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# UNIVERSITY-STATE-BUSINESS COLLABORATION IN THE USA: PRACTICAL TOOLS FOR DEVELOPING THE INNOVATION ECOSYSTEM

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## INTRODUCTION

The modern university is expected simultaneously to educate the workforce, generate patentable knowledge, support regional economies, and contribute to the resolution of grand societal challenges ranging from climate change to post-conflict reconstruction. Whether any university can fulfil this mandate in isolation is a question to which four decades of science policy research have returned a consistent answer: it cannot. A university that patents its discoveries but has no relationships with investors capable of commercialising them, trains graduates whose competencies are misaligned with labour market needs. A university that publishes internationally while remaining detached from collaborative innovation networks is only partially realising its institutional potential. Researchers argue that sustained, structural partnerships with government bodies and private-sector actors are not a supplement to the academic mission; they are, increasingly, its prerequisite[1].

The paper examines the university-state-business collaboration model, drawing primarily on the institutional experience of the United States. As D. Mowery et al. claim, American research universities, particularly those that developed in the post-Bayh-Dole era after 1980, represent the most extensively studied examples of multi-actor innovation ecosystems in the world.[2] Their successes, and their failures, offer a rich empirical basis for identifying transferable principles. The paper is written with a comparative and normative intent: its ultimate concern is with what other higher education systems – including those of Ukraine and the wider European space – can learn, adapt, and critically apply from this experience.

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[1] Mbitse, Y., Salomo, S., & zu Knyphausen-Aufseß, D. Universities as Keystone Orchestrators during Innovation Ecosystem Nascence. *Academy of Management Perspectives*. 2024. Vol. 38, No. 4. P. 512–533. DOI: https://doi.org/10.5465/amp.2023.0047

[2] Mowery D. C., Nelson R. R., Sampat B. N., Ziedonis A. A. Ivory Tower and Industrial Innovation: University-Industry Technology Transfer Before and After the Bayh-Dole Act. Stanford: Stanford Business Books, 2004.

To provide a conceptual foundation for the analysis, the following section reviews the key concepts and theoretical frameworks relevant to university engagement, knowledge transfer, and societal impact. The concept of an *innovation ecosystem* in higher education describes co-innovation networks in which actors concerned with knowledge production, wealth creation, and norm control interact in an adaptive, self-organising manner to generate innovations that none could produce alone[3]. P. Xin et al. (2025)[4] argue that classical ecosystem frameworks rest on assumptions of goal congruence and linear knowledge transfer inadequate for addressing complex sustainability challenges. In response, they propose a revised framework emphasizing three interrelated processes that shape the durability of collaborative arrangements: the alignment of values and norms across partner organisations; the capacity of partners to learn from each other across sectoral boundaries; and the ability of the collaboration to reflect on and adjust its own practices over time.

The *triple-helix model* of H. Etzkowitz and L. Leydesdorff (2000)[5] provides the article's principal theoretical scaffold. It posits that the most productive innovation dynamics arise from the overlapping, mutually constitutive interactions among three institutional helices: the university (knowledge production), industry (wealth creation), and government (normative regulation and public investment). Each helix retains its own institutional logic while simultaneously taking on roles associated with the others: universities engage in entrepreneurship, firms conduct basic research, governments act as venture capitalists generating what H. Etzkowitz terms "innovation in innovation" that is a reflexive capacity to create the organisational arrangements that foster further innovation. Recent empirical work confirms that innovation outcomes in technology-intensive sectors are maximised through synergistic interaction among all three helices, with each contributing distinct resources – scientific knowledge, financial capital, and regulatory legitimacy respectively[6].

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[3] Cai Y., Ma J., Chen Q. Higher Education in Innovation Ecosystems. *Sustainability*. 2020. Vol. 12, No. 11. Article 4376. DOI: https://doi.org/10.3390/su12114376

[4] Xin P., Arshad N. I., Mohamad U. H., Huang Y., Su S. J. Reframing the Triple Helix for sustainability: A mechanism-based framework for university-industry-government collaboration in global innovation systems. *European Journal of Education*, vol. 60, no. 4, e70361, 2025. DOI: https://doi.org/10.1111/ejed.70361

[5] Etzkowitz H., Leydesdorff L. The dynamics of innovation: From National Systems and 'Mode 2' to a Triple Helix of university–industry–government relations. *Research Policy*. 2000. Vol. 29, No. 2. P. 109–123. DOI: https://doi.org/10.1016/S0048-7333(99)00055-4

[6] Wang X., Zhou B., Guan W., Dai J. Triple Helix synergy at the subsidy threshold: Government support, IUR collaboration, and knowledge spillovers in enterprise AI innovation. Technological Forecasting and Social Change, vol. 227, Article 124626, 2026. DOI: https://doi.org/10.1016/j.techfore.2026.124626

The analysis also draws on two further concepts that require brief explanation. *Network interaction and partnership typology*: the literature distinguishes transactional partnerships (one-off contracts), relational partnerships (sustained alliances, joint laboratories), and systemic partnerships (consortia and cluster initiatives in which universities serve as anchor institutions).[7] It is the relational and systemic forms that are most strongly associated with durable transformation of regional innovation capacity, which is a distinction of particular relevance for Ukrainian universities seeking to contribute to post-war economic reconstruction. *Technology transfer and commercialisation*: the Bayh-Dole Act's grant of IP ownership to universities triggered a proliferation of technology transfer offices and licensing activity[8], but patenting and licensing capture only a portion of university-industry engagement. Much significant knowledge exchange occurs through consultancy, collaborative research, professional training, and graduate recruitment – channels that conventional commercialisation metrics do not adequately reflect.[9] Commercialisation is therefore treated here as one instrument in a broader ecosystem toolkit, not as its defining purpose.

The article advances the following argument: *sustainable university innovation ecosystems are built not by institutions operating at maximum individual capacity, but by networks whose relationships are sufficiently dense, diversified, and institutionally embedded to generate emergent collaborative value that no single actor could produce alone.*

## 1. The university as an innovation hub: historical foundations and institutional architecture

### 1.1. Historical formation of the research university model in the USA

The transformation of the American university from a teaching institution into a principal engine of national innovation was the outcome of deliberate policy choices and a succession of legislative interventions that progressively deepened the structural interdependence between the academy, the state, and the market. Three decisions proved foundational. The Morrill

[7] Sarpong D., Meissner D., Moraes G., Vismara S. The impact of university-industry engagement and the rise of competency transfer partnerships. Journal of Technology Transfer, vol. 51, pp. 637–652, 2026. DOI: https://doi.org/10.1007/s10961-025-10251-5

[8] Chen Z., Little V. J., Thuan N. H. The evolving role of technology transfer offices in the entrepreneurial university: Go-betweens or playmakers? Journal of Technology Transfer. 2025. Vol. 50. P. 1060–1079. DOI: https://doi.org/10.1007/s10961-024-10123-4

[9] Zhou R., Baines N. To what extent do universities' formal and informal knowledge exchange activities interact: evidence from UK HE-BCI survey. The Journal of Technology Transfer, vol. 49, no. 4, pp. 1145–1175, 2024. DOI: https://doi.org/10.1007/s10961-023-10051-9

Land-Grant College Act of 1862 established the institutional precedent that universities were not merely custodians of inherited knowledge but agents of national development, whose value was measured partly by their contribution to the material wellbeing of the societies that funded them[10]. Vannevar Bush's 1945 report "Science: The Endless Frontier" then made the case for sustained federal investment in basic research on the grounds that fundamental scientific knowledge was the seed from which technological innovation ultimately grew. It is the permanent federal funding mechanism that secured the institutional architecture of competitive federal grant-making through agencies such as the National Science Foundation, the National Institutes of Health, and the Department of Defense that continues to define American research universities today[11].

The third important moment was the Bayh-Dole Act of 1980. D. Mowery et al. claim that by granting universities the right to retain ownership of inventions resulting from federally funded research, and by requiring them to seek commercialisation, the Act fundamentally restructured the incentive landscape of American higher education.[12] The proliferation of technology transfer offices (TTOs) that followed was rapid: fewer than two dozen American universities had dedicated TTOs before 1980; the number approaches 300 in AUTM (Association of University Technology Managers) surveys today. Two regional clusters crystallised the model which the Bayh-Dole Act accelerated. The Route 128 corridor in eastern Massachusetts, which is a well-known technological, innovative and business hub centred on MIT and Harvard, and the San Francisco Bay Area cluster driven by Stanford University had each begun constructing university-centred innovation regions from the 1950s. At Stanford, provost Frederick Terman established the Stanford Industrial Park (1951), articulated a vision of a "community of technical scholars" working in close proximity to industry, and built the faculty consulting and sponsored research relationships that seeded what became Silicon Valley. A. Saxenian notes that provost's central idea that proximity to a research university lowers the transaction costs of knowledge transfer and creates the dense social networks through which tacit knowledge flows remains a foundational principle of cluster theory[13].

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[10] Goldin C. D., Katz L. F. The race between education and technology. Cambridge, Mass.: Belknap Press of Harvard University Press, 2008.

[11] Bush V. Science: The endless frontier: A report to the President. United States Government Printing Office, 1945. URL: https://www.pi.infn.it/%7Egiorgio/INFN/3M/SciencetheEndlessFrontier.pdf

[12] Mowery D. C. et al. Ivory Tower and Industrial Innovation, 2004.

[13] Saxenian A. Regional Advantage: Culture and Competition in Silicon Valley and Route 128. Cambridge, MA: Harvard University Press, 1994. URL: https://www.ischool.berkeley.edu/research/publications/1994/regional-advantage-culture-and-competition-silicon-valley-and-route-128

### 1.2. Structural characteristics of university innovation ecosystems

The contemporary American research university that is a pillar of a regional innovation ecosystem is not simply a large institution with a strong research record. It has built, over decades, specialised organisational units whose purpose is to translate research excellence into external economic and social impact. The research office manages relationships with federal and state funding agencies, ensures compliance with grant conditions, and sets the strategic direction for the research portfolio. The technology licensing office (TLO) operates at the interface between laboratory and marketplace: it identifies commercially relevant inventions, secures IP (intellectual property) protection, and negotiates licensing arrangements with commercial partners. The literature has converged on the finding that the most effective TTOs adopt an active "playmaker" role – proactively scanning the research portfolio for commercial potential and building deal-flow pipelines rather than passively processing disclosure forms[14]. Industry liaison offices (ILOs) complement the TLO by managing the broader university-industry relationship: consortium memberships, sponsored research agreements, and executive education programmes through which firms access the university's wider capabilities. MIT's Industrial Liaison Program, established in 1948, provides member companies with direct faculty access and early visibility into emerging research across the Institute's departments[15].

Entrepreneurship centres and incubation infrastructure represent a third structural layer whose expansion has been one of the most significant developments in American higher education over the past two decades. More than 90 percent of Carnegie-classified research universities now operate dedicated entrepreneurship support programmes combining curricular training, mentoring, and access to pre-seed capital. The aggregate output of this institutional infrastructure is substantial. The AUTM Licensing Activity Survey 2023 tracked the following figures: participating U.S. institutions collectively received over 25,000 invention disclosures per year, filed more than 9,000 new patent applications, executed over 13,000 new licences and options, and launched more than 900 new startup companies[16]. Behind these totals, however, the distribution is highly uneven: a handful of institutions account for most of the licensing income and startup activity, which means that headline metrics of leading universities cannot be replicated by introducing a TLO alone; they are the product of decades of institutional investment and culture-building.

[14] Chen Z. et al. The evolving role of technology transfer offices…, 2025.

[15] Massachusetts Institute of Technology. Industrial Liaison Program and Startup Exchange. MIT Industrial Liaison Program, 2026. URL: https://ilp.mit.edu

[16] AUTM. 2023 U.S. licensing activity survey. AUTM, 2024. URL: https://autm.net/surveys-and-tools/surveys/licensing-survey/2023-licensing-survey

**1.3. Case examples: MIT, Stanford, and the University of Texas at Austin**

Three institutional cases illustrate how the structural characteristics described in 1.2 are realised in practice, each representing a distinct variant of the university innovation ecosystem model.

The *Massachusetts Institute of Technology* has built an innovation infrastructure comprising more than 80 interconnected organisations, from the Martin Trust Center for MIT Entrepreneurship, which provides curricular programmes, mentoring, and pre-seed funding to student ventures, to the Industrial Liaison Program, which manages sustained research relationships with over 200 corporate members, to The Engine, a venture fund dedicated to deep-technology startups in advanced materials, climate technology, and biotechnology.[17] What distinguishes MIT's model is not the scale of any single unit but the integration of all these functions into a coherent institutional architecture, underpinned by the *mens et manus* ("mind and hands") commitment that laboratory work and prototype development are embedded across both undergraduate and graduate curricula, and that entrepreneurial activity carries genuine cultural status within the community.

*Stanford University* built its innovation ecosystem around deliberate physical co-location, beginning with the establishment of the Stanford Industrial Park (later the Stanford Research Park) in 1951. Provost Frederick Terman's founding insight was that proximity between university researchers and industry partners lowers the transaction costs of knowledge transfer and creates the dense social networks through which tacit knowledge flows most effectively. The park now comprises 700 acres and more than 150 companies, including Tesla, HP, Broadcom, SAP, and Rivian, and continues to serve as a primary vector through which Stanford's research capacity reaches commercial application.[18] Its affiliated non-profit accelerator StartX (a university-affiliated seed-stage accelerator that supports Stanford student, alumni, and faculty founders) illustrates a principled departure from the dominant equity-taking formula: taking zero equity from participating companies, StartX has launched more than 300 companies, 87 percent of which remain operational, with founders raising an average $ 4,5 million and achieving valuations above $ 100 million at three times the sector rate.[19] The no-equity model with its stronger alignment of interests between accelerator and founding team is directly relevant to

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[17] Massachusetts Institute of Technology. Innovation. MIT, n.d. URL: https://www.mit.edu/innovation/

[18] Stanford Research Park. Success story: Tesla. December 1, 2023. URL: https://stanfordresearchpark.com/articles/success-story-tesla/

[19] Stanford Research Park. StartX accelerator. November 11, 2025. URL: https://stanfordresearchpark.com/articles/success-story-startx/

resource-constrained systems where the transaction costs of equity arrangements can be a barrier to participation.

*The University of Texas at Austin* illustrates a third model: philanthropic investment in a new academic unit as a catalyst for broader regional transformation. The Dell Medical School, established in 2016 through a partnership between the Michael & Susan Dell Foundation, the City of Austin, and the UT (University of Texas) system, created from the outset a governance architecture explicitly designed to connect research, clinical care, and commercialisation within a single institutional framework.[20]

The institutional architecture described above does not operate in isolation: its value is realised through structured partnerships with private-sector actors whose forms, governance models, and knowledge integration depth vary considerably.

### 1.4. Typology of business-university partnerships

The literature on business-university partnerships organises partnership forms along two axes: the formality of the arrangement, and the degree of knowledge integration. Understanding this typology matters practically: the governance challenges and innovation outputs differ substantially across forms, and choosing the wrong model for a given research context is one of the most common sources of partnership failure. The five principal forms spanning from the individual consulting engagement to the jointly governed research laboratory are summarised in Table 1.

Table 1

**Typology of business-university partnerships: forms, governance, and outputs**

| Partnership form | Integration level | Governance model | IP arrangement | Primary outputs |
|---|---|---|---|---|
| Sponsored research agreement (SRA) | Transactional | Bilateral; company defines scope; publication review clause | Company: first right to license; background IP stays with university | Targeted research; patents; short-term talent access |
| IUCRC (Industry-University Cooperative Research Centers) consortium | Relational | Multi-member Industry Advisory Board; NSF matching grant funds coordination; ≥90% of fees to direct research | Members share IP developed with their fees; no exclusivity by default | Pre-competitive research; graduate recruitment pipeline; faculty-industry co-authorship |

[20] University of Texas at Austin. Michael and Susan Dell surpass $1 billion in giving to UT Austin. April 21, 2026. URL: https://news.utexas.edu/2026/04/21/michael-and-susan-dell-surpass-1-billion-in-giving-to-ut-austin/

Table 1 (continuance)

| | | | | |
|---|---|---|---|---|
| Co-funded doctoral programme | Relational | Dual supervision (faculty + industry scientist); industrial doctorate variants | Thesis usually published; application rights negotiated with company | Deep tacit knowledge transfer; long-term alumni network |
| Faculty consulting and secondment | Transactional | Individual faculty-company agreement; conflict-of-interest disclosure; typically ≤1 day/week | Consulting outputs belong to company; university background IP protected | Applied problem-solving; network building; informal knowledge flow |
| Joint laboratory | Systemic | Joint governing board; shared campus space; co-appointed researchers; open publication rights retained | Joint ownership or research licence to industry; publication-first principle | Frontier research; shared IP portfolio; sustained talent pipeline; institutional trust |

*Sources:*[21, 22, 23]

Several features of the typology deserve emphasis. Sponsored research agreements (SRAs), despite their dominance in volume terms, mainly serve the sponsor's short-term goals and tend to generate publication delays that affect faculty and graduate student career trajectories[24]. The IUCRC model corrects for this by aggregating industry funding across multiple firms and directing it at a pre-competitive research agenda governed by an Industry Advisory Board. NSF's requirement that at least 90 percent of member fees be allocated to direct research costs ensures the programme retains its research focus rather than becoming an industry lobbying vehicle. The programme currently supports more than 80 active centres across 120 U.S. universities, with over 700 member organisations. Research confirms that IUCRC membership is associated with increased faculty-industry co-authorship and graduate student recruitment into member firms – the relational channels through which much of the most significant knowledge

[21] Perkmann M., Walsh K. The two faces of collaboration: Impacts of university–industry relations on public research. Industrial and Corporate Change, vol. 18, no. 6, pp. 1033–1065, 2009. DOI: https://doi.org/10.1093/icc/dtp015

[22] Davey T., Meerman A., Galán-Muros V., Orazbayeva B., Baaken T. The impact of university-industry engagement and the rise of competency transfer partnerships. The Journal of Technology Transfer. Advance online publication. 2025. DOI: https://doi.org/10.1007/s10961-025-10251-5

[23] MIT–IBM Watson AI Lab. MIT–IBM Watson AI Lab 2023–2024 annual report. January 2025. URL: https://mitibmwatsonailab.mit.edu/wp-content/uploads/2025/01/MIT-IBM-Watson-AI-Lab-2023-2024-Annual-Report.pdf

[24] Perkmann M., Walsh K. The two faces of collaboration…, 2009.

transfer actually occurs[25]. Co-funded doctoral programmes and faculty consulting generate valuable relational capital and informal knowledge flows, but their governance is less institutionalised and their IP implications require careful management at the individual level[26,27].

### 1.5. Joint laboratories and research facilities

Joint laboratories represent the institutional layer of business-university partnership: dedicated organisational units jointly governed, jointly staffed, and physically embedded in or adjacent to the university campus. The model has expanded substantially over the past decade, driven by the recognition that transformative research at the frontier of AI, quantum computing, advanced materials, and precision medicine requires the kind of sustained, multi-year collaboration that neither the SRA nor the grant cycle can adequately support.

The MIT-IBM Watson AI Lab, established in September 2017 with a $240 million IBM commitment, is the paradigmatic example. Operating under joint MIT-IBM governance on the MIT campus, and committed to open publication as a non-negotiable condition, the Lab generated across its first decade more than 550 peer-reviewed joint publications, over 200,000 academic citations, and an h-index of 199 – a measure of impact extraordinary for a laboratory of its age[28].

In April 2026, MIT and IBM announced its successor: the MIT-IBM Computing Research Lab, oriented towards the intersection of AI and quantum computing and governed on the same open-publication principles.[29] The transition is analytically instructive: it demonstrates that joint laboratory arrangements can evolve in response to a shifting technology landscape while preserving the relational and institutional capital built over the preceding decade, which is a form of institutional learning that may be the most valuable long-term output of a sustained alliance. The pharmaceutical sector offers a complementary model: the Broad Institute of MIT and Harvard, jointly governed by two universities and sustained by a combination of endowment, federal grants, and industry partnerships,

[25] National Science Foundation. Industry-University Cooperative Research Centers (IUCRC) programme overview webinar [Webinar]. November 14, 2022. URL: https://iucrc.nsf.gov/sites/default/files/2022_11_14_IUCRC%20Webinar_external.pdf

[26] Davey T. et al.The impact of university-industry engagement…, 2025.

[27] D'Este P., Perkmann M. Why do academics engage with industry? The entrepreneurial university and individual motivations. The Journal of Technology Transfer. 2011. Vol. 36, No. 3. P. 316–339. DOI: https://doi.org/10.1007/s10961-010-9153-z

[28] MIT–IBM Watson AI Lab. MIT–IBM Watson AI Lab 2023–2024 annual report. January 2025. URL: https://mitibmwatsonailab.mit.edu/wp-content/uploads/2025/01/MIT-IBM-Watson-AI-Lab-2023-2024-Annual-Report.pdf

[29] Ibid.

demonstrates that multi-institutional joint governance can generate a drug-target pipeline (a drug production line) and clinical trial candidates that neither a purely academic nor a purely corporate environment could produce independently.[30]

The PostEra-Pfizer AI drug discovery partnership, expanded in January 2025 into a possible $610 million deal, shows a new model where a university-linked AI startup keeps control of its algorithms, while the drug company provides medical expertise and knowledge of approval rules.[31,32] The IP arrangement when PostEra retains algorithm ownership and Pfizer obtains application rights and milestone-contingent payments is a template increasingly relevant for university spin-offs seeking industry partnerships without sacrificing the IP position underpinning their valuation. Across all three cases, the central lesson is the same: joint laboratories succeed when they establish governance structures with clear decision rights for both parties over research agenda, IP policy, publication rights, and staff appointments, combined with a shared commitment to open publication that maintains the academic integrity essential to recruiting world-class researchers.

### 1.6. University research and innovation parks

Research and innovation parks represent the physical layer of the ecosystem: deliberately constructed places where proximity, serendipitous encounter, and shared infrastructure are translated into built form. The United States has more than 170 such parks, collectively employing hundreds of thousands of knowledge workers and generating economic impacts measured in the hundreds of billions of dollars annually. Two different models show the range of design strategies available.

Research Triangle Park (RTP) in North Carolina is the prototype of the deliberate, government-planned university research park. Where Stanford's park evolved organically from entrepreneurial vision and venture capital proximity, RTP was conceived and constructed in 1959 by a coalition of state government, civic leaders, and three research universities – Duke, UNC Chapel Hill, and NC State – as an explicit regional economic development

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[30] IBM Research, Massachusetts Institute of Technology. The MIT–IBM Computing Research Lab launches to shape the future of AI and quantum computing. 29 April 2026. URL: https://newsroom.ibm.com/2026-04-29-the-mit-ibm-computing-research-lab-launches-to-shape-the-future-of-ai-and-quantum-computing

[31] PostEra. PostEra announces expansion to $610M in their AI drug discovery collaboration with Pfizer. January 7, 2025. URL: https://postera.ai/news/postera-announces-expansion-to-610m-in-their-ai-drug-discovery-collaboration-with-pfizer/

[32] Walrath R. Pfizer doubles down on AI partnership with antibody-drug conjugate deal. Chemical & Engineering News, January 7, 2025. URL: https://cen.acs.org/business/start-ups/Pfizer-doubles-down-AI-partnership/103/web/2025/01

instrument, designed to retain the graduates of North Carolina's research universities who were leaving the state for higher-wage opportunities elsewhere[33,34].Today the park hosts more than 300 companies, employs over 65,000 people, and supports a regional ecosystem of more than 7,000 firms. Major pharmaceutical company tenants include Biogen, Eli Lilly, GSK, and Novo Nordisk. The Triangle region supplies 176,000 higher education students and approximately 65,000 annual graduates as a regular source of new talents.[35,36] RTP has shifted from a big corporate campus model to a mix of large companies and small firms. The Frontier innovation hub, which offers flexible lab and office space for startups, shows this change. The broader lesson is that having a diverse mix of company sizes and technology sectors creates more lasting strength than relying mainly on big employers.

The University of Utah Research Park, established in 1968 and ranked thirteenth among U.S. innovation districts in a 2024 George W. Bush Institute assessment, offers the contrasting model of an internally generated tenant base. Its anchor companies – Myriad Genetics, BioFire Diagnostics, ARUP Laboratories, Sarcos Technology – are without exception spin-offs from University of Utah research, demonstrating the viability and value of growing the park from within rather than attracting external corporate tenants. Utah's broader innovation capacity was ranked first nationally by the Gardner Policy Institute in 2024[37]. Across both cases, the "bump-ability factor" – chance meetings made possible by shared space – is an important but insufficient condition for ecosystem vitality[38]. What truly turns a group of buildings into a real ecosystem is the quality of its governance, the role of intermediary organizations, and the steady supply of talent built in and around the place.

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[33] Research Triangle Foundation of North Carolina. Wake County Economic Development' Economy & Business Feature: RTP 3.0 and the future of Research Triangle Park. January 6, 2026. URL: https://www.rtp.org/2026/01/wake-county-economic-development-economy-business-feature-rtp-3-0-and-the-future-of-research-triangle-park/

[34] Wake County Economic Development. Research Triangle Park's historic role in shaping North Carolina's economy. September 26, 2024. URL: https://raleigh-wake.org/blog/research-triangle-parks-historic-role-in-shaping-north-carolinas-economy

[35] Research Triangle Foundation of North Carolina. Wake County Economic Development' Economy & Business Feature…, 2026.

[36] Shah-Neville W. Research Triangle Park: A closer look at North Carolina's burgeoning biotech hub. Labiotech, November 28, 2025. URL: https://www.labiotech.eu/in-depth/research-triangle-park-north-carolina-biotech-hub/

[37] Kem C. Gardner Policy Institute, Economic Development Corporation of Utah. Utah innovation ecosystems. University of Utah, 2024. URL: https://d36oiwf74r1rap.cloudfront.net/wp-content/uploads/2025/01/Innovation-Main-Report-Dec2024.pdf

[38] University of Utah. Research Park: Work, play, learn and–live? @theU, June 12, 2020. URL: https://attheu.utah.edu/facultystaff/research-park-work-play-learn-and-live/

## 2. Government as ecosystem architect: funding mechanisms, regulatory frameworks, and network infrastructure. Technology transfer, and startup development

Governments occupy a dual role in university innovation ecosystems: they are simultaneously the largest single source of funding for basic and applied research, and the regulatory authority that determines the legal conditions under which knowledge can be transferred, commercialised, and shared across national borders. Understanding this duality – the enabling function and the constraining function – is essential for any institution seeking to build productive partnerships. The American federal system, which distributes innovation policy responsibility across multiple agencies and fifty state governments, offers a particularly rich set of instruments to examine. This section maps the architecture at two levels – federal and state, before turning to the regulatory and intellectual property frameworks that shape the conditions of partnership.

### 2.1. Federal funding architecture

The scale of federal investment in university research in the United States is, by any international comparison, exceptional. According to the National Center for Science and Engineering Statistics (NCSES), total U.S. R&D performance reached an estimated $993 billion in 2024, with federally financed higher education R&D expenditures at $64.6 billion in the same year – an increase of over 70 percent from the $37.5 billion recorded in 2010[39]. This growth reflects not merely the expansion of individual agency budgets but a deliberate strategic commitment, embedded in successive administrations' science and technology policy, to the university sector as the primary area of fundamental knowledge generation in the American innovation system. The four agencies that dominate the federal university research funding landscape are distinguished not only by their budget scale but by the distinct collaboration mechanisms each deploys. Their principal characteristics, together with the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) cross-agency programmes and University-Affiliated Research Centres, are summarised in Table 2.

[39] National Center for Science and Engineering Statistics. Higher education research and development: Fiscal year 2024. Table 16. Federally financed higher education R&D expenditures ranked by FY 2024 (NSF 26-304). U.S. National Science Foundation, 2025b. URL: https://ncses.nsf.gov/pubs/nsf26304/assets/data-tables/tables/nsf26304-tab016.pdf

Table 2

**Principal federal instruments supporting university research and university-industry collaboration (FY 2025)**

| Agency | FY 2025 R&D budget | Primary research mission | Key university-facing instruments | University-industry collaboration mechanism |
|---|---|---|---|---|
| NSF – National Science Foundation | $7.0B[40] | Fundamental research across all Science and Engineering (S&E) disciplines; cross-disciplinary grand challenges | Investigator grants; Convergence Accelerators (time-limited, use-inspired research programmes organised around specific national challenges such as quantum sensing or AI, requiring industry partnership at Phase II); NSF Engines (CHIPS Act, up to USD 160M per region)[41] | Convergence Accelerator Phase II requires industry co-funding; NSF STTR mandates university-SME collaboration |
| NIH (National Institutes of Health) | $48.8B[42] | Biomedical and health research; translational medicine; clinical trials | R01 investigator grants (the NIH's primary competitive research award to university-based scientists) and R01-equivalent mechanisms; CTSA (Clinical and Translational Science Awards) consortium (60+ academic medical centres); NCATS (National Center for Advancing Translational Sciences) translational awards [43] | NCATS bridges basic discovery to clinical application; industry-funded clinical trials at CTSA sites |

[40] National Center for Science and Engineering Statistics. Survey of federal funds for research and development: Fiscal years 2024–25. U.S. National Science Foundation, 2025a. URL: https://ncses.nsf.gov/surveys/federal-funds-research-development

[41] U.S. National Science Foundation. Convergence Accelerator. n.d. URL: https://www.nsf.gov/funding/initiatives/convergence-accelerator

[42] National Center for Science and Engineering Statistics. Federal funds for research and development: Fiscal years 2024–25 (NSF 26-316). U.S. National Science Foundation, 2026. URL: https://ncses.nsf.gov/surveys/federal-funds-research-development/2024-2025

[43] National Center for Science and Engineering Statistics. Higher education research and development…, 2025b.

Table 2 (continuance)

| | | | | |
|---|---|---|---|---|
| DARPA – Defense Advanced Research Projects Agency | ~$4.5B[44] | High-risk, high-reward research for national security; mission-driven programme management | Programme-manager-defined solicitations; university performers as primary contractors or subcontractors [45] | Rapid technology hand-off to defence contractors; DARPA Xplorer programme for spin-off formation |
| DOE Office of Science - Department of Energy | $16.9B | Basic energy sciences; large-scale research infrastructure; computing and materials | National laboratory user facilities (synchrotrons, neutron sources, supercomputers); joint university–national lab agreements | Cooperative Research and Development Agreements (CRADAs) between national labs and industry, with university sub-awards |
| SBIR (Small Business Innovation Research) / STTR (Small Business Technology Transfer) – all 11 agencies | Set-aside from each agency's extramural budget[46] | Seed funding for SME-led R&D; technology commercialisation from proof-of-concept to market | Phase I (feasibility): up to $314K. Phase II (full R&D): up to $2.1M. STTR mandates ≥30% university work | Bridges the "valley of death"; mandates university-SME collaboration under STTR |
| UARCs – (Univerity–affiliated research centres) | $1.5B (FY 2021, growing)[47] | Mission-specific contract R&D for the Department of Defense (DoD) and the Department of Energy (DOE); sustained institutional partnerships | Long-term strategic agreements; DoD/DOE-sponsored labs (e.g. Applied Physics Laboratory (APL), MIT Lincoln Lab, Georgia Tech Research Institute) | Mission responsibility embedded in university; government operational needs met through academic capacity |

*Sources:*[48;49,50]*. Figures are projected FY 2025 obligations unless otherwise noted*

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[44] Congressional Research Service. Federal research and development (R&D) funding: FY2025 (R48307). 9 December 2024a. URL: https://www.congress.gov/crs-product/R48307

[45] Azoulay P., Fuchs E. R. H., Goldstein A. P., Kearney M. Funding breakthrough research: Promises and challenges of the "ARPA model". Innovation Policy and the Economy. 2019. Vol. 19, № 1. P. 69–96. DOI: https://doi.org/10.1086/699933

[46] Congressional Research Service. Small business research programs: SBIR and STTR (R43695). U.S. Congress. 2024b. URL: https://www.congress.gov/crs-product/R43695

[47] Pece C. V. National Center for Science and Engineering Statistics. Federal funding to university affiliated research centers totaled $1.5 billion in FY 2021 (NSF 24-315). U.S. National Science Foundation, January 16, 2024. URL: https://ncses.nsf.gov/pubs/nsf24315

[48] National Center for Science and Engineering Statistics. Survey of federal funds…, 2025a.

As Table 2 illustrates, the four agencies differ not only in scale but in their fundamental logic of university engagement. NSF and NIH operate through investigator-initiated competitive grants, leaving research direction largely to the academic community. DARPA inverts this model, with programme managers defining the challenge and universities competing to solve it. DOE's Office of Science adds a fourth modality – shared large-scale infrastructure, in which the university is a user rather than a primary performer. The SBIR/STTR programs span all four agencies. They require universities to work with small firms and direct public funding to the "valley of death" – the stage in the innovation process where a technology has been proven in the laboratory but not yet attracted private investment because is still too risky for investors and too practical for research grants. This is the point where market failure is the strongest, and public support brings the greatest social benefit[51].

UARCs represent a fifth, less visible category: long-term mission contracts that embed university research capacity directly within government operational needs, with federal obligations reaching $1.5 billion in FY 2021 and growing every year since[52]. The effectiveness of each modality is conditioned by the phase of the innovation process it targets. Investigator-initiated grants (NSF, NIH) are most productive at the basic research stage, where the university's comparative advantage (where universities are structurally best positioned for open-ended inquiry) in open-ended inquiry is highest and where mission-direction would prematurely narrow the solution space. Mission-directed funding (DARPA) is most effective at the applied stage, where a defined challenge can mobilise university capabilities without sacrificing their flexibility. The SBIR/STTR instruments serve a different purpose from the research grants above: rather than funding the production of new knowledge, they correct a structural gap in private investment – the fact that venture capitalists consistently underfund technologies that have left the laboratory but have not yet reached the level of development that commercial investors require, which is why their architecture mandates collaboration rather than merely incentivising it. Seen through the triple-

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[49] Congressional Research Service. Federal research and development (R&D) funding: FY2025 (R48307). 9 December 2024a. URL: https://www.congress.gov/crs-product/R48307

[50] National Center for Science and Engineering Statistics. Higher education research and development…, 2025b.

[51] Congressional Research Service. Small business research programs: SBIR and STTR (R43695). U.S. Congress. 2024b. URL: https://www.congress.gov/crs-product/R43695

[52] Pece C. V., National Center for Science and Engineering Statistics. Federal funding to university affiliated research centers totaled $1.5 billion in FY 2021 (NSF 24-315). U.S. National Science Foundation, January 16, 2024. URL: https://ncses.nsf.gov/pubs/nsf24315

helix lens, the federal funding architecture can be read as a division of labour among the three helices: government sets priorities and corrects market failures; universities generate and validate knowledge; industry absorbs and commercialises it. The most resilient ecosystems are those in which all three modalities are present simultaneously, because they cover the full innovation process from basic discovery to market deployment.

**2.2. State-level innovation policy**

Federal programmes establish the national framework of university research investment, but it is at the state level that the most direct and targeted university-industry partnership instruments are typically deployed. States have powerful motivations for investing in university-led innovation: regional economic development, job creation, the attraction and retention of high-technology industry, and the cultivation of human capital. They also have a proximity to regional industrial structure and labour market conditions that federal agencies, operating at national scale, cannot match. The result is a diverse and, in some respects, more experimentally innovative layer of policy that complements federal instruments rather than duplicating them.

The Ohio Third Frontier programme, established in 2002 as a bond-funded economic development initiative and sustained through successive voter referenda, is among the most extensively evaluated state innovation programmes in the United States. Operating through the Ohio Department of Development, Third Frontier combines investment in university research infrastructure with direct support for technology-based startups through its Technology Validation and Start-up Fund (TVSF). The TVSF provides competitive grants of $200,000 to early-stage companies licensing technologies developed at Ohio research institutions, with sequential grant funding stages Phase 1 awards supporting proof-of-concept validation and Phase 2 awards supporting commercialisation and product development[53,54]. The program's wider ecosystem approach is just as important. Third Frontier has steadily invested in pre-seed funds, services for entrepreneurs, and through the Ohio Innovation Exchange – in a shared online platform that lets industry search the research expertise of faculty across ten Ohio universities. This makes it easier to spot potential partnerships, which is often the hardest step in university-industry collaboration.

[53] Ohio Department of Development. State funding now available to bring new technologies to market. April 25, 2025. URL: https://www.publicnow.com/view/FA3C032E10C767AF353E8FE154E4E06360733DFC

[54] Ohio State University. Startups commercializing Ohio State technologies receive TVSF Phase 2 funding. Ohio State Impact, November 17, 2025. URL: https://impact.research.osu.edu/story/ohio-state-startups-receive-tvsf-phase-2-funding

New York's approach centres on the SUNY Research Foundation, the non-profit corporation that manages intellectual property, contracts, and industry partnerships across the sixty-four-campus State University of New York system. By creating a single institutional interface for industry partners, the Research Foundation substantially reduces the search and negotiation costs that discourage smaller firms from initiating academic partnerships. This cost reduction is especially important in a multi-campus system, where different contract templates and IP rules would otherwise create heavy barriers[55,56]. The state has complemented this system-level coordination through the New York State Energy Research and Development Authority (NYSERDA) and the Empire State Development Corporation, channelling resources into clean energy, semiconductor manufacturing, and life sciences.

Texas presents a third model, emphasising large-scale direct investment in university research capacity as a regional economic development instrument. The Texas Enterprise Fund has historically conditioned grants and loans to businesses on commitments to partner with Texas universities in research or workforce development[57,58]. Even more important is the state's Permanent University Fund – an endowment of over $30 billion from mineral rights on public lands, set by the constitution for the University of Texas and Texas A&M systems. Together these two largest university networks include more than 30 schools and about 280,000 students. The fund gives them a stable base for research investment that most public universities don't have, and it creates the conditions for partnerships like the Dell Medical School to grow and succeed.

A critical observation across these state-level cases is that the most effective programmes are not simply grant distribution mechanisms; they are ecosystem orchestrators. Ohio Third Frontier's explicit aim, articulated by its founders, was to "create a culture of collaboration among Ohio businesses and research institutions that lasts beyond the funding". That is a goal that reflects an understanding that the durable outputs of state innovation

[55] Howells J. Intermediation and the role of intermediaries in innovation. Research Policy. 2006. Vol. 35, No. 5. P. 715–728. DOI: https://doi.org/10.1016/j.respol.2006.03.005

[56] Research Foundation for the State University of New York. Sponsored programs administration. n.d. URL: https://www.rfsuny.org/our-work/sponsored-programs-administration/

[57] Texas Economic Development Corporation. Texas Enterprise Fund program. Texans.org, n.d. URL: https://www.texans.org/enterprise-fund/

[58] University of Texas/Texas A&M Investment Management Company. Permanent University Fund (PUF). n.d. URL: https://www.utimco.org/funds-managed/endowment-funds/permanent-university-fund-puf/

investment are relational and institutional, not merely financial[59]. In other words, the primary value of public investment in university-industry collaboration may be the trust, the shared vocabulary, and the cross-sectoral networks it builds rather than the specific innovations it funds. This insight has direct implications for systems, including those of Ukraine, that are designing innovation policy under severe resource constraints.

### 2.3. Regulatory and IP frameworks as enablers

Government shapes university-industry ecosystems not only through funding but through the legal and regulatory infrastructure within which research, IP, and personnel can move. Two frameworks are of primary importance in the American context: the Bayh-Dole Act's implementation practice, and the export control regime governing dual-use research. Both have significant implications for international partnerships and, by extension, for universities in other countries seeking to build collaborative relationships with American institutions.

Bayh-Dole's cumulative impact since 1980 is now extensively documented. According to the Association of American Universities (AAU) and the ITIF (Information Technology and Innovation Foundation), academic technology transfer under the Act has contributed over $1.9 trillion to U.S. gross industrial output between 1996 and 2020, generated more than 4.2 million jobs, and supported the formation of over 11,000 startup companies[60]. In 2024 alone, university technology transfer offices executed over 9,500 licences and helped launch approximately 950 new startup companies (an average of three new companies and two new products entering the market every working day)[61,62].

The Act's implementation has, however, evolved considerably from its original intent. Leading technology transfer offices now judge each invention based on its commercial potential instead of automatically filing a patent. A related debate concerns the Act's "march-in rights" provision – a rule that allows the federal government to step in and require a university or its licensee to make a federally funded invention available to additional parties if the current licence holder is not making real efforts to bring it

[59] Ohio's polymer industry adds jobs, strengthens economy. MRS Bulletin, vol. 37, no. 6, pp. 526–527, 2012. Published by the Materials Research Society via Cambridge University Press. URL: https://www.cambridge.org/core/journals/mrs-bulletin

[60] Ibid, p. 527.

[61] Association of University Technology Managers. U.S. licensing activity survey infographic. 2024b. URL: https://autm.net/AUTM/media/SurveyReportsPDF/2024-US-AUTM-Infographic.pdf

[62] Bayh-Dole Coalition. Impact of the Bayh-Dole Act and academic technology transfer. February 2025. URL: https://bayhdolecoalition.org/wp-content/uploads/2025/02/Impact-of-the-Bayh-Dole-Act-and-Academic-Technology-Transfer.pdf

to market. Industry groups and university associations have argued strongly against expanding the use of this provision, on the grounds that the threat of government intervention would discourage companies from investing in the further development of licensed university technologies in the first place.

The regulatory framework governing dual-use research presents a different set of challenges. The International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR) control the transfer of technologies, equipment, and information with potential military or national security applications.[63,64] The "*fundamental research exclusion*" (a provision in U.S. export control law that exempts basic and applied university research from export licensing requirements, provided the results are intended for open publication and are not subject to access or publication restrictions) protects the great majority of university research from ITAR /EAR compliance burdens, but its boundaries are increasingly blurred as AI, quantum computing, and advanced materials research intersects with national security concerns. Researchers note that American universities engaged in such domains face growing scrutiny of their collaborative arrangements with foreign partners, including disclosure requirements and in some cases restrictions on the participation of researchers affiliated with certain foreign institutions.[65] For Ukrainian universities, this landscape has a dual significance: the current geopolitical context creates favourable conditions for defence-related and dual-use research collaboration with American partners. But U.S. rules under ITAR/EAR mean Ukrainian institutions must build real capacity for export control governance. Meeting this requirement shows the level of institutional maturity that American partners expect.

The broader lesson from this section is one that the funding data and the state-level case studies confirm: government is most effective as an ecosystem builder when it acts simultaneously as investor, convener, and rule-setter, and when the rules it sets are sufficiently clear and stable to reduce transaction costs without being so prescriptive as to eliminate the flexibility genuine innovation requires. The American system is imperfect on all three dimensions; but its imperfections are, for the most part, those of a system that has been learning and adapting for more than four decades, rather than those of a system that has not yet begun.

[63] International Traffic in Arms Regulations, 22 C.F.R. §§ 120–130. 2025.

[64] Export Administration Regulations, 15 C.F.R. §§ 730–774. 2025.

[65] Atkinson R. D. The Bayh-Dole Act's role in stimulating university-led regional economic growth. Information Technology and Innovation Foundation. 16.06.2025. URL: https://itif.org/publications/2025/06/16/bayh-dole-acts-role-in-stimulating-university-led-regional-economic-growth/

The funding mechanisms and regulatory frameworks examined above determine the conditions under which university-industry collaboration is possible. The network platforms, technology transfer instruments, and entrepreneurial infrastructure examined in this section determine whether that potential is actually realised.

### 2.4. Consortia, associations, and inter-university networks

No single university can internalise all the knowledge and practice relevant to managing a mature innovation ecosystem. The American higher education system has responded to this limitation by developing a dense infrastructure of professional associations and inter-university consortia that circulate expertise, establish standards, and create shared platforms for collaboration that individual institutions could not afford to build independently.

The Association of University Technology Managers (AUTM), with more than 3,200 members across 800 universities, research centres, hospitals, businesses, and government organisations worldwide, is the pre-eminent professional association in the technology transfer field[66].

Its most consequential contribution to the ecosystem is the annual Licensing Activity Survey and the associated STATT (Statistics Access for Technology Transfer) database: with over 30 years of longitudinal data on invention disclosures, patent applications, licences, startup formations, and licensing revenues, STATT enables TTOs to benchmark their performance against peers and make evidence-based arguments to institutional leadership about the returns to investment in commercialisation capacity. The database acts as shared knowledge infrastructure, helping reduce the information gap between well-resourced technology transfer offices and smaller, less experienced ones. This role is often overlooked but is a key function of the network.

The Big Ten Academic Alliance (BTAA), now comprising 18 member institutions following its 2024 expansion, is governed and funded directly by the provosts of its member universities and oriented towards shared academic infrastructure: reciprocal library access, the OmniPoP fibre optic research network connecting members to global research hubs, and leadership development programmes that build inter-institutional collaboration competencies at scale[67]. Its importance for innovation ecosystems is indirect but real. By lowering the cost of collaboration between universities through shared infrastructure, the Alliance makes it easier to launch cross-institutional research programs and talent exchanges

[66] AUTM. Who we are. n.d.(a). URL: https://autm.net/about-autm/who-we-are

[67] Big Ten Academic Alliance. International programs and professional development. 2026. URL: https://btaa.org/

that are the foundation of multi-university research parks and consortia. The Association of Public and Land-grant Universities (APLU) extends this network logic internationally, facilitating joint research, faculty exchange, and institutional capacity-building between American public research universities and counterpart institutions across Africa, Latin America, Asia, and Europe[68]. For Ukrainian universities aiming to join the global research ecosystem, APLU's network of public land-grant institutions offers a more accessible entry point than elite private universities. With their public-service mission, applied research focus, and commitment to regional development, these institutions align structurally with Ukrainian priorities and provide a practical path into international collaboration.

### 2.5. Technology transfer: practical instruments of commercialisation

The technology transfer process (from researcher disclosure to market-ready product) involves a sequence of specialised decisions and legal instruments that experienced TTOs have refined over decades and that less experienced offices consistently underestimate in complexity. The process begins with invention disclosure: formal notification by a researcher that a potentially patentable invention has been made. Disclosure quality is the single most important determinant of commercialisation success, yet it is the step most neglected in institutional capacity-building. As reported by Chen et al., at leading institutions, 70-80 percent of disclosures are returned without further action as either non-patentable or commercially unviable. For those that proceed, the TTO must decide between provisional and full patent prosecution, domestic and international filing strategies, and whether to pursue prosecution independently or in partnership with a potential licensee[69].

The choice between exclusive and non-exclusive licensing is among the most consequential decisions a TTO makes. An exclusive licence gives one company the sole right to commercialize a technology, usually in return for upfront fees, annual payments, and royalties. This option is preferred when the technology still needs major development, since companies will only invest heavily if they know competitors can't benefit from their work. A non-exclusive licence, on the other hand, lets multiple parties use the same technology at once. That's the better choice when wide adoption matters more than one firm's success, or when universities want to ensure broad public access. In practice, the choice is rarely binary. The literature indicates that leading technology transfer offices often use tailored middle-ground

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68 Association of Public and Land-grant Universities. (n.d.). Supporting international programs. URL: https://www.aplu.org/our-work/3-deepening-community-economic-engagement/supporting-international-programs/

69 Chen Z. et al.The evolving role of technology transfer offices…, 2025.

licensing strategies. For example, they may grant an exclusive licence only for a specific field of use, keeping rights in other sectors. They can add milestone clauses that switch an exclusive licence to non-exclusive if the company fails to meet development goals. Or they combine commercial exclusivity with retained rights for research and teaching[70,71]. Material transfer agreements (MTAs), governing the transfer of biological or chemical materials between institutions for research purposes, represent a second category of instrument that in transaction volume exceeds patent licensing but receives far less policy attention. The NIH-developed Uniform Biological Material Transfer Agreement (UBMTA), adopted by over 600 institutions, has substantially reduced the negotiation friction that previously delayed collaborative research for months. Similar standardisation efforts are underway for software and data transfer agreements, as noted by researchers[72,73].

Spin-off company formation is the most visible output of the technology transfer system. Leading technology transfer offices now run founder support programs that bridge the gap between starting a company and raising venture capital. These programs include entrepreneurship training, mentoring networks, proof-of-concept funds, and introductions to early-stage investors. According to AUTM's FY 2023 Licensing Activity Survey, universities reported 1,094 new startup companies in a single year, more than four spin-offs every working day. They also recorded 13,099 new licences and options, along with 9,562 active licences[74].

### 2.6. Startup ecosystems within universities

Technology transfer handles the legal and financial side of commercialisation; the startup ecosystem handles the human side. A university with strong patent licensing capabilities but no entrepreneurship education, no mentoring, no early-stage funding, and no investor relationships will still fail to turn its research into viable companies.

[70] Association of University Technology Managers. Technology transfer practice manual. 4th ed. AUTM, 2019. URL: https://autm.net/surveys-and-tools/tech-transfer-practices-manual/

[71] Lach, S., Schankerman, M. Incentives and invention in universities. The RAND Journal of Economics. 2008. Vol. 39, no. 2. Pp. 403–433. DOI: https://doi.org/10.1111/j.0741-6261.2008.00020.x

[72] Campbell E. G., Clarridge B. R., Gokhale M., Birenbaum L., Hilgartner S., Holtzman N. A., Blumenthal D. Data withholding in academic genetics. *JAMA*. 2002. Vol. 287, No. 4. P. 473–480. DOI: https://doi.org/10.1001/jama.287.4.473

[73] National Institutes of Health. Uniform Biological Material Transfer Agreement finalized (NIH Guide, Vol. 24, No. 14). April 14, 1995. URL: https://grants.nih.gov/grants/guide/notice-files/not95-116.html

[74] AUTM. 2023 U.S. licensing activity survey, 2024.

The American university startup ecosystem addresses each of these gaps through a layered set of instruments.

MIT's *delta v* accelerator accepts 20–25 student teams each summer for a programme of customer validation, business model development, and mentored milestone-setting. Each team receives up to $ 75,000 in funding and over $ 200,000 in partner resources without surrendering any equity[75,76]. The no-equity model, which aligns the accelerator's interests directly with the founders', distinguishes university-affiliated programmes from commercial accelerators and is directly relevant to institutions operating under resource constraints. The results are strong: 61 percent of *delta v* alumni companies remain active or have been acquired, and teams have collectively raised more than $1 billion in follow-on funding.

Two further instruments address the funding gap between laboratory discovery and institutional investment. Proof-of-concept funds-grants of $25,000 to $250,000 help show whether a technology is feasible before formal engagement with a technology transfer office. A.Goldstein and V. Narayanamurti claim that these funds greatly increase the chances that a discovery will be licensed, attract co-investment, and lead to a spin-off company[77]. Alumni angel networks at institutions like MIT and Stanford have collectively deployed hundreds of millions of dollars at the pre-institutional stage, bridging the gap that venture capital does not cover. The Dorm Room Fund takes this idea further: it's a student-run seed fund across 12 campuses where students, not professional VCs (venture capitalists), make the investment decisions. This directly reduces the information gap that often disadvantages early-stage university startups in formal funding processes[78,79]. T. Kene-Okafor argues that *Y Combinator's September* 2025 "Early Decision" track (a specialized application pathway aimed directly at college students and recent graduates allowing students to secure funding while still enrolled and defer participation until after

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[75] Martin Trust Center for MIT Entrepreneurship. MIT delta v 2024 info session presentation. Massachusetts Institute of Technology. 2024. URL: https://entrepreneurship.mit.edu/wp-content/uploads/MIT-delta-v-2024-Info-Session-Presentation.pdf

[76] Martin Trust Center for MIT Entrepreneurship. MIT delta v accelerator. Massachusetts Institute of Technology. 2026. URL: https://entrepreneurship.mit.edu/accelerator/program/

[77] Goldstein A. P., Narayanamurti V. Simultaneous pursuit of discovery and invention in the US Department of Energy. *Research Policy*. 2018. Vol. 47, No. 8. P. 1505–1512. DOI: https://doi.org/10.1016/j.respol.2018.05.005

[78] Dorm Room Fund. The original student venture fund. n.d.(a). URL: https://www.dormroomfund.com/

[79] Dorm Room Fund. Dorm Room Fund 5-year report. 2017. URL: https://5years.dormroomfund.com/

graduation) removes the long-standing barrier that forced student founders to choose between finishing their degree and building their company[80].

The broader lesson is practical. A startup ecosystem is not a single programme but a sequence of them: entrepreneurship education first, proof-of-concept funding second, incubation third, investor relationships last. This order reflects not just resource logic but the actual developmental stages a founder moves through from first idea to fundable venture.

## 3. Outcomes, challenges, and implications for Ukraine

The preceding sections have examined the institutional mechanics of university-state-business collaboration: the funding architecture, the partnership typology, the technology transfer workflow, and the entrepreneurial infrastructure. This final section widens the analytical lens. It asks what these mechanisms produce beyond patents, licences, and startup companies, what they contribute to regional economies, to global research networks, and to the social fabric of the communities in which universities are embedded. It then turns to the forward-looking challenges that the American model itself has not fully resolved, and to the implications of the whole analysis for Ukrainian universities navigating post-war reconstruction and accelerating European integration.

### 3.1. Social and regional development impact of university-state-business partnerships

The economic impact of research universities on their host regions is both large and structurally distinctive. According to the most comprehensive recent assessment which is the Urban Institute's analysis of the Federal Reserve Bank of Philadelphia's Anchor Economy Dashboard, drawing on 2024 data across 524 regions, anchor institutions (universities and hospitals combined) add on average \$4.3 billion to local GDP (gross domestic product), \$3.1 billion in personal income, and more than 37,500 jobs per region. In total, anchor institutions contributed more than \$2.2 trillion to the U.S. economy in 2024[81,82]. At the individual institution level,

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[80] Kene-Okafor T. Y Combinator launches "Early Decision" for students who want to graduate first, build later. TechCrunch, September 24, 2025. Available at: https://techcrunch.com/2025/09/24/y-combinator-launches-early-decision-for-students-who-want-to-graduate-first-build-later/

[81] Diamond D., Dunne T., Scavette A. Eds and meds: Variability of anchor institution employment impacts across U.S. regions. Federal Reserve Bank of Philadelphia. May 2026. DOI: https://www.philadelphiafed.org/community-development/workforce-and-economic-development/eds-and-meds-variability-of-anchor-institution-employment-impacts-across-us-regions

[82] Federal Reserve Bank of Philadelphia. Anchor Economy Dashboard. 2026. URL: https://fedcommunities.org/data-tools/anchor-economy-dashboard/

the compounding effects of research expenditure on regional employment are substantial: a 2024 study published in Studies in Higher Education finds that $1 million in external university research expenditure is associated with $711,000 in regional value added, ten jobs, and $ 159,000 in tax revenue in micropolitan areas, with effects per million dollars typically larger in metropolitan settings[83].

These overall figures, however, conceal a distribution of benefits that is considerably less equitable than the headline numbers suggest. The employment and wage premiums associated with research cluster formation are concentrated among workers with post-secondary qualifications, since they are best able to get the high-skill jobs created by university-anchored innovation ecosystems. The benefits for communities with less education – from local buying, indirect employment, and infrastructure investment – are real but much smaller. They can shrink even more when rising land prices and living costs in research cluster areas push out lower-income residents. The anchor institution strategy in U.S. urban policy was created to deal with this fairness problem. It seeks to leverage the university's purchasing power, hiring practices, and community engagement capacity – rather than solely its research and entrepreneurship functions – to generate broadly shared local economic benefit[84].

Community Benefit Agreements (CBAs) are legal contracts between universities and community groups. They require the university to meet local hiring goals, set aside purchases for minority-owned businesses, contribute to affordable housing, and invest in workforce training, in return for planning approval or public funding. According to researchers, they represent the most explicit institutional mechanism for operationalising this strategy[85,86]. The NCRC's 2026 analysis of anchor institution workforce initiatives across U.S. regions documents the emerging consensus around four principles for effective anchor-driven community development: focused help for low- to middle-income populations; full support services to remove

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[83] Apriesnig J., Connolly L., Xavier-Oliveira E., Halvorsen K. E. Regional economic impact of university research expenditures. *Studies in Higher Education.* 2024. DOI: https://doi.org/10.1080/03075079.2024.2376262

[84] Harris M. S., Holley K. A. Universities as anchor institutions: Economic and social potential for urban development. In: Paulsen M. B. (Ed.). *Higher education: Handbook of theory and research.* Vol. 31. Springer, 2016. P. 393–439. DOI: https://doi.org/10.1007/978-3-319-26829-3_8

[85] Meagan, M. E. Neighborhood Revitalization and the Anchor Institution: Assessing the Impact of the University of Pennsylvania's West Philadelphia Initiatives on University City. *Urban Affairs Review,* 2015, Vol. 52, No. 5. DOI: https://doi.org/10.1177/1078087415601220

[86] Puckett J. L. The West Philadelphia initiatives. In: West Philadelphia Collaborative History. University of Pennsylvania Graduate School of Education, n.d. URL: https://collaborativehistory.gse.upenn.edu/stories/west-philadelphia-initiatives

barriers to programme completion; integration of workforce development with procurement and small business support; and multi-anchor coordination to expand reach and create more varied opportunities[87,88].

For Ukrainian universities thinking about their role in rebuilding regions after the war, the "anchor institution" model is highly relevant. Universities in regions affected by conflict-driven displacement, industrial destruction, and population loss are often the most stable institutions left and precisely fulfil the kind of anchor function that the American literature describes. The strategic question is not whether Ukrainian universities should play an anchor role in regional recovery, but how they can mobilise the partnership instruments, community engagement practices, and institutional governance arrangements that make anchor strategies effective rather than merely hopeful ideas.

### 3.2. International integration: global research networks and joint projects

University innovation ecosystems do not stop at national borders. The most productive knowledge-generation environments in the contemporary world are those with the densest and most diverse international connections. These connections bring together different disciplinary traditions, experimental infrastructure, regulatory contexts, and cultural perspectives creating useful tension. American research universities have historically been among the most internationally connected in the world, and the instruments through which they build and sustain these connections offer instructive models for institutions in other higher education systems.

The NSF's Partnerships for International Research and Education (PIRE) programme, operating since 2005, is the primary federal instrument for supporting international collaborative research involving U.S. universities. PIRE awards fund projects in which advances in research and education could not occur without international collaboration. The selection criteria for the programme clearly state that international partnership is a scientific need, not just a strategic choice[89,90].

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[87] Harris M. S., Holley K. A. Universities as anchor institutions…, 2016.

[88] Mollett D. Economic mobility on the ground: How anchor institutions invest in workforce development. National Community Reinvestment Coalition. March 9, 2026. URL: https://ncrc.org/economic-mobility-on-the-ground-how-anchor-institutions-invest-in-workforce-development/

[89] National Science Foundation. Partnerships for International Research and Education (PIRE) (NSF 16-571). 2016. URL: https://nsf-gov-resources.nsf.gov/solicitations/pubs/2016/nsf16571/nsf16571.pdf

[90] National Science Foundation. NSF announces 14 new PIRE awards to support scientific collaboration in 24 countries. *EurekAlert!*, September 13, 2017. URL: https://www.eurekalert.org/news-releases/816419

PIRE's active partnerships span 24 countries and cover the full spectrum of NSF-supported disciplines. Its significance as a model lies not in its budget scale, which is modest relative to the other major federal research programmes, but in its institutional logic: it treats international collaboration not as a diplomatic gesture but as an epistemological requirement, a claim about what kinds of knowledge problems can only be addressed through globally distributed research teams. Ukraine's international research integration has accelerated since 2022 through multiple parallel tracks. The association of Ukraine to Horizon Europe, which entered into force on 9 June 2022 and grants Ukrainian research and innovation actors full participation rights on equal terms with EU Member States, with retroactive application from 1 January 2021, represents the single most significant structural development in Ukrainian research internationalisation in decades[91,92]. The European Commission opened a Horizon Europe office in Kyiv in December 2023, tasked with actively promoting EU funding opportunities and supporting Ukrainian researchers. In July 2025, the Commission, together with Ukraine, Italy, and UNESCO, launched the International Coalition for Science, Research and Innovation in Ukraine as a multi-stakeholder initiative explicitly framed as a pillar of Ukraine's modern and sustainable recovery[93]. Germany's bilateral science cooperation agreement, signed in October 2024, commits more than €100 million to Ukrainian university cooperation by 2029, including a German-Ukrainian University Network established from July 2025 with €24 million in funding for joint degree programmes and digital teaching infrastructure[94.95].

The USA-Ukraine bilateral science and technology relationship has a longer but more intermittent history. A Science and Technology Working Group was established following the 2010 U.S.–Ukraine Strategic Partnership

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[93] European Commission. International coalition launched to support Ukraine's research and innovation ecosystem. 11 July 2025b. URL: https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/international-coalition-launched-support-ukraines-research-and-innovation-ecosystem-2025-07-11_en

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[95] German Federal Ministry of Research, Technology and Space. German-Ukrainian University Network. 2025. URL: https://www.bmbf.de

Commission, but its last formal meeting was held in 2012. Since then, the relationship has been mediated primarily through multilateral channels such as NATO science programmes, USAID higher education partnerships, and the Science and Technology Center in Ukraine, rather than through a dedicated bilateral research collaboration framework[96,97]. The most significant recent development on the U.S. side is the Science and Innovation Fund for Ukraine, convened by the National Academy of Sciences, the Simons Foundation, and ETH Zürich following a March 2024 meeting of international experts, which aims to provide near-term support to the Ukrainian research community and build the framework for a long-term innovation ecosystem based on science and commercialisation[98,99]. For Ukrainian universities seeking to engage with American research universities through PIRE, NSF, or bilateral arrangements, the U.S. experience shows that durable collaboration rests on shared research infrastructure, co-supervised doctoral students, and joint publications. These forms of relational capital endure beyond political fluctuations and provide the only stable foundation for systemic university-state-business cooperation.

### 3.3. Challenges and prospects for ecosystem development

The American model has generated extraordinary innovation outputs over four decades. It has also generated persistent inequities, governance failures, and value conflicts that its most thoughtful practitioners acknowledge and that institutions in other systems should not import uncritically.

The tension between commercialisation and open science is the most fundamental. The Bayh-Dole Act's grant of IP ownership to universities has generated undeniable commercialisation benefits, but it has also created institutional incentives that can distort the allocation of research effort, delay the publication of findings, restrict the sharing of research materials, and divert faculty time and attention from teaching and basic research towards the management of licensing relationships and startup ventures. Researchers note that the most harmful expression of this tension occurs in the biomedical

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[98] National Academy of Sciences. Science and Innovation Fund for Ukraine. The National Academies of Sciences, Engineering, and Medicine, 2024. URL: https://www.nationalacademies.org/programs/PGA-PGA%20EO-24-02

[99] National Research Foundation of Ukraine. Representatives of the National Research Foundation of Ukraine joined the workshop on strengthening Ukraine's science and innovation system held in Zurich, Switzerland. March 17, 2025. URL: https://nrfu.org.ua/en/news-en/representatives-of-the-national-research-foundation-of-ukraine-joined-the-workshop-on-strengthening-ukraines-science-and-innovation-system-held-in-zurich-switzerland/

sciences: when universities or their licensees aggressively enforce patents on research tools such as cell lines, assay methods, or gene sequences, they impose transaction costs that slow downstream research and undermine the very progress the patent system is meant to encourage[100,101]. Researchers state that the open-science movement, exemplified by the U.S. OSTP's 2022 mandate for immediate public access to federally funded research, is a deliberate policy correction. Yet its relationship with technology transfer remains contested. It is argued that concerns about equity, specifically, who gains from the commercialization of publicly funded research, have intensified, fuelled by evidence of uneven revenue distribution and heightened public debate over pharmaceutical pricing. Resistance by AAU and industry groups to expanded Bayh-Dole march-in rights reflects this tension, as does the broader question of whether concentrated technology transfer activity in elite universities reinforces regional inequality rather than reducing it[102,103]. Thus, institutions designing technology transfer systems in other countries should consider from the outset how IP policies, revenue-sharing arrangements, and equity allocation conventions can be structured to maximise not only commercial returns but access to the publicly funded knowledge on which those returns ultimately rest.

Cybersecurity and IP protection in international collaborations represent a third challenge whose salience has grown substantially in the 2020s. The research security policies are responses to IP theft and research integrity violations that have occurred within ostensibly collaborative international research relationships[104,105,106]. For Ukrainian universities building

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[106] National Science Foundation. Important Notice No. 149: Updates to NSF research security policies. June 30, 2025. URL: https://www.nsf.gov/notices/important/important-notice-no-149-updates-nsf-research-security/in149

partnerships with American institutions, this security landscape has a dual character: on one hand, Ukraine's geopolitical alignment with the United States and its designation as a partner nation in U.S. national security strategy creates broadly favourable conditions for research collaboration, including in dual-use technology domains; on the other hand, the compliance requirements that American institutions must meet before engaging in collaborative research with foreign partners are substantial and require Ukrainian counterparts to develop institutional governance capacities including research security offices, IP management systems, export control awareness programmes that most Ukrainian universities do not yet possess at the required level of maturity.

The prospects for Ukrainian university ecosystem development are, despite these challenges, genuinely promising. The international coalition of support, the structural opportunity presented by Horizon Europe association, the bilateral investment commitments of Germany and other European partners, and the convening of the Science and Innovation Fund for Ukraine collectively represent a more substantial and better-coordinated international commitment to Ukrainian research infrastructure than any previous generation of post-conflict reconstruction has enjoyed. The American experience analysed across this paper suggests that the most important investments Ukrainian universities can make in the near term are not in physical infrastructure (which can be rebuilt) but in the relational and institutional infrastructure: the professional networks, the governance standards, the technology transfer competencies, and the entrepreneurial culture whose development takes time, sustained commitment, and deliberate institutional design. The lesson of the American model, at its best, is that university-state-business ecosystems are built not in decades but in generations, and that the decisions made in the founding period about governance, incentive alignment, and public mission shape the ecosystem's character and distribution of benefits for a very long time to come.

## CONCLUSIONS

The article has traced the architecture of university-state-business collaboration from its legislative foundations through to its operational instruments, social consequences, and international dimensions. Four transferable conclusions emerge. First, sustainable ecosystem collaboration requires governance architectures that align incentives, clarify decision rights, and balance commercial return with public-interest access: proximity, funding, and goodwill are necessary but not sufficient. No partner should be asked to sacrifice its core institutional identity – universities remain universities, firms remain firms – but each must be willing to extend beyond its traditional role. Second, the minimum viable institutional infrastructure comprises three interdependent units: a technology licensing office capable of genuine commercial triage rather than mere paperwork processing; an industry liaison function managing the relational dimension of university-industry engagement independently of specific IP transactions; and an entrepreneurship and incubation infrastructure providing the education, mentoring, proof-of-concept funding, and investor access that convert IP into viable ventures. Investing in only one or two of these elements, which is the common pattern under resource constraints, makes the missing unit the binding constraint on the institution's entire commercialisation performance.

Third, the policy instruments most immediately applicable to the Ukrainian context are those requiring relational investment rather than capital expenditure: participation in AUTM's benchmarking and professional development network; engagement with NSF's PIRE programme and the bilateral science cooperation frameworks that have proliferated since 2022; co-funded doctoral programmes that build the dual-supervision alumni networks through which tacit knowledge transfer occurs most effectively; and the IUCRC model of consortium-based pre-competitive research. Ukraine's association with Horizon Europe together with the European Research Area and Erasmus+ frameworks, provides the most immediate and best-resourced entry point into the international innovation ecosystem. These frameworks should be treated not merely as funding sources but as governance schools: participation in Horizon Europe consortia builds the IP negotiation, project management, and cross-cultural collaboration competencies that are prerequisites for deeper integration with American research partners and for the construction of domestic university-state-business ecosystems capable of anchoring Ukraine's post-war regional recovery.

Fourth, the American model should be adopted critically, not copied wholesale. Its inequities, such as technology transfer revenues concentrated in elite universities, research cluster benefits favoring high-skill workers, and the ongoing tension between commercialization incentives and open-science norms are structural consequences of its founding design choices, not incidental imperfections. Ukrainian policymakers designing ecosystems from the ground up have a rare opportunity to prioritise broad IP access, anchor institution strategies directed at conflict-affected regions, and revenue-sharing arrangements that return commercial gains to the public funders who made them possible. Future research should focus on the issues: which governance models work best in post-conflict reconstruction; whether digital collaboration tools can replicate the co-location effects such as serendipitous encounters and informal knowledge flows that drive research park productivity; how the sequencing of ecosystem investments changes when reconstruction coincides with European integration. These are questions that Ukrainian researchers are uniquely positioned to address.

**SUMMARY**

The underdevelopment of structural partnerships between universities, government bodies, and private-sector actors represents one of the most persistent barriers to innovation capacity in higher education systems worldwide, and an acute challenge for universities rebuilding in post-conflict environments. Drawing on the triple-helix model of university-industry-government interaction and on recent empirical advances in innovation ecosystem theory, the article examines the institutional architecture and practical instruments through which American research universities have built some of the world's most productive multi-actor innovation ecosystems.

The analysis maps five interconnected layers of this architecture: the historical and institutional formation of the American research university as an innovation ecosystem; the federal and state-level government support mechanisms; the forms and governance models of business-university alliances; the connective infrastructure of technology transfer offices, professional networks, accelerators, and startup ecosystems that translate research outputs into commercial ventures; and the broader social and regional development impact of these partnerships, including their international dimensions and the governance challenges they generate.

The paper shows that sustainable innovation ecosystems emerge not from institutions working at their individual capacities. They emerge when networks build strong, diverse, and embedded relationships that create collaborative value that no single actor could achieve alone. The research also highlights that the most effective public investment in university-industry collaboration lies in building relational and institutional infrastructure, which are trust, shared governance, and cross-sector professional networks, rather than focusing solely on physical or financial assets.

The paper highlights that for Ukrainian universities, the most transferable policy tools are those built on relationships rather than large capital spending. Examples include consortium-based research programs modeled on the IUCRC, co-funded doctoral schemes that strengthen alumni networks, and active participation in communities like AUTM benchmarking and the NSF PIRE international partnership framework. Ukraine's full association with Horizon Europe since June 2022, along with the European Research Area and Erasmus+ programmes, are not just funding channels. They are governance learning environments where universities can build skills in IP negotiation, project management, and cross-cultural collaboration that are competencies essential for creating a systemic university-state-business ecosystem capable of driving post-war regional recovery.

The paper concludes with four transferable principles. First, governance architecture must precede and enable all other ecosystem investments. Second, the minimum viable infrastructure includes a technology licensing office, an

industry liaison, and an integrated entrepreneurship unit. Third, the distributional consequences of ecosystem design – who benefits from publicly funded knowledge and on what terms – should be set at the founding stage. Finally, urgent research questions such as post-conflict governance, digital co-location, and investment sequencing under European integration are areas where Ukrainian scholars are uniquely positioned to lead.

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