ECOSYSTEM ANALYSIS OF RESEARCH COMMERCIALISATION IN UZBEKISTAN

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https://doi.org/10.5281/zenodo.17441403

"What gets measured gets managed."— Peter Drucker

Abstract. *This study presents a comprehensive analysis of Uzbekistan's research commercialization ecosystem from 2017 through 2024. Drawing on official reports and global data, it documents rapid growth in innovation outputs alongside persistent structural gaps. Patent filings and IP registrations in universities have risen markedly (e.g., from 366 filings in 2017 to 428 in 2021), and HEIs registered 5,916 new IP objects (including 662 patents) during 2021–2023. State support has likewise expanded: new ministries (Ministry of Innovative Development, later Ministry of Higher Education, Science and Innovation) and World Bank–backed projects (MUNIS) have injected funding into grants, laboratories, and tech parks. By 2024, 486 university projects were commercialized (worth 275.1 billion UZS) and 71 start-ups launched. Yet challenges remain: commercialization mechanisms and legal frameworks are weak, and IP revenues are low (Uzbekistan ranked 104th globally on "IP revenue" in 2023). We apply SWOT framework to systematize strengths, weaknesses, and contextual factors, and benchmark Uzbekistan against regional peers and global best practices. Compared to neighbors (e.g. Kazakhstan 78th vs Uzbekistan 83rd in the Global Innovation Index 2024) and leading economies, Uzbekistan's innovation system shows strong government commitment and rising outputs, but still lags in industry linkages and commercialization culture. Policy reforms since 2017 – including institutional restructuring, digitalization of grants, and incentives for university tech transfer – have laid groundwork for further progress. We conclude by identifying strategic opportunities (growing human capital, international partnerships) and threats (limited R&D spending, weak IP enforcement) and recommend targeted measures to align Uzbekistan's commercialization model with global best practice.*

Key words*: technology transfer, intellectual property, research commercialization, innovation ecosystem, innovation policy, innovation funding, university-industry collaboration, technology transfer offices (TTOs).*

Introduction

Over the past decade Uzbekistan has undertaken an ambitious transformation of its science and innovation landscape. In response to low historical R&D investment and underdeveloped tech transfer, national leaders have prioritized innovation as a driver of economic diversification. Key reforms include creation of innovation-focused government bodies, competitive funding programs, and legal changes to encourage academia–industry collaboration. This paper analyzes the evolution of Uzbekistan's research commercialization ecosystem from 2017 through 2024, covering descriptive trends, policy and institutional reforms, and comparative benchmarks. We use a mixed-methods approach: reviewing official documents (e.g. Ministry reports, IP statistics) and applying analytical framework (SWOT) to provide a holistic view. The goals are to document growth in IP

outputs, funding flows, human capital, and international cooperation; to assess major reforms and organizational models; and to compare Uzbekistan's performance to global and regional norms. The analysis is grounded in data from government reports (Ministry of Innovative Development 2018–22; Ministry of Higher Education, Science and Innovation 2023–24), WIPO/IP statistics, and innovation indices.

Literature review

The commercialization of scientific research – often termed technology transfer or knowledge transfer – depends critically on both market-based incentives and institutional frameworks. In advanced economies like the USA, the Bayh–Dole Act (1980) is widely credited with catalyzing university-industry innovation by allowing universities to retain intellectual property from federally funded research.[i] Similar reforms followed in many countries (e.g. Japan, the EU), abolishing the "professor's privilege" so that institutions, not individual researchers, own inventions. For example, Germany's 2002 law removed professors' automatic ownership of inventions, aligning it with practice in the USA.[ii] Such changes are associated with spikes in licensing and spin-offs.

In innovation leaders like Israel and Singapore, dedicated mechanisms support tech transfer. Israel's Office of the Chief Scientist (now Innovation Authority) and programs like KAMIN fund proof-of-concept work to bridge the "valley of death". Likewise, Singapore's top universities (NUS, NTU) have well-staffed Technology Transfer Offices (TTOs) that handle disclosure, patenting and licensing. For instance, NUS's INTRO office (established 1992) has filed over 700 patent applications and concluded dozens of license deals, generating significant revenue and equity. All five Singapore polytechnics maintain innovation offices to nurture student and faculty inventions. These institutions illustrate that supportive IP policies *and* operational tech-transfer units can generate concrete commercialization outcomes.

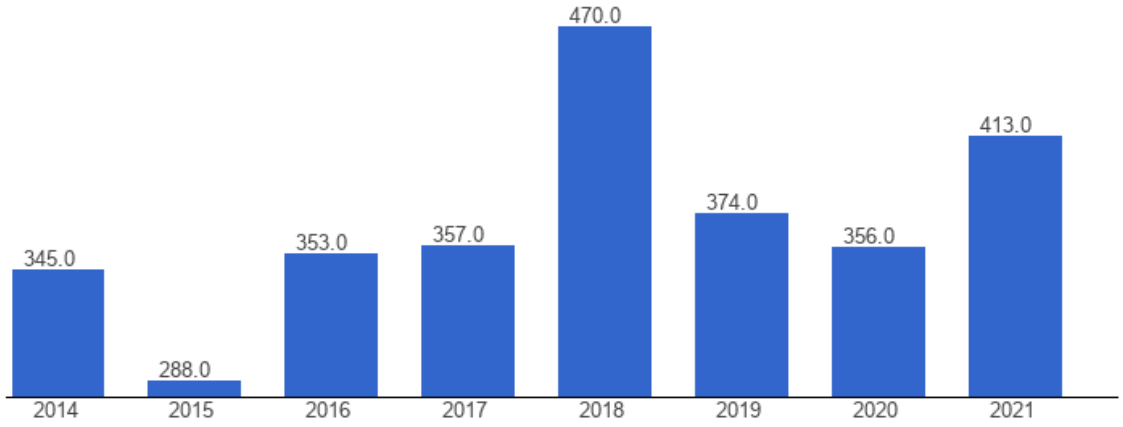
Comparative studies highlight the importance of soft institutional factors. WIPO's survey of transitioning countries found that research organizations with active TTOs often carry out patent licensing and technology contracts, whereas countries lacking clear tech-transfer offices see these functions fall on individual researchers (World Intellectual Property Organization, 2012). In Uzbekistan today, nascent TTOs have begun handling licensing and legal coordination, but broader policy support remains weak. Analysts argue that Uzbekistan's innovation laws are "overdetailed" and rigid, leaving little room for entrepreneurial experimentation (Oqyulov and Tursunov, 2021). By contrast, "softer" frameworks in places like the US or UK – which focus on incentives rather than prescribing methods – have helped spark technology transfer without stifling it.

In sum, the literature suggests that key components of a successful commercialization ecosystem include: (a) clear and flexible IP ownership rules (often granting ownership to universities/researchers); (b) funding mechanisms (grants, tax incentives, venture funds) that support innovation projects; (c) professional TTOs and incubators as intermediaries; and (d) streamlined regulations and supportive legislation (like specialized technology-transfer laws) to coordinate actors. Our analysis builds on these insights and benchmarks Uzbekistan's policies against those of USA, India, Iran, Pakistan, Indonesia, Singapore, and Kazakhstan.

Analysis and results

Patent filings and other IP outputs have grown substantially. According to WIPO statistics, total patent applications filed in Uzbekistan climbed from 366 in 2017 to 480 in 2018, before fluctuating around 400–450 and reaching 428 by 2021. Notably, domestic (resident) filings rose from 356 in 2020 to 413 in 2021, reflecting expanding local inventive activity. **Figure 1** shows the trend in resident patent applications from 2014–2021, highlighting a general upswing in recent years. It suggests a rebound after a pandemic dip in 2020, with 2021 at the highest level on record (413 applications).

Figure 1: Patent applications filed by Uzbekistan residents (2014–2021).



Data source: WIPO.

In addition to patents, Uzbekistan's universities and research institutes generated a wide array of IP. During 2021–2023, state-funded HEIs registered 5,916 IP objects: including 662 patents (inventions, utility models, designs), 56 trademarks, and 5,142 software certificates. These filings were accompanied by commercialization attempts: universities concluded 11 license agreements generating about 441.3 million UZS in revenue. Nevertheless, the revenue per IP is low by global standards (Uzbekistan is ranked 104th in "IP revenue" among GII economies). By comparison, leading U.S. universities filed over 7,600 patents and earned $2.94 billion from commercialization in recent years, underscoring the gulf in scale.

Licensing and spin-offs have only partially kept pace with the increase in IP. Official reports note 486 research projects were commercialized (delivered to industry or market) in 2023, with total sales of 275.1 billion UZS. From these, 17 spin-off companies were created and 71 start-up ventures launched. While still modest compared to advanced systems, these figures represent a significant uptick: between 2018–2022 some 455.1 billion UZS of scientific output was commercialized overall. University technology transfer offices (TTOs) remain underdeveloped, however: only 92 commercialization units exist across 115 universities, often with limited staffing and expertise. Reported challenges include weak IP ownership rules in academia, insufficient industry linkages, and low awareness of patent commercialization.

Institutional Development and Infrastructure. Institutionally, Uzbekistan has built an ecosystem of supportive organizations. Dozens of innovation centers, technoparks and incubators have been launched. For example, during 2018–2022 a total of 19 new innovation infrastructures (tech parks, accelerators, coworking spaces) were established, bringing the nationwide network of innovation entities to 55 by 2024. University-affiliated innovation centers expanded similarly: 11 new centers were added in 2023 (for a total of 47). Alongside these, laboratory facilities saw a major

upgrade: more than 272 types of high-tech lab equipment (worth 160.16 billion UZS) were supplied to research institutions by 2022, and some 148 million USD was spent on lab equipment at leading HEIs between 2021–2023. In total, 203 specialized research labs (across 37 top universities) now operate with 1,820 devices, vastly improving capacities for applied R&D.

Critically, Uzbekistan has invested in funding flows for commercialization. Eighty dedicated innovation funds (often at universities or regional centers) received 18.3 billion UZS in state endowments; these funds are required to invest in promising projects and businesses. Remarkably, the first rounds of disbursements to firms and spin-offs have already returned 53.9 billion UZS to the fund accounts, suggesting a positive multiplier. A large state-financed "scientific start-up" competition (the Global Innovation Program) has awarded grants to hundreds of teams, promoting early-stage commercialization of student and faculty inventions. The Ministry also emphasizes digitalization of innovation processes: for example, the ias.gov.uz portal now catalogs R&D projects and IP, and the grant.mininnovation.uz system transparently manages research funding, streamlining university–industry linkages.

Human Capital and Scientific Output. Human capital improvements underpin the commercialization drive. Uzbekistan greatly increased graduate training: doctoral quotas rose 7.1-fold by 2022 (to 3,600 slots), and over 3,300 researchers earned PhDs/DSc degrees by 2024. The share of faculty holding scientific degrees reached 45%. International exchange is also a priority: thousands of students and scholars studied abroad (e.g. 4,970 professors trained overseas, 2,510 foreign professors teaching in Uzbek universities in 2024), and roughly 500 young scientists undertook internships abroad. The number of academic publications has grown accordingly (7,512 articles in Scopus/Web of Science by 2024), indicating rising research activity.

However, an imbalance persists between research inputs and outputs. According to the 2021 WIPO report, Uzbekistan ranked 75th on "innovation inputs" but only 100th on "innovation outputs". The limited R&D spending (just 0.13% of GDP as of 2023) and low productivity of research results illustrate this gap. Average salaries for PhD scientists remain low, though improved 3.2-fold by 2022. Overall, human capital is expanding rapidly, but research teams still need stronger industry connections and commercialization skills.

International Cooperation and Funding. Uzbekistan has actively pursued international partnerships to boost commercialization. By 2022 over 117 memoranda and contracts were signed with foreign entities, yielding 98 joint R&D projects worth 112.2 billion UZS. Major collaborations include technology transfer agreements with universities and corporations in Russia, China, Turkey and Europe. These partnerships have also brought international funding: from 2018–2022 some $19.5 million of foreign investment and $8.3 million of grant aid flowed into Uzbek innovation projects. Additionally, around 480 young scientists participated in foreign training or research (2018–2022), and 277 in 2024 alone. In science diplomacy, bilateral agreements and forums (e.g. science cooperation accords, InnoWeek events) have further integrated Uzbek researchers into global networks. The impact of international engagement is seen in improving innovation indicators: Uzbekistan's Global Innovation Index rank rose from 122nd in 2015 to 82nd by 2022.

Policy and Institutional Reforms. Since 2017, Uzbekistan has enacted major reforms to strengthen the commercialization ecosystem. Politically, a new Ministry of Innovative Development was formed (2017), later merged into the Ministry of Higher Education, Science and Innovation in 2023. These bodies centralize authority over science and tech policy. A flagship initiative was the World Bank–supported Modernizing Uzbekistan's National Innovation System (MUNIS) project,

launched in 2018. MUNIS's component on research commercialization created a competitive Research Excellence Program and Research Commercialization Program, allocating grant funding (initially $10 million) to university R&D projects with strong market potential. The goal is "improv[ing] the capacity of public research organizations… to achieve international standards of research quality and enable the commercialization of research results". These programs introduced rigorous peer review, commercialization milestones, and monitoring of outcomes, exemplifying a model of performance-based innovation funding.

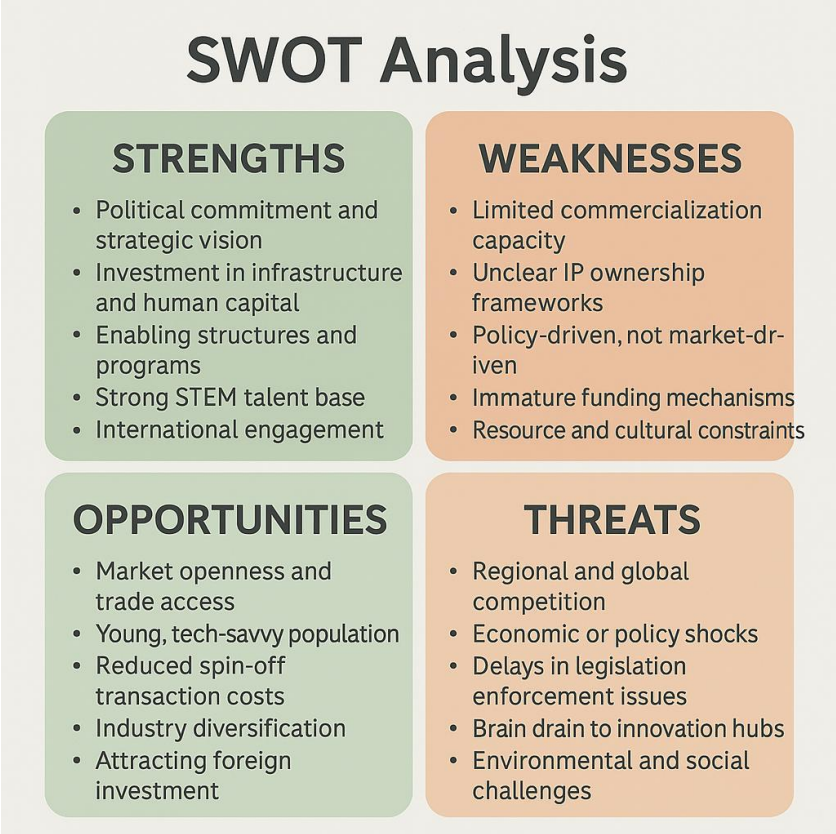
Legislatively, Uzbekistan has reformed IP and science laws. Recent amendments clarify ownership of inventions: per a 2021 decree, IP created at state-funded institutions is jointly owned by the creator and state (with compensation schemes). Universities are encouraged to establish TTOs, and a draft law on technology transfer (now pending adoption) would formalize licensing and IP revenue-sharing frameworks. Some reports note that unresolved ambiguities still hinder commercialization: for example, strict state ownership of IP can discourage inventors, and the absence of "author-owned" or "mixed" IP models (common in advanced systems) is cited as a gap.

On the institutional side, government policy has emphasized the Triple Helix (university-industry-government) model. Public funding is now contingent on industry relevance: the 2020–2022 state research order prioritized projects aligned with key economic sectors (agriculture, ICT, energy), and 40% of research grants were earmarked for equipment/materials. The Ministry instituted a national research ranking system for universities and institutes, with commercialization as one criterion. A "Commercialization Forum" (annual high-tech expo) showcases academic innovations to investors. Meanwhile, administrative reforms simplified licensing: the number of permits needed to start a tech enterprise was reduced, and innovation projects are now supervised by a single "one-stop" agency (the Ministry's project office) to cut red tape.

University reform has also targeted commercialization. As of 2024, 92 TTOs now operate across public universities, and 108 universities have set up dedicated innovation funds and registrars to manage IP and startup incubation. Academic incentives have been aligned to R&D productivity: for example, faculty salary bonuses were introduced for patented inventions and industry partnerships. At the same time, curricula and graduate programs have been revamped: several universities have launched Masters/PhD courses in Technology Transfer, Innovation Management, and IP Law (often with foreign collaboration), to build human capacity for commercialization.

SWOT Analysis

A **SWOT** assessment (Figure 2) highlights key internal and external factors shaping Uzbekistan's commercialization system.



- **Strengths:** Uzbekistan benefits from strong political commitment and clear strategic vision. The government's sustained investment in innovation infrastructure (laboratories, tech parks) and human capital (researchers, grants) is a major asset. Institutional reforms have created enabling structures (dedicated ministries, funding agencies) and programs (replicable models from South Korea, China, etc. have informed MUNIS program design). Large pools of technical talent—driven by expanding STEM education—provide a growing base of innovators. International engagement (over 117 agreements with foreign partners) further brings know-how and market access. Collectively, these strengths have translated into rising outputs (patents, startups, tradeable R&D products) and improved innovation rankings.
- Weaknesses: Nevertheless, institutional weaknesses persist in commercialization capacity. University IP offices are often understaffed or inexperienced, limiting outreach to industry. There is a lack of clear ownership and revenue-sharing frameworks for IP created at public institutions, dampening inventors' incentives. The innovation ecosystem remains policy-driven rather than market-driven, so many patented ideas fail to find industrial partners. Funding mechanisms, while growing, are still immature: for example, only 11 license deals generated revenue in 2021–23. On the resource side, R&D budgets are low (<0.2% GDP), and GDP per capita is modest; this constrains universities' ability to spin off firms without external support. Cultural factors also limit commercialization: historically, academics have prioritized publications and teaching over patents and startups, and strong risk-aversion in industry slows adoption of new technologies.
- **Opportunities:** Several external trends and domestic shifts offer opportunities to accelerate commercialization. The government's "New Uzbekistan" vision and accession to global trade bodies have opened markets and investor interest in high-tech sectors. A young, technologically literate population creates potential both as creators and consumers of innovation. Digitization reforms (e-government, online IP registration, fintech) reduce transaction costs for spin-offs.

Moreover, Uzbekistan's growing middle class and industry diversification (into pharmaceuticals, agro-processing, renewables) increase demand for homegrown R&D solutions. Strategic international events (e.g. InnoWeek) and soft-landing programs attract foreign capital; in 2023 alone foreign startups invested $19.5M in Uzbek projects. Finally, Uzbekistan can emulate global best practices: benchmarking shows room to adopt models like "entrepreneurial universities" in the US and Europe, or "innovation districts" in Asia, tailoring them locally to strengthen tech transfer.

- **Threats:** The ecosystem faces several threats. Regionally, competition is rising: neighboring Kazakhstan (GII rank 78) and India (39) are also boosting innovation, which may divert talent and capital. Globally, shocks like economic crises or the COVID-19 pandemic strain R&D budgets and priorities (Uzbekistan's patent filings dipped in 2020). On the policy front, delays in passing key legislation (e.g. a comprehensive innovation law) risk stalling momentum. Weaknesses in rule of law—particularly in IP enforcement and contract integrity—could discourage foreign investors and joint ventures. Additionally, brain drain remains a risk: if domestic careers do not open up, top researchers may emigrate to more dynamic innovation hubs. Finally, environmental and social challenges (e.g. climate change impacts on water and agriculture) could divert resources away from high-tech R&D, or create mismatches between research projects and immediate national needs.

Comparative Benchmarking. How does Uzbekistan's commercialization performance stack up globally and regionally? On the 2024 Global Innovation Index (GII), Uzbekistan ranked **83rd out of 133** economies, making it an "overperformer" relative to its income level for the third consecutive year. This is a marked improvement from **93rd in 2020 and 86th in 2021**, and far above its 2013 rank of 122nd. In its region (Central and Southern Asia), Uzbekistan is 4th, trailing India (39th), Iran (64th) and Kazakhstan (78th). Among the lower-middle-income group, it ranks 10th.

In concrete terms, these indices reflect both progress and remaining gaps. Uzbekistan's strongest relative scores are in growth-oriented metrics: it was 7th globally in labor productivity growth and 12th in science & engineering graduates per capita. Its weakest areas are in outputs: IP assets and creative outputs lag (e.g. patenting and IP incomes are low). The nation's GII "innovation efficiency" has risen, but lags behind regional leaders. For instance, Kazakhstan (an upper middle-income country) files far more patents annually and has hosted international tech events (Astana Hub) to foster startups. India (a lower-middle-income peer) outstrips Uzbekistan in university–industry links and R&D spending.

On IP commercialization benchmarks: Uzbekistan's university IP revenue is negligible compared to leaders. As noted, U.S. universities generate billions annually, whereas Uzbek HEIs earned only tens of millions of UZS. The number of patent filings by residents (413 in 2021) also trails similarly populous peers: for context, in 2021 India saw ~60,000 patent applications (overwhelmingly domestic), and even neighboring Tajikistan reported 107 filings (GII 2023). On the other hand, Uzbek patent growth (a near-50% rise from 2017 to 2021) has outpaced global averages, suggesting a catch-up trend.

In terms of broader innovation ecosystem rankings, Uzbekistan has few university or regional "clusters" in global top lists. The WIPO 2024 country profile notes Uzbekistan has "no clusters in the top 100" of science and tech regions. Nonetheless, Uzbekistan's climb in multiple GII pillars (such as human capital, infrastructure, and institutions) is among the fastest globally; only a few emerging economies (e.g. Pakistan, Indonesia, Iran) have improved as much since 2013.

This indicates that while output levels remain modest, the **trajectory** is positive and competitive among peers.

Conclusion

Between 2017 and 2024, Uzbekistan's research commercialization ecosystem has undergone rapid development. Patent filings and university IP registrations have risen, the number of commercialization units and innovation centers has grown, and significant sums have been invested in labs and research projects. Government-led reforms and programs (notably the MUNIS project and a unified science ministry) have created a platform for tech transfer, while international cooperation and private-sector linkages have begun to take root. The result is palpable: Uzbekistan's innovation rankings have climbed dramatically (e.g. GII rank improving to the mid-80s), and first cohorts of commercialized technologies are emerging in fields like agriculture, healthcare, and IT.

However, challenges remain substantial. Commercialization processes are still nascent: many university inventions do not reach market, and IP revenues are minimal. SWOT analysis highlights internal weaknesses in management capacity and external threats from global competition. Factors show strong political and demographic support but caution that economic and legal constraints could stall progress. In benchmark terms, Uzbekistan is outperforming many similar economies and rapidly closing gaps with regional neighbors, but it still trails international best practice in metrics such as R&D intensity, patent yields, and innovation outputs.

To sustain momentum, Uzbekistan should further embed commercialization in its strategy. Recommendations include: refining IP ownership laws to incentivize both researchers and institutions; expanding private sector partnerships through co-funded research and industry advisory boards; scaling up venture funding (e.g. via public–private innovation funds); and embedding entrepreneurship education across universities. Enhancing transparency and career pathways in technology transfer offices will build trust among innovators. Moreover, adopting international benchmarks such as tech transfer offices in U.S. research universities or public–private consortiums (e.g. Germany's Fraunhofer Institutes) can guide local institutional design. Finally, targeted support for high-growth sectors (ICT, biotech, renewable energy) aligned with Uzbekistan's comparative advantages could yield quick wins and foster role models for commercialization.

In sum, Uzbekistan's commercialization ecosystem is on an upward path, driven by strong policy backing and institutional building. With continued reforms and resource commitment, it can align more closely with global innovation norms. Ongoing monitoring of key indicators (patents, spin-offs, technology exports) and learning from international best practices will be crucial. This analysis provides a baseline and framework for policymakers and stakeholders to evaluate progress and refine strategies towards a vibrant national innovation economy by 2024 and beyond.

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