IP commercialization, patenting, and the creation of spin-offs is currently underdeveloped, which poses significant challenges for research institutions and inventors seeking to bring their innovations to market.

One of the key issues lies in the country's legal approach to university spin-offs, which are crucial for translating academic research into commercial ventures. In 2020, Bulgaria introduced *Decree No. 61*, aimed at regulating the formation of spin-offs from universities. However, despite its potential to promote innovation and entrepreneurial activity within academia, the decree remains largely underutilized. Legal uncertainties surrounding the decree, particularly regarding its alignment with public funding regulations, have deterred universities and researchers from actively engaging in spin-off creation. Concerns about possible conflicts between the commercialization of publicly funded research and existing regulations have further limited the effectiveness of this legislation, leaving researchers hesitant to navigate the complexities involved in creating and managing spin-off companies.

In addition to issues with spin-off creation, Bulgaria's universities and research institutes generally lack robust systems for intellectual property (IP) management and commercialization. Many institutions do not have dedicated offices or personnel with the expertise needed to handle the complexities of IP protection, patent filing, and licensing. Without these systems in place, research outputs often remain confined within academic settings, rather than being commercialized to their full potential. This gap is exacerbated by a lack of clear guidelines on how universities and inventors should approach IP commercialization, including how revenues from IP exploitation are shared between institutions and individual researchers.

For a functioning TT ecosystem, it is essential that Bulgaria establishes clearer and more comprehensive legal frameworks governing how research results can be commercialized. This includes creating well-defined regulations that clarify ownership of intellectual property

arising from publicly funded research, the rights of inventors, and the role of institutions in managing and exploiting IP. A key part of this reform involves ensuring that universities are equipped with the legal and administrative tools to effectively protect and commercialize their innovations. This would not only increase the efficiency of the technology transfer process but also provide greater incentives for researchers to engage in commercialization activities.

One example of how legal reforms could enhance the TT ecosystem is the introduction of clearer mechanisms for *IP revenue sharing* between universities and researchers. In many countries with strong innovation ecosystems, universities have established transparent policies outlining how profits from patenting, licensing, and other forms of IP exploitation are distributed. Such systems provide incentives for researchers to participate in technology transfer while ensuring that institutions benefit from the commercial success of their innovations. In Bulgaria, the absence of such frameworks has created ambiguity and disincentives for academic researchers, who often bypass institutional channels in favor of direct collaboration with industry, further fragmenting the TT process.

Moreover, aligning Bulgaria's legal framework with international best practices in IP protection and commercialization is critical for the country's integration into the global innovation ecosystem. Bulgaria is a signatory to international treaties such as the *Paris Convention for the Protection of Industrial Property* and the *Patent Cooperation Treaty*, but stronger enforcement of these standards at the national level is needed. Enhancing patent laws to ensure that inventions arising from Bulgarian research institutions are protected globally would increase the confidence of both domestic and international investors in Bulgarian innovation. Additionally, streamlining the patent application process and reducing the costs associated with IP protection could encourage more researchers and entrepreneurs to seek patents for their innovations.

Addressing the legal gaps related to *conflicts with public funding regulations* is another critical area for reform. Publicly funded research often comes with strict guidelines on how research outputs can be commercialized, which can create obstacles for researchers trying to engage in TT activities. By reforming these regulations to provide clearer pathways for commercialization, including allowing researchers to hold equity in spin-offs or startups, Bulgaria could significantly enhance its TT ecosystem. These reforms would help align the interests of researchers, institutions, and investors, fostering a more dynamic environment for innovation and commercialization.

3.7 Missing or Needing Improvement Aspects

- **Coordination and Fragmentation**: Fragmentation of efforts across ministries, agencies, and research institutions continues to be a significant obstacle to a cohesive technology transfer ecosystem in Bulgaria. The lack of coordination among these bodies results in overlapping roles, inefficiencies in funding allocation, and inconsistent support for research commercialization. The proposed *Law on Research and Innovation* (2023) seeks to address some of these issues, but further action is needed to streamline policies and ensure that TT efforts are well-coordinated across the national innovation landscape.

- **Sustainable Funding**: Bulgaria faces a persistent lack of systemic national funding dedicated to technology transfer (TT) and intellectual property (IP) commercialization. Current funding is often project-based and short-term, which limits the ability of research institutions and universities to build long-term commercialization strategies. Significant investment in *Proof-of-Concept (PoC)* grants, venture capital (VC), and dedicated technology transfer funds is essential for the sustained growth of the TT ecosystem. Ensuring more consistent and strategic public and private funding streams would enable Bulgaria to scale up its TT efforts and support high-potential sectors such as biotechnology, green technologies, and materials science.
- **Human Capital**: Attracting and retaining skilled researchers and technology transfer professionals remains a pressing challenge for Bulgaria. The country faces a significant *brain drain*, with many talented individuals seeking better opportunities abroad due to limited incentives for innovation and commercialization within the domestic ecosystem. Addressing this issue requires not only financial incentives but also the development of a more supportive environment for entrepreneurial researchers. Without strong human capital, Bulgaria's TT system will continue to struggle to reach its full potential.
- **Legal Clarity**: Unclear and fragmented legal frameworks for intellectual property commercialization present another major barrier to the development of Bulgaria's TT ecosystem. *Decree No. 61 (2020)*, which governs university spin-offs, has not been widely used due to uncertainties surrounding its application and conflicts with public funding regulations. Additionally, many universities lack robust IP management systems, resulting in missed opportunities for patenting, licensing, and spin-off creation. Clarifying legal pathways for IP commercialization and establishing standardized systems for IP management in research institutions would significantly improve Bulgaria's TT performance. Clearer guidelines on IP revenue sharing and patent protection, aligned with international best practices, are also essential to foster more innovation-driven entrepreneurship.

4 Main Actors of the Technology Transfer Ecosystem in Bulgaria

4.1 Profile of Major Institutions

Bulgaria's technology transfer ecosystem is anchored by a number of key academic institutions, research centers, and initiatives that support innovation and collaboration between academia and industry. The ecosystem is primarily driven by universities with well-established technology transfer offices (TTOs) and several prominent research institutes under the Bulgarian Academy of Sciences (BAS). These institutions play a pivotal role in fostering innovation, commercialization of research, and collaboration with industry through intellectual property (IP) management, licensing, and the creation of spin-offs. In recent years, public and private initiatives have worked to streamline and enhance technology transfer mechanisms, with an increasing focus on bridging the gap between research outputs and market needs. Funding for these activities is sourced from national budgets, international research grants, and industry

partnerships, while specialized centers of competence and excellence act as catalysts for technology development in specific sectors.

4.1.1 Leading Universities and Their Technology Transfer Offices (TTOs)

4.1.1.1 1. Technical University of Sofia

- **Background and Expertise**: The Technical University of Sofia is one of Bulgaria's largest and most renowned technical institutions, with a focus on engineering, ICT, and applied sciences. It plays a leading role in national research and innovation, particularly in collaboration with industry.
- **Technology Transfer Office (TTO)**:
  - **Year of Establishment**: The Research and Development Sector/Centre, which also functions as the TTO, was created in 1963.
  - **Organizational Structure**: The TTO has a Committee on Intellectual Property, consisting of experts from both engineering and IP backgrounds. It operates within the university's structure and engages with both internal and external stakeholders.
  - **Staff**: Includes sectorial Deputy Directors and a Committee on Intellectual Property. There are several administrative staff handling accounting and human resources.
- **Operations**:
  - **Core Services**: Intellectual property (IP) management, licensing of technologies, industry collaboration, and spin-off incubation.
  - **Funding Mechanisms**: The TTO's activities are funded through state budgets, national and international research programs, and industry partnerships (contractual research generates 30-40% of the total income).
  - **Policies/Strategies**: The university's IP policy encourages the protection and commercialization of inventions through licensing, partnerships with industry, and support for spin-off creation. The university is part of the European University of Technology alliance, providing a platform for international TT collaboration.
  - **Key Achievements**: TU-Sofia holds 20 national patents, 15 utility models, and continues to file for new patents both nationally and internationally. It has also actively participated in Bulgaria's Centres of Competence (CoC) and Centres of Excellence (CoE) projects.
  - **Challenges**: Despite its strong research output, there are few international patents, and most patents have not yet been licensed or sold. (Technical University Sofia, n.d.)

4.1.1.2 2. Plovdiv University

- **Background and Expertise**: Plovdiv University focuses on bioeconomy, biotechnologies, and applied research. It is a key academic institution in the central region of Bulgaria, contributing to various sectors through its innovation and technology transfer activities.
- **Technology Transfer Office (TTO)**:

- **Year of Establishment**: The TTO at Plovdiv University was formally established in 2022.
- **Staff**: Managed by a legal expert who also oversees the university's fully owned company, established to facilitate IP commercialization.

- **Operations**:
  - **Core Services**: IP management, spin-off support, licensing, and industry collaboration. The TTO also trains academic teams in spin-off creation and technology commercialization.
  - **Funding Mechanisms**: The university receives funding from state sources and international research programs, with additional support from industry partnerships.
  - **Policies/Strategies**: The university has set up a spin-off company and is actively working to commercialize its IP. However, they are awaiting additional government guidance on legislative and regulatory frameworks that would facilitate smoother TT processes.
  - **Key Achievements**: Plovdiv University owns six patents (one active), three utility models, and has applied for three new patents. The TTO has successfully trained two teams to establish spin-offs and continues to engage in negotiations with businesses for commercialization.
  - **Challenges**: The university faces legislative barriers that complicate the commercialization of academic research, and many successful collaborations are driven by individual enthusiasm rather than systemic support. (University of Plovdiv, n.d.)

4.1.1.3 3. Sofia University

- **Background and Expertise**: Sofia University is the oldest and most prestigious university in Bulgaria, known for its excellence in physics, chemistry, ICT, and other scientific disciplines. It plays a crucial role in both national and international research projects.
- **Technology Transfer Office (TTO)**:
  - **Year of Establishment**: The TTO was set up under project BG2005/ESC/G/TTO.
  - **Staff**: The TTO employs three staff members (two full-time, one part-time), providing legal and financial assistance for patent filing and commercialization.
- **Operations**:
  - **Core Services**: Managing IP, facilitating commercialization, and strengthening industry-academia collaboration through patent filings and spin-offs. The TTO also organizes match-making events and training sessions for researchers.
  - **Funding Mechanisms**: Funded by the state, national programs, and EU research initiatives. About 40% of Sofia University's R&D budget comes from contractual research with industry.
  - **Policies/Strategies**: Sofia University's TTO contributes to the university's Commercialization Strategy and IPR Policy, emphasizing IP marketing and collaboration with the business sector.

- **Key Achievements**: Sofia University currently holds two active patents and has ten pending patent applications. Its TTO has trained over 150 researchers in IP management and commercialization.
- **Challenges**: The university has not yet licensed or sold any patents, and the creation of spin-offs has been limited. Many industry partnerships occur outside the formal TTO processes, driven by personal relationships between researchers and businesses. (Sofia University, n.d.)

4.1.1.4 4. Technical University of Varna

- **Background and Expertise**: TU-Varna is a key technical university in Eastern Bulgaria, with a focus on engineering, ICT, and maritime studies. It plays a significant role in the regional economy, especially through its industry collaborations.
- **Technology Transfer Office (TTO)**:
  - **Year of Establishment**: The Centre for Intellectual Property Management was established in 2019.
  - **Staff**: The TTO has one full-time employee with a legal and engineering background.
- **Operations**:
  - **Core Services**: Provides consultancy, IP filing, legal support, and partnerships with industry. The TTO also plays a role in raising awareness about the importance of IP among students and staff.
  - **Funding Mechanisms**: Funded by state budgets and external collaborations, the TTO engages with local businesses to promote technology transfer and commercialization.
  - **Key Achievements**: While there are no new patents since 2019, TU-Varna has a historical portfolio of 13 patents and utility models.
  - **Challenges**: The TTO is understaffed, limiting its ability to expand its IP portfolio and promote commercialization. Collaboration with other regional institutions, such as Medical University of Varna, is seen as a potential way to enhance TT activities. (Technical University of Varna, n.d.)

4.1.1.5 5. Medical University of Plovdiv

Background and Expertise: Medical University of Plovdiv is a leading institution in healthcare innovation, particularly in the fields of medical research and healthcare technologies.

Technology Transfer Office (TTO):

Year of Establishment: The TTO is in the process of being set up (expected by 2023) under the Recovery and Resilience Plan.

Staff: The TTO will be developed as part of the university's broader strategy to promote IP protection and commercialization.

Operations:

Core Services: Focusing on developing and commercializing medical and healthcare-related IP. The TTO will support patent filings, partnerships with hospitals and medical enterprises, and spin-off creation.

Funding Mechanisms: Funded under the National Recovery and Resilience Plan, as well as through partnerships with healthcare providers and international research programs.

Policies/Strategies: Medical University of Plovdiv plans to use its TTO to promote the commercialization of medical technologies and healthcare innovations.

Key Achievements: The TTO is expected to significantly increase collaboration between the university and the healthcare industry once it is fully operational.

Challenges: The university is currently awaiting the full establishment of its TTO and faces challenges in navigating the regulatory complexities of healthcare-related IP commercialization. (Medical University of Plovdiv , n.d.)

4.1.2 Prominent Research Centers

4.1.2.1 1. Institute of Robotics, Bulgarian Academy of Sciences (BAS)

- **Brief Description**: The Institute of Robotics is the leading research center in robotics in Bulgaria and holds the largest number of patents in the field. It focuses on applied research, primarily in robotics, automation, and artificial intelligence.
- **Technology Transfer Office (TTO)**:
  - **Year of Establishment**: The Institute does not have a dedicated TTO but is supported by the **QUASAR Centre of Competence** TTO, which is closely tied to the Institute.
  - **Staff**: The TTO of QUASAR employs experts in IP management and lawyers focused on selling or licensing IP, including the management of industrial partnerships.
- **Operations**:
  - **Core Services**: The TTO handles IP protection, licensing, and commercialization of robotics innovations. It facilitates partnerships with international firms and supports technology marketing strategies.
  - **Funding Mechanisms**: The TTO's activities are supported by both national and international collaborations, including partnerships with British companies.
  - **Key Achievements**: The Institute has commercialized 30 patents, mostly through full ownership transfers. The TTO has developed strategies for licensing and selling intellectual property and has established a Memorandum of Understanding with a British consortium in the field of robotics. (Sciences, n.d.)

4.1.2.2 2. Institute of Information and Communication Technologies, BAS

- **Brief Description**: Created in 2010 through the integration of five institutes, this center specializes in computer science, ICT, and interdisciplinary ICT applications. The Institute is a prominent player in Bulgarian ICT research, frequently collaborating with both national and international partners.
- **Technology Transfer Office (TTO)**:
  - **Year of Establishment**: The TTO was established between 2009 and 2012 under the First Operational Programme of Competitiveness.
  - **Staff**: The TTO is integrated into several Digital Innovation Hubs, which promote collaboration with industry.
- **Operations**:
  - **Core Services**: The TTO facilitates industry partnerships, manages IP, and participates in collaborative projects, such as digital innovation hubs in cybersecurity and energy transition.
  - **Funding Mechanisms**: Funded by both EU programs (e.g., Horizon) and national programs like the National Innovation Fund.
  - **Key Achievements**: The TTO has strong links with industry and has led or participated in multiple innovation projects. It continues to be a leading institution in ICT research across Europe. (Institute of Information and Communication Technologies, n.d.)

4.1.2.3 3. Institute of Mechanics, BAS

- **Brief Description**: This institute is involved in research on mechanics, materials, and structural dynamics. Its work spans both basic and applied research, often focusing on mechanics innovations applicable to the industrial sector.
- **Technology Transfer Office (TTO)**:
  - **Year of Establishment**: The Institute relies heavily on the GIS-Transfer Centre for technology transfer support.
  - **Staff**: While the Institute is attempting to establish its own TTO, the GIS-Transfer Centre plays a pivotal role in providing expertise and instruments for innovation.
- **Operations**:
  - **Core Services**: IP consultancy, management, and technology commercialization services provided through the GIS-Transfer Centre.
  - **Funding Mechanisms**: Supported by both institutional and external project funding.
  - **Key Achievements**: The Institute holds several active patents, with growing collaboration in areas like structural dynamics and mechanics. (Institute of Mechanics, n.d.)

4.1.2.4

4.1.2.5 4. Joint Innovation Centre (JIC), BAS

- **Brief Description**: Established in 2005, the JIC acts as a central coordination unit for the Bulgarian Academy of Sciences (BAS) institutes, assisting with innovation, IP management, and technology transfer. It supports 50 autonomous research units across BAS.
- **Technology Transfer Office (TTO)**:

- **Staff**: JIC employs three people and coordinates IP protection activities and commercialization processes across BAS institutes.

- **Operations**:
  - **Core Services**: The JIC supports IP protection, patent filing, licensing, and commercialization of innovations developed by BAS institutes. It also provides training and consultancy in project application and IP rights protection.
  - **Funding Mechanisms**: JIC is primarily project-funded and partners with the Enterprise Europe Network to offer commercialization services.
  - **Key Achievements**: JIC has supported the commercial success of several BAS innovations, though it struggles with long-term sustainability beyond project funding. (Joint Innovation Centre of the Bulgarian Academy of Sciences, n.d.)

4.1.2.6 5. GIS-Transfer Centre (GIS-TC)

- **Brief Description**: GIS-TC is the oldest technology transfer network in Bulgaria, coordinating a national TT network comprising over 30 member entities. It has significant experience in supporting both academic institutions and SMEs in the transfer of technologies.
- **Technology Transfer Office (TTO)**:
  - **Staff**: The core team consists of engineers, economists, and legal experts with decades of experience in TT.
- **Operations**:
  - **Core Services**: GIS-TC provides IP support, collaborative research contracts, industry matchmaking, and consultancy services. It emphasizes support for SMEs and innovation transfer.
  - **Funding Mechanisms**: Funded through its partnerships with BAS, multiple universities, and international foundations, GIS-TC also collaborates with the Steinbeis Foundation in Germany.
  - **Key Achievements**: GIS-TC has facilitated the creation of seven BAS spin-offs and supports numerous academic institutions, including Sofia University and the University of Varna. (GIS-Transfer Centre, n.d.)

4.1.3 Public and Private Initiatives Supporting the TT Ecosystem

4.1.3.1 1. Fund of Funds Bulgaria

- **Mission and Objectives**: The Fund of Funds (FoF) is a state-owned financial institution responsible for managing public financial instruments to foster innovation and technology transfer. Its mission includes providing financial support to Bulgarian startups, including deep-tech ventures, through a combination of grants and equity financing.
- **Operations**:
  - **Services Offered**: The FoF offers a range of financial instruments, including seed funding, Proof of Concept (PoC) grants, venture capital co-investment funds, and start-up equity investments. It also oversees the establishment of deep-tech technology transfer funds, including a new EUR 60 million facility aimed at technology transfer in deep-tech sectors.

- **Funding Mechanisms**: Funding is primarily sourced from the European Union (EU) through the 2021-2027 PRIDST Operational Programme. The FoF also partners with private venture capital firms to co-invest in startups and scale-ups.
- **Policies/Strategies**: The FoF works closely with research institutions, universities, and startups, ensuring that projects receive early-stage financial support before progressing to larger investments.
- **Key Achievements**: The Fund manages significant financial instruments, including EUR 146.5 million allocated to venture capital co-investment and has supported projects across various sectors, including fintech, SaaS, and deep-tech startups. The Fund is also creating stronger links between universities, research institutions, and the private sector.
- **Metrics and Impact**: The Fund has helped attract EUR 244 million in startup investments in 2022, positioning Bulgaria as a top venture capital market in Southeastern Europe. (Fund of Funds Bulgaria, n.d.)

4.1.3.2 2. Sofia Tech Park

- **Mission and Objectives**: Sofia Tech Park is a science and technology park created to foster the development of innovation and technology transfer in Bulgaria. It aims to build an entrepreneurial ecosystem, facilitate collaboration between academia and industry, and support startups in their early stages.
- **Operations**:
  - **Services Offered**: The park offers infrastructure support for early-stage technology startups, hosting innovation labs, business incubators, and providing Proof of Concept funding. It also organizes networking events and innovation challenges.
  - **Funding Mechanisms**: Sofia Tech Park receives government funding, private investments, and European Union support. The park collaborates with various funding programs, including venture builders and deep-tech financing from the PRIDST Operational Programme.
  - **Policies/Strategies**: The park aims to create a robust innovation culture by providing both infrastructural and financial support for technology transfer projects. It also collaborates with the Fund of Funds to implement Proof of Concept funding and incubation for startups.
  - **Key Achievements**: Sofia Tech Park has launched several programs, including the Bulgarian Business Incubation Centre Program (a joint venture with CERN) and the Innovators Program, supporting hundreds of R&D projects and startups. It has built relationships with BAS and universities, contributing to the commercialization of scientific results.
  - **Metrics and Impact**: In 2022, the park supported numerous startups, and through its partnerships, has contributed to creating a vibrant innovation hub in Sofia. Additionally, the labs at the park have served as testing and experimentation facilities for over 50 startups. (Sofia Tech Park, n.d.)

4.1.3.3 3. Bulgarian Patent Office (BPO)

- **Mission and Objectives**: The BPO is the national authority responsible for granting intellectual property rights (IPR) protection in Bulgaria. It plays a crucial role in the

technology transfer ecosystem by supporting universities and research institutions in their IP commercialization efforts.

- **Operations**:
  - **Services Offered**: BPO provides training and consultancy on IP management, patent filing, and IP commercialization. It works closely with international organizations like the World Intellectual Property Organization (WIPO) and the European Patent Office (EPO) to offer resources for academic and business institutions, including IP diagnostic tools and commercialization toolkits.
  - **Funding Mechanisms**: The BPO is publicly funded, with support from international collaborations, including programs through WIPO and the EPO.
  - **Policies/Strategies**: The BPO emphasizes building capacity in Bulgarian universities and research institutions to strengthen IP management and commercialization strategies. It also provides support for patent filing and licensing activities.
  - **Key Achievements**: Over the past five years, the BPO has collaborated with BAS and universities to improve IP protection and technology transfer capabilities. Despite facing challenges in licensing and commercialization, the BPO has actively participated in international initiatives aimed at strengthening TT capacity.
  - **Metrics and Impact**: The BPO reports increasing numbers of patent filings, with over 92% of IP-related services provided electronically. It continues to expand its training programs for academic staff on IP protection. (Bulgarian Patent Office , n.d.)

4.1.3.4 4. National Innovation Fund

Mission and Objectives: The National Innovation Fund (NIF) supports Bulgarian companies in developing innovative products and services. It aims to foster R&D, support technology transfer, and create opportunities for startups and businesses to commercialize research results.

Operations:

Services Offered: The NIF provides financial grants for innovative projects, facilitates collaborations between businesses and research institutions, and funds R&D activities across industries like biotechnology, ICT, and environmental technologies.

Funding Mechanisms: The NIF is funded by the Bulgarian government and European Union programs, including the Horizon 2020 framework. It allocates grants to both SMEs and large enterprises for technology transfer initiatives.

Key Achievements: The NIF has funded hundreds of R&D projects, enabling companies to bring innovative products to the market. It also promotes collaboration between universities and industry to support the commercialization of technologies.

Metrics and Impact: The Fund has disbursed millions of euros to support technology transfer projects, creating a pipeline of commercializable technologies from academic and research institutions. (National Innovation Fund, n.d.)

4.2 Main Conclusions on TT Processes and Practices

Technology Transfer (TT) in Bulgaria has made significant strides, especially with the establishment of numerous public and private institutions aimed at bridging the gap between research and industry. However, there are key areas of improvement, commonalities, and differences that shape the country's TT ecosystem. This section provides an in-depth analysis based on the institutions and initiatives mentioned earlier, focusing on popular processes, common strategies, and challenges.

4.2.1 1. Common TT Processes and Practices Across Major Institutions

4.2.1.1 1.1 Intellectual Property (IP) Management and Protection

- **Processes**: Nearly all major universities and research institutes have well-defined IP management structures. Institutions like the Technical University of Sofia and Sofia University have formal IP policies guiding the protection and commercialization of research. These policies typically include filing patents, managing IP portfolios, and providing legal assistance for patent application processes.
- **Commonality**: IP management is universally recognized as a core function of TTOs, with nearly all institutions prioritizing IP protection as a key step in their TT processes. Institutions such as the **Bulgarian Patent Office** play a pivotal role in supporting these processes by providing consultancy and training.
- **Differences**: While some institutions have advanced IP processes with robust IP portfolios (e.g., Technical University of Sofia and the Institute of Robotics), others are still developing their IP management strategies (e.g., Medical University of Plovdiv). The variation in institutional capacity, staff expertise, and legal support often leads to differences in the efficiency of IP commercialization.

4.2.1.2 1.2 Licensing and Industry Partnerships

- **Processes**: Licensing is a common practice across major research institutions. Universities like Plovdiv University and Sofia Tech Park focus heavily on building industry partnerships to facilitate the commercialization of research. Licensing agreements are typically executed through the TTOs, which provide legal support and matchmaking between academic researchers and companies.
- **Commonality**: Most institutions, particularly **Sofia Tech Park** and **GIS Transfer Centre**, are well-connected with industry and prioritize licensing as a major TT pathway. Industry partnerships are key to ensuring the market viability of innovations, and most TTOs aim to build long-term collaborations with private enterprises.
- **Differences**: Institutions in more advanced technology sectors, such as ICT and robotics, tend to have stronger licensing operations due to greater industry demand. Universities and institutes working in fields with slower technology adoption rates, such as medicine or materials science, have fewer licensing opportunities.

4.2.1.3 1.3 Spin-off Creation

- **Processes**: Several universities, including the **Technical University of Sofia** and **Plovdiv University**, are focused on creating spin-offs as a pathway to commercialize their research. This process typically involves identifying research projects with commercialization potential, helping researchers file for patents, and offering incubation support through TTOs or dedicated innovation hubs.
- **Commonality**: Spin-off creation is increasingly being recognized as a critical process for transferring academic research to the market. **Sofia Tech Park** and **Fund of Funds** provide startup incubation and financial support to help facilitate spin-off formation.
- **Differences**: The maturity of spin-off processes varies significantly. For instance, while universities in Sofia and Plovdiv are developing successful spin-offs, medical institutions such as the **Medical University of Plovdiv** are still in the early stages of setting up their TT infrastructure. Legislative hurdles, such as the lack of clarity around spin-off regulations, particularly in the medical sector, pose additional challenges for some institutions.

4.2.2 2. Popular TT Strategies and Mechanisms

4.2.2.1 2.1 Proof of Concept (PoC) Funding

- **Processes**: PoC funding is a critical mechanism for advancing research from the lab to commercialization. Initiatives like the **Fund of Funds** and **Sofia Tech Park** provide financial support for early-stage research validation.
- **Commonality**: PoC funding is recognized as essential across nearly all institutions for reducing the risks associated with transferring technologies to the market. Most TTOs collaborate with venture capital funds or government-backed initiatives to secure such funding.
- **Differences**: While institutions like **Sofia Tech Park** and universities in major cities have access to substantial PoC resources, regional institutions or those with fewer industry ties struggle to secure similar funding. Moreover, deep-tech projects tend to receive more PoC funding than those in less commercially appealing fields.

4.2.2.2 2.2 Industry Collaboration and Networking

- **Processes**: Most institutions prioritize building networks with industry partners. **Sofia Tech Park**, for example, hosts networking events and innovation challenges, while universities like the **Technical University of Sofia** establish industry-academic partnerships for joint R&D projects.
- **Commonality**: Establishing industry connections is fundamental to successful TT, and most institutions facilitate these relationships through formal collaborations or by participating in public-private partnerships. Institutions like the **National Innovation Fund** also fund projects that promote academia-industry collaboration.
- **Differences**: Institutions in Sofia and Plovdiv, where industry clusters are more concentrated, tend to have stronger networks and more frequent collaborations with private enterprises. Conversely, institutions in more remote areas, such as **Trakia University**, have fewer opportunities for industry engagement, limiting their ability to commercialize research effectively.

4.2.3 3. Key Challenges and Differences in TT Practices

4.2.3.1 3.1 Fragmentation and Lack of Coordination

- **Challenges**: One of the recurring themes across Bulgarian institutions is the fragmentation of the TT ecosystem. Different universities, research institutes, and TTOs operate independently, often leading to duplicated efforts, especially when it comes to IP protection and licensing. The government has acknowledged this issue and is working towards improving coordination.
- **Differences**: Some research centers, such as those under the **Bulgarian Academy of Sciences (BAS)**, suffer more from fragmentation due to the large number of institutes (over 50) operating under separate TTOs. On the other hand, smaller universities or regional hubs like **Plovdiv University** are more streamlined in their operations but may lack the resources for large-scale coordination.

4.2.3.2 3.2 Human Capital and Expertise

- **Challenges**: A major bottleneck in Bulgaria's TT ecosystem is the lack of skilled personnel within TTOs. Many institutions struggle to attract and retain qualified IP managers, legal experts, and technology transfer specialists.
- **Differences**: Institutions like **Sofia University** and the **Technical University of Sofia** have a more developed TTO infrastructure with skilled staff, while smaller universities or newly established TTOs, like those in **Medical University of Plovdiv**, face challenges in staffing their offices adequately. This disparity affects the effectiveness of TT processes and limits the commercialization potential of research.

4.2.3.3 3.3 Legislative and Regulatory Barriers

- **Challenges**: Unclear regulations surrounding spin-offs, IP ownership, and university-industry collaborations have been a barrier for many institutions. Specifically, the creation of spin-offs and the legal framework around equity ownership for researchers have been contentious.
- **Differences**: Research institutions in highly regulated fields, such as medicine, face more significant hurdles. For instance, **Medical University of Plovdiv** has reported regulatory conflicts between academic research and healthcare legislation, making it difficult to commercialize medical innovations. Meanwhile, institutions in less regulated fields, like ICT and engineering, have clearer pathways to commercialization.

4.2.4 4. Major Achievements and Impact

4.2.4.1 4.1 Successes in Patenting and Licensing

5 **Key Achievements**: Institutions like the **Institute of Robotics** and **Sofia University** have made significant progress in patenting technologies and filing international patents.

Although commercialization is still limited in some fields, institutions in the ICT and robotics sectors have been successful in selling or licensing technologies.

6 **Metrics**: The **Bulgarian Patent Office (BPO)** reports an increasing number of patents filed, with universities like the **Technical University of Sofia** holding 20 national patents and **Plovdiv University** filing for several new patents. The **GIS-Transfer Centre** has also facilitated licensing deals, though there is room for improvement in terms of commercialization rates.

6.1.1.1 4.2 Startups and Spin-offs

- **Key Achievements**: Institutions like **Sofia Tech Park** have been instrumental in fostering startups, particularly in the ICT and deep-tech sectors. Startups such as **Payhawk** have achieved international success, with Bulgaria now recognized as a leading startup hub in Southeastern Europe.
- **Metrics**: **Sofia Tech Park** and related initiatives have supported the creation of over 200 startups, contributing to job creation and economic development. **GIS-Transfer Centre** has also played a role in facilitating seven spin-offs, though sustainability remains a challenge for some.

6.2 SWOT Analysis

The technology transfer ecosystem in Bulgaria is evolving but faces a mix of strengths, weaknesses, opportunities, and threats. This SWOT analysis provides an in-depth look at the factors shaping the technology transfer landscape, drawing from information on universities, research institutes (RIs), and Technology Transfer Offices (TTOs), as well as public and private initiatives supporting innovation.

6.2.1 Strengths

1. **Strong Research Base**:
    - Bulgaria has several prominent research institutions and universities with well-established research activities, such as the **Technical University of Sofia**, **Sofia University**, and various institutes under the **Bulgarian Academy of Sciences (BAS)**. These institutions provide a robust foundation for innovation and technology transfer.
    - **Chance of Occurrence**: High
    - **Impact**: High
2. **Experienced Staff in Certain TTOs**:
    - Institutions like **Sofia Tech Park** and **GIS-Transfer Centre** have built experienced teams with expertise in intellectual property (IP) management, licensing, and commercialization. This expertise is pivotal in supporting spin-offs, startups, and industry collaborations.
    - **Chance of Occurrence**: Medium
    - **Impact**: High
3. **Government Support and Funding**:
    - The Bulgarian government, through initiatives like the **Fund of Funds** and **National Innovation Fund**, has shown strong support for fostering innovation

and technology transfer, providing funding for early-stage startups and Proof of Concept (PoC) programs.
    - **Chance of Occurrence**: High
    - **Impact**: High
4. **Emerging Innovation Hubs**:
    - **Sofia Tech Park** has become a national hub for innovation, fostering entrepreneurship and collaboration between academia, industry, and government. It serves as a model for integrating research and commercialization.
    - **Chance of Occurrence**: Medium
    - **Impact**: High

6.2.2 Weaknesses

1. **Fragmented Research and Innovation System**:
    - The technology transfer ecosystem is fragmented, with multiple TTOs operating independently. Research institutions, especially within the **Bulgarian Academy of Sciences (BAS)**, often duplicate efforts due to a lack of coordination between them.
    - **Chance of Occurrence**: High
    - **Impact**: Medium
2. **Underdeveloped Spin-Off and Start-Up Culture**:
    - Although there have been some success stories, most universities lack a mature spin-off culture. Institutions such as the **Medical University of Plovdiv** are still in the early stages of developing their TTOs and support mechanisms for spin-off creation.
    - **Chance of Occurrence**: High
    - **Impact**: Medium
3. **Limited Access to Venture Capital and Private Sector Engagement**:
    - Despite the presence of the **Fund of Funds**, access to venture capital remains limited, especially for early-stage startups and deep-tech companies outside of Sofia. Additionally, many research institutions struggle to attract private sector engagement.
    - **Chance of Occurrence**: Medium
    - **Impact**: Medium
4. **Bureaucratic and Regulatory Barriers**:
    - Complex and slow bureaucratic processes hinder the speed of commercialization. The regulatory framework surrounding spin-offs and IP ownership for researchers is still underdeveloped, particularly for fields such as medicine and life sciences.
    - **Chance of Occurrence**: High
    - **Impact**: High
5. **Limited Human Capital in TTOs**:
    - Many universities and research institutions lack sufficient human resources with expertise in IP management, commercialization, and legal aspects of technology transfer. This is a significant bottleneck in developing effective TT processes.
    - **Chance of Occurrence**: High
    - **Impact**: Medium

6.2.3 Opportunities

1. **Government Incentives and EU Funding**:
   - There is a growing availability of government grants, tax incentives, and EU programs (e.g., Horizon Europe) aimed at fostering research commercialization and innovation. Programs like the **National Innovation Fund** and the **PRIDST Operational Programme** offer substantial support for research institutions and startups.
   - **Chance of Occurrence**: High
   - **Impact**: High
2. **Growing Demand from the Tech Industry**:
   - Bulgaria's tech and ICT sectors are growing rapidly, creating demand for innovative solutions and technologies developed by research institutions. Universities focusing on ICT, AI, and digitalization, such as **Sofia University** and **INSAIT**, can capitalize on this trend.
   - **Chance of Occurrence**: High
   - **Impact**: High
3. **Strengthening International Collaboration**:
   - Increased collaboration with international research institutions and industry, particularly through programs such as **Horizon Europe**, provides opportunities for knowledge transfer and commercialization of Bulgarian research in global markets.
   - **Chance of Occurrence**: Medium
   - **Impact**: High
4. **Development of Innovation Incubators and Accelerators**:
   - Initiatives such as the **Sofia Tech Park Incubation Centre** and partnerships with global organizations (e.g., CERN, World Bank) offer opportunities to develop new incubators and accelerators focused on high-tech and deep-tech industries.
   - **Chance of Occurrence**: Medium
   - **Impact**: Medium
5. **Capacity Building for TTOs**:
   - There are significant opportunities for training and developing TTO staff and researchers in areas such as IP management, commercialization, and industry collaboration. Programs aimed at building this capacity can boost the efficiency and output of technology transfer activities.
   - **Chance of Occurrence**: High
   - **Impact**: High

6.2.4 Threats

1. **Brain Drain**:
   - Bulgaria continues to face a high rate of brain drain, with many skilled researchers and innovators leaving the country for better opportunities abroad. This reduces the local talent pool needed for technology transfer and innovation activities.
   - **Chance of Occurrence**: High
   - **Impact**: High
2. **Economic Instability**:

- Economic downturns could reduce both public and private sector investment in research and development. Reduced funding for innovation would slow down TT activities and diminish industry interest in new technologies.
- **Chance of Occurrence**: Medium
- **Impact**: High

3. **Political Uncertainty and Policy Discontinuity**:
   - Changes in political leadership or instability could disrupt the continuity of government support for innovation, potentially stalling funding programs and legislative improvements. The technology transfer ecosystem relies heavily on sustained government backing.
   - **Chance of Occurrence**: Medium
   - **Impact**: Medium
4. **IP Theft and Challenges in Global Markets**:
   - There is a risk of IP theft, especially when Bulgarian research institutions engage in international markets. Enforcing IP rights globally remains a challenge for institutions that are less experienced in international patenting processes.
   - **Chance of Occurrence**: Medium
   - **Impact**: Medium

		6.2.4.1.1.1 Possible impact to the Country		
		High	**Medium**	**Low**
Chance of Occurring	**High**	High Priority ● Brain Drain	High Priority	Medium Priority
	Medium	*6.2.4.1.2 High Priority* ● Economic Instability	Medium Priority ● IP Theft and Challenges in Global Markets ● Political Uncertainty and Policy Discontinuity	Low Priority
	Low	Medium Priority	Low Priority	Low Priority

7 Conclusion

The technology transfer (TT) ecosystem in Bulgaria is undergoing significant development, driven by strong research capabilities at universities and research institutions, increasing government support, and a growing entrepreneurial spirit within sectors like ICT, biotechnology, and engineering. However, several structural and operational challenges still need to be addressed to foster a more efficient and sustainable ecosystem. The following is a summary of the main findings and key recommendations for improving technology transfer in Bulgaria, with special attention to the internationalization of TT activities.

7.1.1 Main Findings

1. *Strong Research Base and Emerging Innovation Hubs*
   - Bulgaria's universities, such as **Sofia University**, **Technical University of Sofia**, and the institutes under the **Bulgarian Academy of Sciences (BAS)**, provide a strong foundation for research and innovation. Emerging hubs like **Sofia Tech Park** have created dynamic environments conducive to technology commercialization.
   - However, while there are strong research capabilities, many technologies are not being sufficiently commercialized or translated into economic value due to limited resources, fragmented efforts, and lack of coordination.
2. *Government and EU Funding Support*
   - The government, through initiatives such as the **Fund of Funds** and the **National Innovation Fund**, along with EU programs like **Horizon Europe**, has significantly increased financial support for research and innovation activities. This has bolstered early-stage technology validation and startup creation.
   - However, long-term, sustainable funding is still needed for critical aspects such as TTO development, IP management, and commercialization support, especially in regions outside Sofia and for smaller universities.
3. *Fragmentation and Coordination Challenges*
   - Bulgaria's technology transfer efforts remain fragmented, with over 30 TTOs and various research institutions working in silos. This leads to inefficiencies in resource use, duplication of efforts, and missed opportunities for collaboration and commercialization.
   - National coordination between academic institutions, government agencies, and industry needs to be significantly improved to streamline technology transfer processes.
4. *Nascent Spin-off and Startup Culture*
   - While there have been some success stories, such as startups emerging from **Sofia Tech Park**, **INSAIT**, and universities, the spin-off ecosystem in Bulgaria remains underdeveloped. Universities and research institutions need clearer regulatory frameworks and support systems to foster spin-off creation.
   - The legal landscape around spin-offs, particularly regarding researcher equity and IP ownership, is still evolving and needs clearer definitions to encourage more commercial activity.
5. *Human Capital Deficiencies*
   - A lack of skilled personnel in TTOs, particularly in areas such as intellectual property management, commercialization strategies, and industry collaboration, remains a significant challenge. Many TTOs operate with insufficient staff and expertise, hindering their ability to take on large-scale commercialization projects.
   - Brain drain continues to weaken the ecosystem, as many skilled researchers and technology experts seek better opportunities abroad, reducing the country's capacity for innovation.
6. *Limited Internationalization of TT Activities*
   - Many of the technology transfer processes and outcomes in Bulgaria are confined to the national level. There is limited engagement with international

markets, collaboration with foreign companies, or participation in global technology exchange networks.
- This limits the potential for Bulgarian innovations to gain global recognition and reduces opportunities for scaling up successful technologies beyond domestic markets.

7.1.2 Key Recommendations for Improvement

1. *Strengthening National Coordination and Reducing Fragmentation*
   - **Recommendation**: Establish a national body or network to better coordinate the activities of universities, research institutes, and TTOs across Bulgaria. This body could facilitate information sharing, reduce duplication of efforts, and support joint commercialization initiatives.
   - **Impact**: A more coordinated system will lead to more efficient use of resources, better alignment with national priorities, and increased opportunities for collaborative innovation projects.
2. *Enhancing Human Capital and Expertise within TTOs*
   - **Recommendation**: Invest in capacity-building programs for TTOs and research institutions, focusing on intellectual property management, technology licensing, industry collaboration, and commercialization skills. This could involve specialized training programs, partnerships with international experts, and scholarships for technology transfer professionals.
   - **Impact**: Increased expertise within TTOs will lead to higher success rates in technology commercialization, greater industry engagement, and more effective management of intellectual property portfolios.
3. *Developing a Clear Legal and Regulatory Framework for Spin-offs*
   - **Recommendation**: Streamline and clarify the regulatory framework around spin-offs and equity ownership by researchers. The government should establish policies that make it easier for researchers to hold equity in their spin-off companies and incentivize commercialization efforts.
   - **Impact**: A more transparent and supportive legal framework will foster greater innovation, increase the number of successful spin-offs, and encourage researchers to engage in entrepreneurial activities.
4. *Improving Access to Venture Capital and Private Sector Investment*
   - **Recommendation**: Expand access to venture capital and private sector funding for startups and spin-offs, particularly in deep-tech and high-growth sectors. This could include creating specialized funds targeting early-stage innovations or enhancing the role of the **Fund of Funds** in co-investing with private investors.
   - **Impact**: Improved access to funding will accelerate the commercialization of innovations, create more startups, and drive economic growth in high-potential sectors like ICT and biotechnology.
5. *Addressing Brain Drain and Retaining Talent*
   - **Recommendation**: Develop incentive programs to retain top researchers and innovators in Bulgaria. This could include offering competitive salaries, research grants, and entrepreneurial support, as well as creating clear

pathways for researchers to commercialize their innovations within the country.

- **Impact**: Reducing brain drain will strengthen Bulgaria's innovation ecosystem by retaining the talent needed to develop cutting-edge technologies and grow the technology transfer pipeline.

6. *Internationalizing Technology Transfer Activities*
   - **Recommendation**: Bulgarian universities and research institutions should proactively engage in international technology transfer networks, participate in global R&D consortia, and seek collaborations with foreign companies and research organizations. Programs that encourage international patent filings and cross-border licensing should be promoted.
   - **Impact**: Internationalizing TT activities will open up new markets for Bulgarian innovations, create opportunities for global partnerships, and ensure that successful technologies can scale up beyond the domestic market.
7. *Leveraging Digital Platforms for Technology Commercialization*
   - **Recommendation**: Invest in digital platforms that connect universities, TTOs, and industry partners for seamless technology transfer. These platforms should offer features such as virtual patent showcases, matchmaking tools for industry collaborations, and online IP marketplaces.
   - **Impact**: Digital platforms will make it easier to identify commercialization opportunities, connect researchers with industry, and showcase Bulgarian innovations on the global stage.

7.1.3 The Road Ahead for Bulgaria's Technology Transfer Ecosystem

In conclusion, Bulgaria's technology transfer ecosystem is at a pivotal stage of development. Strong research institutions, growing government support, and an increasing focus on innovation provide a solid foundation for progress. However, to fully realize the potential of technology transfer, it is essential to address key challenges such as fragmentation, lack of human capital, and regulatory barriers.

By implementing coordinated strategies for capacity building, legal reforms, and internationalization, Bulgaria can position itself as a regional leader in technology transfer and innovation. Focused efforts to integrate Bulgarian research into global markets, combined with improved infrastructure for commercialization and IP management, will ensure long-term success and economic impact. Internationalizing the technology transfer process is particularly crucial for scaling innovations and establishing Bulgaria as a global player in high-tech industries.

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