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University-Industry Integration Policies and Practices in China - Potential Applications in Hungary

Draft Ex-ante Impact Study (4th extended version)

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Tartalomjegyzék

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Executive Summary

Universities in Hungary are under growing pressure to contribute more directly to innovation, skills development and regional competitiveness. European policy agendas (Horizon Europe, the Green Deal, the Digital Decade, Cohesion Policy, EIT, Erasmus+) promote **university–industry cooperation (UIC)** and deeper **university–industry integration (UII)** as central tools. In parallel, Chinese UII reforms demonstrate how **mission-oriented, system-wide coordination** between higher education, industry and the state can transform an economy and its skills base.

This study addresses a demanding question:

How can Hungary learn meaningfully from the Chinese UII experience—without copying it—within EU constraints, and how can this learning be translated into designs whose impacts are comparable in spirit to Chinese results, but aligned with Hungarian and European conditions?

The answer is a **"best fit" approach**: a context-sensitive hybrid that combines

- the **directional strengths** of Chinese UII (strong alignment with missions, tight education–industry coupling, coordinated governance),
- the **instrumental richness** of EU and Hungarian policies, and
- a **professional, complexity-aware impact framework** that allows ex-ante, ongoing and ex-post assessment of whether adapted interventions are actually delivering the intended types of impact.

From conceptual learning to concrete hybrid designs

The study develops three main **hybrid models** for Hungarian UIC/UII, explicitly inspired by Chinese patterns but redesigned for EU/Hungarian realities:

1. Sectoral FIEK 2.0 hubs

Chinese inspiration: large, mission-oriented university–industry platforms tied to strategic sectors (e.g. advanced manufacturing, AI, green technologies). Hungarian/EU adaptation: FIEK 2.0 hubs focused on **Green Manufacturing** or **Health Tech**, combining Horizon Europe, Cohesion Policy and NRDI funding with industry co-financing. They host portfolios of joint R&D, talent programmes, and entrepreneurship support, governed by boards including HEIs, firms, and regional actors.

2. Integrated talent pipelines

Chinese inspiration: vertically integrated pathways from vocational to postgraduate levels, strongly linked to industrial parks and key employers. Hungarian/EU adaptation: sectoral "Green Energy Talent Pipeline" with dual programmes, internships and industry-based master's projects, aligned with national energy strategy and EU Green Deal goals. Students rotate between university, firms and possibly applied research institutes.

Curriculum integration design rules

Chinese inspiration: industry input systematically shaping curricula, practice schools, and applied project work. Hungarian/EU adaptation: simple, system-wide rules for new or renewed programmes: minimum proportion of practice-based credits; at least one co-taught or co-supervised course with external partners; a final-year project based on real industry/public-sector challenges; and micro-credentials co-branded with firms in priority areas (e.g. AI in manufacturing, digital health).

These design elements aim to produce **Chinese-style impact types**—stronger mission-oriented skills, innovation and regional development—but **within EU legal and governance constraints** (university autonomy, state-aid rules, quality assurance standards).

Logic model and conversion thinking: how impact is assessed ex-ante

To judge whether such adapted interventions can realistically produce "Chinese-like" impacts in Hungary, the study builds on a logic model (similar to the logframe method) with conversion analysis. It distinguishes:

A) Inputs → Activities → Outputs → Outcomes → Impacts,
B) along three pathways: skills, innovation, and institutional change.

For example, for a Green Manufacturing FIEK 2.0 hub:

Inputs

€X million from NRDI + Horizon Europe; committed staff from 2–3 universities and 5–10 firms; Chinese-derived design knowledge on sectoral hubs.

Activities

Co-designed green manufacturing curriculum modules; joint R&D projects on energy-efficient production lines; internships and dual placements; innovation challenges and start-up support.

Outputs

1–3 years: 3–4 new or redesigned programmes, 10 joint projects, 100 student placements, 20 firm-mentor agreements; formalised UII governance structures, logic models and indicator sets.

Outcomes

(3–5 years): graduates with demonstrably higher green-manufacturing skills and better placement in relevant firms; repeat partnerships between HEIs and firms; institutional changes (UII in strategies, incentives, internal funding).

Impacts

5+ years: a recognised **Green Manufacturing regional ecosystem** with more high-value jobs, more innovative SMEs and start-ups; improved energy efficiency and technological sophistication in participating firms; stronger international positioning of the region/universities in this domain.

Ex-ante, the framework asks: **what are the conversion rates** likely to be at each step?

- Of 10 funded projects, how many will become real, high-quality joint activities?
- Of 200 students in UII programmes, how many will actually participate in intensive placements or challenge-based courses?
- Of those students, how many will show measurable skill gains and employability advantages in green manufacturing?
- Of firms involved, how many will shift from single-project involvement to long-term strategic cooperation?

By making such **conditional probabilities explicit**, the study argues that we can estimate the **probability of achieving "Chinese-type" impacts under Hungarian/EU conditions** and see where we need to adjust design or invest more (e.g. in project management, staff incentives, trust-building, or data systems).

Domain dynamics: ordered, complex, aporetic

The study uses a **Cynefin-inspired perspective** to avoid the illusion that Chinese-style coordination can simply be transplanted:

- **Ordered domains** (e.g. how to account for funds, basic eligibility criteria, standard IP clauses) can be addressed with European-style rules and compliance indicators. Here, impact assessment is relatively straightforward.

- **Complex domains** (e.g. how trust evolves between HEIs and firms, how curricula change teaching practice, how ecosystems emerge around hubs) require **probe–sense–respond cycles**. Chinese UII shows that strong missions can guide experiments; the Hungarian adaptation requires **pilots, mixed-method monitoring, and adaptive governance** to see what actually works in each region and sector.
- **Aporetic situations** (e.g. tensions between academic autonomy and strong state steering, or between EU conditionality and national politics) cannot be solved by more KPIs. They demand **deliberation and reframing**, so the study treats aporetic "flare-ups" as **warning signals** when something about the classification or design is off.

By contrasting an **instinctive trajectory** (aporia → pseudo-order → painful discovery of complexity) with a **professional trajectory** (explicit complexity → selective ordering → use of aporetic signals as diagnostics), the study shows how Hungarian UIC/UII governance can **converge towards Chinese-like coherence** without denying EU/Hungarian constraints.

Concrete impact assessment examples

The executive framework is made tangible through **concrete assessment scenarios**, such as:

1. Assessing a Chinese-inspired talent pipeline in Hungary (skills pathway)
    - **Chinese reference:** strong pipeline from vocational schools to industry-linked universities in a strategic sector, with high placement rates.
    - **Hungarian adaptation:** "Smart Mobility Talent Pipeline" involving a technical university, a vocational school network and major automotive suppliers.
    - Ex-ante assessment:
        - Inputs: expected number of students (e.g. 150/year), firms (10), staff involved.
        - Target conversions

- ≥80% of enrolled students complete at least one structured industry placement;
- ≥60% of graduates employed in mobility-related jobs within 6 months;
- ≥50% of firms offer repeated placements or joint thesis projects.
-

The impact alignment question is whether this pipeline, if conversions are achieved, produce a **labour-market and skills impact profile** comparable to Chinese UII pipelines, but compatible with EU quality assurance, labour law, and institutional autonomy? If not, design needs to be adjusted (more intensive placements, stronger firm co-governance, better support for students etc.).

2. Assessing a sectoral FIEK 2.0 hub (innovation + institutional pathway)
    - **Chinese reference:** university–industry platforms that transform local industries and universities' role in them (e.g. in advanced manufacturing or ICT).
    - **Hungarian adaptation:** FIEK 2.0 in **Digital Health** involving a medical university, a technical university, hospitals, and med-tech companies.
    - Ex-ante assessment:
        - Map expected conversions: from funding to joint projects; from joint projects to prototypes or digital solutions; from prototypes to adoption in hospitals or export-ready products; from initial governance boards to sustained cross-institutional structures.
        - Identify risk points (e.g. adoption in the health system; regulatory hurdles; staff overload).
    - **Impact alignment question:** Are we moving towards Chinese-style **ecosystem transformation**—within EU standards for data protection, procurement, and patient safety? If conversion from prototype to adoption is weak, additional design elements (e.g. regulatory sandboxes, clinical champion roles) are needed.

In both examples, Chinese UII is used as a benchmark for what "strong impact" looks like, but the actual success criteria and metrics are grounded in EU and Hungarian reality.

Practical takeaways

For **policy-makers**, the study shows how to design programmes that **start from complexity**, restrict ordered solutions to appropriate areas, and assess impact via realistic conversion analysis rather than only input/output counts.

For **universities**, it offers a way to turn Chinese-inspired ambitions into **internally coherent strategies** and portfolios, with clear pathways from projects to structural change.

For **industry**, it demonstrates why long-term, co-governed engagement yields **better conversions** (from projects to usable results, from graduates to high-performing employees) than one-off collaborations.

For municipalities, local governments act as integrators that convene hospitals, universities, SMEs and anchors, and they open adoption paths through pre-agreed procurement and regulatory sandboxes. They co-fund practice bases and recognise micro-credentials to strengthen talent pipelines, while place-based incentives and a simple public dashboard (placements, pilots, adoptions, time-to-permit) keep conversions moving.

Overall, the study argues that **learning from Chinese UII can lead to Chinese-comparable impacts** in Hungary—stronger skills, innovation and regional development—only when that learning is:

1. Translated into hybrid institutional models suited to EU/Hungarian constraints;
2. **Governed via a domain-sensitive approach** to ordered, complex and aporetic issues; and
3. **Continuously assessed ex-ante and ex-post** through logic models, conversion rates and funnel-type reasoning that make both investments and impact expectations explicit.

Further to these, a competitiveness paradox has to be taken into account. Hungarian UII becomes globally competitive by operating within larger EU-level missions and clusters while remaining locally agile.

The resolution is to standardise the ordered parts (IP/data, QA, procurement) and run short-cycle experiments in the complex parts (governance, curriculum, prototype→adoption), amplifying what works and damping what doesn't. Success is evidenced by conversion rates rather than intentions.

Chapter 1: Introduction

1.1 Strategic Importance of University–Industry Collaboration

University–industry collaboration (UIC) and its deeper variant, university-industry integration (UII), are widely recognised as crucial drivers of education modernisation, innovation capability, and economic competitiveness worldwide. As economies confront ongoing digital transformation, shifting labour market demands, and intensifying global competition, such collaboration systems are critical for producing future-ready talent, accelerating knowledge transfer, and fostering entrepreneurial ecosystems (Halász & Huang, 2025; Cheng & Huang, 2025).

China provides an instructive case, having embedded UII in the national development agenda to fuel its transition toward a knowledge-based economy (Halász & Huang, 2025). In the Chinese model, universities, government, and industry act as tightly interconnected partners within a Triple Helix framework, co-creating curricula, driving skills-based innovation, and co-managing institutional reforms. This fusion is not only policy-driven but also extensively manifests in on-the-ground forms such as modern industrial colleges and integrated vocational programs (Cheng & Huang, 2025).

For Hungary, positioned within the European Higher Education Area and actively seeking to expand its innovation ecosystem, analysing the Chinese UII offers strategic lessons. The Hungarian system benefits

from a strong tradition of comprehensive higher education reform and recent commitment to innovation-led development, but it faces barriers including institutional inertia, fragmented policy efforts, and limited industry engagement (OECD, 2025; Eurydice, 2025). Understanding the mechanisms that enabled China's UII success can pave the way for Hungary's universities and businesses to strive toward deeper collaboration for skills development and innovation.

1.2 Research Problem and Objectives

This study focuses on university–industry integration (UII) as a strategic capability within higher education systems, rather than addressing higher education reform in general terms. Its analytical perspective is anchored in the impact prediction (more precisely ex-ante impact assessment) of a comparative policy learning trajectory spanning China, the European Union, and Hungary, examining how different governance models, funding architectures, and institutional logics shape the effectiveness of university–industry collaboration. Within this framework, the study deliberately adopts a skills-oriented sub-focus, complementing and partially rebalancing the traditionally dominant emphasis on research and innovation outputs. It argues that while innovation-driven approaches have been central to both Chinese and European policy agendas, the sustainability and depth of UII increasingly depend on the integration of talent development, applied competencies, and labour-market relevance. By positioning skills not as a derivative outcome but as a core driver of collaboration and impact, the study aims to bridge education and innovation into a unified analytical and policy framework, and to identify context-sensitive adaptation pathways for Hungary within its EU-embedded environment.

This study addresses the central research problem of assessing, how Hungary could strategically adapt the Chinese university–industry integration model to enhance the effectiveness and impact of its university-business cooperation, particularly regarding skill development and innovation outcomes.

To answer this, the study pursues multiple specific objectives

- The prior objective is to develop a structured methodology, grounded in complexity theory and Theory of Change models, for ex-ante impact assessment of UII adaptation in Hungary.
- To identify and characterise the organisational forms, intrinsic motivations, operational practices, key enablers and inhibitors, and measurable outcomes of the Chinese UII experience (Halász & Huang, 2025).
- To critically compare these findings with existing Hungarian higher education and innovation frameworks to identify adaptation opportunities and contextual challenges.
- To produce evidence-based, actionable policy recommendations with implications for both Hungary's national innovation strategy and the broader European context.

These objectives build on extensive literature and empirical case studies conducted in China to inform an adaptation framework aimed at fostering sustainable university-industry partnerships in new socio-economic ecosystems.

1.3 Scope and Limitations

The scope of this study centres on education-driven university–industry collaboration focusing on skill development rather than traditional research commercialisations or patent-oriented collaborations. It aims to advance comprehensive integration of talent cultivation with applied innovation, highlighting transformative pedagogy, joint training, and continuous learning models.

While the Chinese UII serves as the primary benchmark for analysis, differences in institutional autonomy, governance structures, market dynamics, and cultural factors in Hungary and Europe are taken into account to moderate transferability claims.

Methodologically, it adopts a qualitative comparative framework supported by policy analysis, case study synthesis, and stakeholder discussions. It does not undertake quantitative impact measurement or broad cross-national surveys but establishes a foundational, conceptual and strategic grounding for future empirical investigation and policy recommendations.

1.4 Research Methodology Overview

The research methodology integrates a multi-method qualitative approach, combining literature references, comparative policy analysis, and empirical case study synthesis—drawing on Chinese policy texts, institutional documents, academic sources, and European initiatives. A distinctive element of this design is its grounding in the author's extensive professional experience as both a national and European expert in higher education innovation and entrepreneurship.

For almost a decade, the author has represented Hungary in the European Commission's HEInnovate Expert Network, collaborating with OECD and EU partners to support higher education entrepreneurship initiatives (European Commission, 2025). He was a national expert during the HEInnovate review of Hungary, and contributed to major studies such as *Supporting entrepreneurship and innovation in higher education in Hungary* (OECD/European Union, 2017) and the OECD country note on doctoral education relevance (OECD, 2022). As a regular contributor to the EU's HEI Initiative, he coordinated the ABCD (Alliance of Boundary Crossing in DeepTech) project supported by EIT HEI Initiative, targeting the entrepreneurial university model in the Western Balkans (European Institute of Innovation and Technology, n.d.).

Additionally, his role as expert in the RE-ACT project (Self-reflection tools for smart universities acting regionally) and participation in several Hungarian innovation and university-industry schemes—including preparation of Corvinus University's application to the University Innovation Ecosystem call—provide deep, context-rich empirical sources for analysis (RE-ACT, 2025; National Research, Development and Innovation Office, 2019).

This portfolio contributes to the study's methodology, benefiting from firsthand insight into policy formation, project implementation, and evaluation within both Hungarian and European contexts. The analysis will be accomplished with a stakeholder workshop, interviews, and validation loops utilising networks and institutional contacts established during this project. Such integration enables a substantial context-aware examination of the feasibility, transferability, and impact potential of the Chinese UII model in Hungary.

During the preparation of this study, the author engaged in professional dialogue with AI-based tools (primarily Perplexity.ai and ChatGPT) to explore concepts, structure arguments and refine the academic language. Responsibility for the final content rests solely with the author.

1.5 Structure of the Study

The study progresses through the following chapters to address its objectives comprehensively:

- Chapter 2: Detailed analysis of China's university–industry integration policies, governance, organizational forms, operational mechanisms, and outcomes.
- Chapter 3: Mapping of the Hungarian university-industry cooperation landscape, highlighting current initiatives, institutional capacities, and evaluative insights.
- Chapter 4: Framing Hungarian efforts within European Union innovation and educational strategic instruments and funding mechanisms.
- Chapter 5: Formulation of tailored UII adaptation strategies for Hungary considering systemic complexity, feasibility, and impact forecasts.
- Chapter 6: Presentation of an advanced, hybrid impact assessment framework incorporating Theory of Change and Cynefin domains for ex-ante evaluation and policy design.
- Chapter 7: Conclusion with integrated policy recommendations, implementation plans, and future research directions.

This structure ensures strategic coherence from theoretical foundations through empirical insights to practice-oriented policy design.

Chapter 2: The Chinese Model of University-Industry Integration: A Deep Dive

2.1 Introduction

China's university-industry integration (UII) model represents a strategic cornerstone in the modernisation of its education, industrial, and innovation systems. Unlike conventional partnership approaches, the Chinese model is characterised by deep fusion between academia and industry, as indicated by the original Chinese term " 产学融合 (chǎn-xué rónghé)" which connotes blending or merging beyond simple cooperation (Halász & Huang, 2025). This model operates within a Triple Helix framework, in which government (central and regional/local), universities, and industry engage closely at multiple governance levels to co-design policies, programs, institutional frameworks and processes (Cheng & Huang, 2025; Halász & Huang, 2025).

2.2 Policy Ecosystem and Historical Evolution

The evolution of UII in China can be divided into three main stages: early integration during the 1950s–70s largely motivated by Marxist ideology and practical necessity; a period of detachment and restoration of traditional academic independence from the late 1970s until the mid-2010s; and a renewed, government-led phase of deep integration since the 2010s focusing on innovation-driven and skills-enhancing economic development (Nan, 2019; Ouyang, 2020; Halász & Huang, 2025). A critical milestone was the 2017 State Council's "Opinions on Deepening Industry-Education Integration," which introduced a coherent strategic framework supporting systemic reforms (State Council, 2017). UII is embedded within broader policy ecosystems—vocational education, innovation policy, skills development, and corporate human resource strategies—that mutually reinforce integration aims (Halász & Huang, 2025).

2.3 Organisational Forms of UII

Several distinctive organizational forms operationalize UII. Modern Industrial Colleges function as co-managed faculties within universities or industrial parks that focus on applied, interdisciplinary curricula aligned with industry standards (Halász & Huang, 2025). Local city-level industry-education integration alliances and sectoral integration communities coordinate resources and programs across territories or industrial sectors, facilitating large-scale cooperation (Cheng & Huang, 2025). In addition, university-run enterprises and collaborative applied research institutes create hybrid spaces for knowledge transfer and innovation co-creation. These forms reflect the model's flexibility in adapting to institutional diversity, including research universities and universities of applied sciences that emphasize different elements of education, research, and application (Halász & Huang, 2025).

2.4 Motivations Driving UII

Drawing on Oliver's contingencies framework, UII motivations in China span six dimensions: necessity (driven by national innovation priorities and coercive policy frameworks), reciprocity (mutually beneficial knowledge-sharing and talent development), efficiency (reducing graduate work mismatches and optimizing resource use), stability (long-term partnership building), legitimacy (alignment with national strategies and accreditation), and asymmetry (industry's influence in shaping educational content balanced by institutional autonomy) (Halász & Huang, 2025; Cheng & Huang, 2025). This multifaceted motivation ensures robust stakeholder commitment and sustained UII development.

2.5 Formation and Operationalisation of UII

The formation process is iterative and multi-level, beginning with national policy articulation, followed by local stakeholder alignment and experimentation, and culminating in formalized consortia and co-governance mechanisms. While the process is often referred to be top-down, mutual learning, and the flow of information to both directions mean reflective feedback and help to apply layered policy and implementation mechanisms that combines standards and room for local adaptation. Operational activities include joint curriculum design, co-teaching, student internships, joint supervision, applied research, and innovative pedagogies such as project-based and scenario learning (Cheng & Huang,

2025; Halász & Huang, 2025). Digital platforms and shared facilities further enable coordination and knowledge exchange, supporting scalable, evolving practices reflecting local industrial needs.

2.6 Enablers and Inhibitors

Key enablers include substantial government funding and coordinated multi-stakeholder governance, legal frameworks gradually addressing intellectual property and partnership management, and emerging organisational cultures that allow flexibility and cross-sector collaboration. Inhibitors involve uneven regional resource distribution, persistent silos in academic and industrial cultures, the challenge of rapid curriculum adaptation to evolving industries, and occasional resistance to governance innovation (Halász & Huang, 2025; Cheng & Huang, 2025).

2.7 Outcomes and Challenges

UII has delivered clear benefits: improved graduate employability, enhanced teaching quality, stronger innovation ecosystems, and regional economic upgrading. It has sparked a "pedagogical revolution" marked by new interdisciplinary, applied teaching and assessment methods (Halász & Huang, 2025). However, challenges remain, including risks of industry-driven curricular mission drift, quality assurance complexities, inequalities in access and benefit distribution, and the need for continual policy and institutional refinement (Halász & Huang, 2025; Cheng & Huang, 2025).

2.8 Summary and Implications for European/Hungarian Adaptation

China's UII model offers a complex, dynamic ecosystem approach that exemplifies how coordinated policy, innovative organizational forms, and multi-layered stakeholder engagement drive systemic change. The model's adaptability across university types and sectors, combined with its strategic policy thrust, provides valuable lessons for Hungary. Any adaptation will require respect for Hungary's unique institutional and policy ecosystem while leveraging China's insights to boost skill ecosystems and innovation-driven collaboration.

Germany's applied university system—especially its dual study model and long-standing tradition of tightly integrated, work-based higher education—has served as a key comparative reference point not only for Western but also for Chinese policy analysts reflecting on their own reforms (Yang & Dong, 2024). Chinese scholarship has extensively explored how Germany's decentralised governance, strong industry-education collaboration, and practical-focused curricula have helped bridge skills gaps and ensure high graduate employability (Yang & Dong, 2024). Notably, analysts recommend for China a closer partnership between universities and firms, decentralised and flexible program management, ongoing curriculum adaptation with industry, and more systematic, practical work-integrated learning opportunities—insights directly inspired by German practices and the success of institutions like Duale Hochschule Baden-Württemberg.

From this vantage, Hungary's modernisation journey stands to benefit from learning "from those who have already learned": both by examining Chinese efforts to adapt successful German practices for their context, and by applying these second-order insights to its own higher education and innovation ecosystem. As Chinese analysts have concluded, the mutual benefits of international cross-learning go beyond policy borrowing—they inspire ongoing dialogue and adaptive problem-solving, helping each country respond more effectively to evolving skill needs, technological change, and innovation challenges (Yang & Dong, 2024). Thus, while the present study's core focus remains the Chinese experience, it highlights the importance of "learning from the learners," and points to an iterative model of international policy enrichment highly relevant to the aspirations of Hungary and the European Higher Education Area.

2.9 The Importance of Skill Focus over Classical R&D&I and Knowledge Transfer

Traditional models of university–industry collaboration have often prioritised research, development, and innovation (R&D&I) as the key channels for transferring knowledge from academia to business and industry. In this classical paradigm, knowledge valorisation is typically framed around technological

breakthroughs, patenting, joint research consortia, and spin-off creation. However, as industrial modernisation increasingly hinges not only on technical invention but also on adapting work processes, organisational forms, and human capital itself, this R&D&I-centric lens is being complemented—and in some contexts overtaken—by a stronger focus on developing skills and learning capacity at individual and organisational levels (Halász & Huang, 2025; Cheng & Huang, 2025).

The 产学融合 (chǎn-xué rónghé) approach, now prevalent in China, exemplifies this shift. It sees talent pipelines, workplace learning, and joint skill development as equally valuable outcomes of university–industry partnership. Industrial upgrading is no longer seen as an exclusively technological endeavour but as a complex interplay of human, procedural, and institutional transformation. In this context, applied curricula co-design, faculty/industry staff exchanges, and joint problem-solving projects cultivate not just explicit knowledge but also rich stores of tacit, procedural expertise and collective capability. Learning in this model is not restricted to students—organizational actors, from university managers to business leaders, also engage in mutual adaptation, acquiring new skills, mindsets, and routines.

Crucially, the relationship between skill-focused and R&D&I-centric approaches is not a binary or mutually exclusive choice. On the contrary, experience in China, Germany, Finland and other advanced innovation systems demonstrates strong complementarities and opportunities for strategic synergy. High-quality research collaboration often stimulates new learning needs and upskills all partners, while effective skill development programs create the absorptive capacity and workforce resilience needed to maximize the impact of technology transfer and joint R&D. It is also acknowledged that skill development occurs even without explicit reference; tacit and procedural knowledge are inherently produced through dialogic engagement, co-creation, and the practice of innovation itself (Yang & Dong, 2024). In order to utilise the analytical knowledge collected by Ankrah and AL-Tabbaa in a systemic literature review of 1500 studies on UIC (mostly on the R&D&I area) the processed central typologies are presented in a summary table in the Annex.

Thus, the future-facing university–industry integration model positions human and organisational capability building at all levels—alongside classical R&D&I. This dual focus enables ecosystems to better navigate rapid technological change and uncertainty, and more fully realise the societal and economic benefits of collaboration-driven innovation.

2.10. Chinese Ambitions of Knowledge Export

China’s ambitions of knowledge export are increasingly channelled through the internationalization of vocational education, branded initiatives like Luban Workshops, and a dense web of university–industry cooperation mechanisms that project Chinese technical standards abroad. Rather than limiting cooperation to student mobility, these platforms transfer curricula, training equipment, teacher-training models and assessment standards, positioning Chinese expertise in advanced manufacturing, robotics and digital industries as a reference for partner systems. For Hungary, this “educational diplomacy” aligns closely with the evolving Chinese university–industry integration (UII) model, which emphasizes deep, institutionalized partnerships (e.g., Modern Industrial Colleges) that tightly couple education and innovation with firms’ needs. Adapting elements of this model could support Hungarian priorities in dual education and regional innovation ecosystems by offering concrete templates for co-developed laboratories, standards-based curricula and joint talent pipelines with Chinese and local enterprises. At the same time, a selective, critical adaptation is essential: Hungarian stakeholders can draw on Chinese experience in scaling UII platforms and vocational brands, while embedding them into EU regulatory frameworks, Hungarian quality assurance norms and local industrial strategies to avoid over-dependence or misalignment. In this sense, Chinese ambitions of knowledge export become most productive when reframed as a bidirectional learning process, where Chinese vocational and UII models serve as catalysts for Hungarian experimentation with new forms of practice-oriented higher education, rather than as turnkey blueprints. (Cheng, 2025)

Chinese ambitions of knowledge export, especially through the internationalization of vocational education and university–industry integration, offer powerful templates but also carry pitfalls that Zong

Cheng's analysis makes explicit. Alongside brands like Luban Workshop and the export of Chinese standards, there is a risk of fragmented, weakly coordinated policy: without strong cross-ministerial mechanisms and systematic national planning, overseas initiatives can become duplicative, compete with each other in the same regions and struggle with misaligned legal or regulatory expectations of partner countries. School–enterprise cooperation may also remain superficial if firms' incentives are short-term and benefit-sharing or risk-sharing mechanisms are unclear, leaving vocational colleges to bear most costs while enterprises contribute only limited placements, which undermines the "education follows industry" principle. Zong Cheng further highlights that large differences in partner countries' educational baselines, cultures, and governance systems complicate localization: Chinese certificates may not be recognized, curricula may be only linguistically translated rather than structurally adapted, and teachers may lack deep intercultural and local industry understanding. Guarantee systems can become another bottleneck, with slow and complex procedures for exporting equipment, weak national-level risk-monitoring of political and security contexts, and over-reliance on institution-level self-funding that constrains infrastructure, equipment quality and staff development. Finally, brand and qualification systems remain incomplete; if international communication and mutual recognition mechanisms lag behind the speed of outward expansion, Chinese projects risk being seen as isolated aid-type ventures, and learners may face real barriers using their qualifications in regional labour markets. For a Hungarian adaptation of the Chinese UII model, these warnings suggest the need to build strong inter-agency coordination, invest heavily in genuine localization and mutual recognition, guarantee sustainable multi-source funding, and treat Chinese models as adaptable references rather than ready-made solutions. (Cheng, 2025)

2.11 **Revisiting the Interpretation of the Chinese UII Model**

The study adopts a more nuanced interpretation of Chinese university–industry integration (UII), moving beyond the frequently cited characterisation of the system as predominantly top-down. While central strategic direction and policy steering are undeniably strong, both empirical evidence and comparative policy analysis suggest a more complex governance pattern that can be more accurately described as a **"centre-integrated model."** In this configuration, central authorities do not simply impose uniform solutions, but rather identify, align, and scale locally developed initiatives, creating coherence across the system while preserving space for decentralised experimentation (Halász & Huang, 2025).

This interpretation is consistent with analyses emphasising that Chinese education and innovation governance combines strong central framing with adaptive, locally embedded implementation processes (Halász, 2023). A relevant illustrative example is Xi'an Jiao Tong-Liverpool University (XJTLU), which operates as a hybrid institution integrating international academic standards with strong regional and industry engagement. Its development model—particularly in its engagement with innovation districts and industry-linked programmes—demonstrates how institutional autonomy, industry collaboration, and policy alignment can coexist within a centrally framed system. Rather than being purely directive, such arrangements rely on the active integration of local initiatives into broader strategic frameworks.

This perspective challenges the mainstream view of Chinese UII as a predominantly hierarchical system, and instead highlights its capacity to combine coordination with adaptability. For the purposes of this study, this distinction is critical: it suggests that the transferable element is not centralisation per se, but the ability to **connect strategic direction with locally generated innovation and learning processes**. This insight reinforces the study's argument that effective policy adaptation in Hungary requires not replication, but the development of mechanisms that can similarly align national priorities with institutional and regional initiatives.

Chapter 3: Hungarian Context: UIC and Innovation Ecosystem

3.1 Structural Overview: Higher Education System, Innovation and Policy Legacies

Hungary's higher education system includes a broad range of institutions, from classical universities to applied sciences and doctoral schools. Recent policy reforms have reshaped governance and funding, emphasising performance, entrepreneurial third missions, and stronger alignment with innovation

objectives (OECD/European Union, 2017). However, these reforms have incited significant criticism domestically and from EU bodies due to concerns over politicisation and academic freedom erosion. The 2022 suspension of 21 Hungarian universities from EU research funding highlighted systemic vulnerabilities and fragmented policy implementation (FKA/MTA, 2023; Science|Business, 2023). Regional disparities further complicate national innovation efforts, concentrating R&D activities and investments largely in Budapest and Central Hungary (Birkner et al., 2022).

3.2 Recent Programmes as Foundations for Deeper Ecosystem Development

Hungary's efforts to foster university–industry collaboration (UIC) are reflected in several key recent programmes that, despite critiques, laid the needed groundwork for more organic and systemic integration:

- FIEK Centres (Higher Education and Industry Collaboration Centres): These serve as regional innovation hubs aimed at mobilising complementary capacities of HEIs and enterprises (OECD, n.d.). While criticised for funding dependence and bureaucratic burdens, they create durable platforms for network and knowledge co-creation.
- NRDI Competitive Calls: Multi-year grants for competence centres, joint R&D, and doctoral cooperation projects target enhanced alignment with labor and industry needs (LMRO, 2021). Administrative complexity and project sustainability remain concerns.
- University Innovation Ecosystem Programmes: These national tenders promoted entrepreneurship education, professional knowledge transfer, and SME engagement strategies, fortifying higher education's third mission (NRDI, 2019).
- Smart Specialisation Strategy (S3) Integration Projects: EU-supported initiatives like RE-ACT encourage embedding regional priorities and strategic alignment into HEIs' activities, reinforcing multi-level governance synergy (RE-ACT, 2025).
- European Partnerships: Engagement with EU initiatives such as HEInnovate and EIT HEI projects (e.g., ABCD) facilitates transnational knowledge exchange, entrepreneurial capability enhancement, and integration into broader innovation ecosystems (European Commission, 2025; EIT HEI Initiative, n.d.).

Critically, these programmes face unintended effects including "projectification," network fragility, and misalignment between funding incentives and genuine skills development, as highlighted by several independent analyses (FKA/MTA, 2023; European Commission, 2024). Addressing these issues is pivotal for transitioning from fragmented interventions to sustained, embedded, organically evolving innovation ecosystems.

3.3 Analysis of Key UIC/UII Initiatives

Hungary's university–industry cooperation initiatives encompass several key programmes that structure the evolving innovation ecosystem, while also facing significant challenges and critiques.

The government-driven Centres for Higher Education and Industrial Cooperation (FIEK) form the backbone of regional collaboration hubs designed to synergize academic and business knowledge. OECD reports and recent analyses highlight how FIEK centres, often externally funded, have intensified reliance on measurable, grant-eligible outputs at the expense of sustainable, organic partnership building (OECD, n.d.; Birkner et al., 2022). Bureaucratic complexities and top-down management structures limit flexibility and stakeholder engagement, resulting in relatively shallow collaborative outcomes and persistent skills mismatches between academia and industry needs (Kováts, 2020).

Complementing FIEK, Competence Centres have emerged as critical nodes of specialized expertise and innovation within Hungary's innovation landscape. These Centres are multi-institutional research and application platforms designed to deepen sector-specific collaboration between universities and enterprises, fostering high-tech R&D, skills development, and technology commercialization in targeted fields. Integrating academic research with business needs, Competence Centres aim to develop critical mass and visibility around strategic industry-university domains, promoting knowledge flow and cluster effects (Kováts & Rónay, 2018; National Research, Development and Innovation Office, 2019).

Despite their strategic importance, Competence Centres also face challenges related to governance fragmentation, variable stakeholder commitment, funding discontinuities, and uneven capacity across regions, which limit their transformative potential beyond pilot or flagship cases (Birkner, 2022). Nevertheless, they represent promising institutional innovations that could anchor deeper UIC/UII practices if linked better to regional innovation ecosystems and policy consistency.

Additional Hungarian programmes including the University Innovation Ecosystem tenders strive to professionalize technology transfer, enhance corporate relationships and entrepreneurial education services linked to SMEs and regional development. However, cyclicality of funding and capacity heterogeneity curtail long-term impact (NRDI, 2019).

Stakeholder roles in this ecosystem are diverse and layered: universities navigate between academic missions and emerging entrepreneurial mandates; industry actors—predominantly SMEs—contend with capacity constraints and risk aversion; public actors and intermediaries strive to mediate and coordinate across actors and levels. Motivations generally align around innovation gains, but barriers are persistent, including administrative burdens, insufficient absorptive capacity, trust deficits exacerbated by EU fund suspensions, and competing performance expectations (OECD/European Union, 2017; FKA/MTA, 2023; Science|Business, 2023).

The significant reputational and operational impacts of the 2022 EU funding suspension, documented by Science|Business (2023), have further destabilized cross-sector collaborations, with leading institutions like Budapest University of Technology and Economics reporting partner losses. The consequent erosion of trust poses a serious risk to the sustainability and systemic development of Hungary's UIC ecosystem.

Overall, while Hungary is steadily progressing in establishing a diverse and layered UIC/UII framework, there is a clear need to address both structural weaknesses and emerging perverse incentives to nurture effective, long-lasting partnerships rooted in mutual trust and aligned incentives (Kováts, 2020; Birkner et al., 2022).

3.3.1 Stakeholder Roles, Motivations, and Barriers

Hungary's HEIs exhibit multiple internal divides: between teaching and research, modes of knowledge production (Mode 1 disciplinary knowledge vs. Mode 2 contextual knowledge per Gibbons et al., 1994), and tensions in reward structures. While research excellence focuses on traditional academic prestige, teaching and applied fields emphasise skill development and local responsiveness.

Funding agencies external to institution governance often lack capacity or incentives to integrate resource allocation across these divisions, generating internal frictions and hampering strategy coherence (Kováts, 2020). Administrative units tasked with managing externally funded projects often view them as compliance burdens, aggravating the disconnect from academics.

The deepest external divide is between academic staff and industry partners, who differ in language, timelines, expectations, and operational culture. Academics often possess market-relevant skills, yet apply them mostly outside institutional roles, limiting university–industry knowledge integration (Kováts & Rónay, 2018). Bridging these gaps requires dedicated attention to building trust, aligning incentives, and nurturing hybrid professional identities.

3.3.2 Comparative Reflections with China: System Maturity and Cultural Embedding

Hungary's policy landscape for university–industry cooperation (UIC) features a complex mix of recent programmes aiming to establish the foundations for systemic innovation ecosystem development. These efforts are characterised by both promise and challenges and can be usefully contrasted with the mature Chinese University-Industry Integration (UII) model. The following comparative table succinctly presents these contrasts and harmonises the policy landscape with ambitions and constraints:

Table 1 - Comparison of the Chinese UII and the Hungarian UBC efforts

Aspect	**Chinese UII Model**	**Hungarian UIC Landscape and Ambition**
Governance structure	Centralised, multi-level coordinated governance driven by strong state leadership.	Decentralised, pluralistic governance with varying institutional autonomy; influenced by EU frameworks.
Policy coordination	Highly coordinated across national, regional, and institutional levels with embedded industry representation.	Fragmented policy landscape with overlapping actors and less strategic coordination.
Institutional integration	Deep functional fusion of universities and industry including curricula, research, governance.	Limited structural integration; coexistence of traditional and emerging collaboration formats.
Funding mechanisms	Long-term, stable state-led funding complemented by industry partnerships.	Dependent on cyclical, externally driven project funding with sustainability concerns.
Cultural embedding	Universities are viewed as co-innovators with industry; an entrepreneurial and applied focus is emphasised.	Traditional academic emphasis on disciplinary research; emerging recognition of entrepreneurial roles.
Scope of collaboration	Broad, encompassing teaching, research, innovation, skills, and regional development.	More limited scope focused on project-based, grant-dependent collaboration, growing ecosystem orientation.
System maturity and potential	Mature, strategic model with proven outcomes and policy-driven evolution.	Evolving and fragmented, but with strong ambitions for strategic, systemic UIC ecosystem development.

The author's edition

This comparative table highlights key distinctions and convergences between the Chinese University-Industry Integration (UII) model and Hungary's evolving University-Industry Cooperation (UIC) landscape. China exemplifies a mature, strategically coordinated model characterised by strong centralised governance, deeply embedded institutional fusion, and stable state-led funding frameworks. Its universities are integrated co-innovators with industry, engaged comprehensively across teaching, research, innovation, and regional development, yielding systemic synergies and policy-driven evolution.

Hungary's UIC context, by contrast, remains in an emergent and fragmented state. Governance structures are decentralised with significant institutional autonomy, influenced by EU norms and funding regimes. While ambitions towards systemic integration and entrepreneurial academic roles are explicit, practical realisation is hampered by overlapping policies, project-based, cyclical funding dependencies, and the coexistence of traditional and emergent collaboration formats.

Culturally, Hungarian universities predominantly emphasise disciplinary research and academic reputation, with entrepreneurial and applied missions still crystallising into core institutional identities. This contrasts with the Chinese model's holistic cultural embedding of universities as active shapers of innovation ecosystems.

Despite systemic and cultural gaps, Hungary is actively building foundational structures—including FIEK centres, Competence Centres, and University Innovation Ecosystem programmes—that echo strategic elements of the Chinese model adapted to local conditions. International collaboration frameworks further offer knowledge exchange opportunities critical to this maturation (next chapter). At the same time there are some universities that have advanced relationship with their industry. One of the most

eminent examples is the Széchenyi István University in close, synergetic collaboration with the AUDI Hungaria LTD.

Figure 1 The case of the Széchenyi István University and the Audi Hungaria LTD

Széchenyi István University in Győr and Audi Hungaria Ltd. have developed a form of university–industry collaboration that comes very close to organisational integration. Set in Hungary's main automotive city, their relationship has evolved over nearly three decades from project-based cooperation into a dense web of educational, research and governance tie that shape both the university's profile and the company's regional embeddedness.

Seen through the ISO/TS 44006 lens, the partnership spans all four functional areas of university–business collaboration. In **education**, the creation of the Audi Hungaria Faculty of Automotive Engineering in 2015 marked a decisive step: curricula in vehicle and mechanical engineering are designed around Audi's technological needs, Audi engineers teach in university courses, and students work on company-based projects throughout their studies. The dual higher education programmes make this link even tighter. Students sign employment contracts with Audi Hungaria, receive a salary, and alternate between academic semesters at the university and practical phases inside the plant. Their learning trajectory is thus embedded simultaneously in the university's degree structure and Audi's HR and production systems. The education pipeline is extended backwards into secondary schooling through cooperation with the Audi Hungaria School Centre, where graduates can transfer credits into Széchenyi bachelor programmes, reinforcing a long, continuous "Audi pathway" from school to employment.

In terms of **research collaboration**, SZE and Audi maintain a portfolio of joint and contract research projects in areas such as internal combustion engines, alternative drives, whole-vehicle optimisation, production technologies, logistics and environmental analysis. These projects often use shared or closely connected laboratories and test facilities in Győr, and Audi supports several PhD students each year whose theses are anchored in company-relevant topics. The **valorization** dimension is present in the strong orientation of R&D towards practical applicability; many themes are chosen because they can feed directly into process improvements, product development or sustainability initiatives at Audi rather than remaining purely academic.

The **management and ecosystem** aspects of ISO/TS 44006 are particularly visible. The Audi Hungaria Faculty, with its six departments (Internal Combustion Engines, Whole Vehicle Engineering, Vehicle Manufacturing, Materials Science, Environmental Engineering, Logistics and Forwarding), is housed within the university yet co-branded with the company, and some key positions are held by Audi employees. This gives Audi formal voice in academic governance and allows continuous adjustment of teaching and research priorities to evolving technological needs. Joint initiatives such as the Audi Development Camp, an international summer programme where students tackle real Audi engineering and sustainability challenges, function as intensive knowledge-exchange forums and help to socialise students into the company's culture and problem-solving style. On the regional scale, SZE and Audi are central pillars of Győr's automotive ecosystem, working with the city and other actors on a career-path model that links education, employment and local development and positions Győr as an automotive knowledge hub.

If we reinterpret the same case using the UIC organizational-form typology from Ankrah & Al-Tabbaa, the depth of this cooperation becomes even clearer. At the relational level, there are numerous **personal informal and formal ties**: consultancy relationships, guest lectures, co-supervised theses and student projects conducted within Audi's facilities. These are complemented by **third-party mediated arrangements**, for example when university liaison units and project offices handle contracting and project administration in externally funded programmes. More structurally, the partnership rests on layers of **formal targeted agreements**, such as specific contracts for research projects, laboratory collaborations and the dual study programmes, each with defined rights, obligations and deliverables. Behind these sit broader **formal non-targeted agreements** in the form of long-term strategic

cooperation frameworks under which scholarships, infrastructure investments and various joint activities are launched.

At the highest level of institutionalization, the Audi Hungaria Faculty itself is a **focused structure** in the sense of the UIC typology: a dedicated, co-branded organisational unit situated inside the university but functionally oriented towards the company's needs. It combines teaching, research and third-mission activities under one roof and symbolically signals that the relationship with Audi is not just an external partnership but a constitutive part of Széchenyi's institutional identity. Students in the dual programmes are simultaneously university students and company employees; Audi engineers act as lecturers and supervisors; and research agendas are jointly shaped. This blurring of boundaries across ISO's functional areas and across UIC's organisational forms is what justifies describing the SZE–Audi relationship as an "almost integrated" constellation rather than a conventional collaboration: the university and the firm remain legally distinct, but in key domains of education, research and regional engagement they operate as a tightly coupled system. (Audi Hungaria, 2025)

Source: The author's summary, based on the referred articles, public information, and several study-visits to SZE, and to the AUDI Hungaria factory

BME–FIEK: Origins, Trajectory, and Lessons

At the Budapest University of Technology and Economics (BME), the Centre for University–Industry Cooperation (FIEK) serves as a "one-stop" interface for firms and an internal enabler for research, tech transfer and partner development—both a project and an organizational unit dedicated to sustained university–industry collaboration (Budapest University of Technology and Economics [BME], n.d.).

From the late-2010s, FIEK helped seed tangible collaboration platforms: the Industry 4.0 Technology Center (I4.0 TK), a hands-on hub for digital manufacturing; the 5G campus network, a multi-building R&D testbed; and the Zero Carbon Center (ZKK), a cross-disciplinary hub for the green transition (BME Ipar 4.0 Technológiai Központ, n.d.; BME, 2021; BME, 2023; Zéró Karbon Központ, n.d.).

The I4.0 Technology Center was created within FIEK through GINOP 1.1.3-16 ("Mintagyár") support, pooling multiple BME faculties and colocating equipment in the university's "I" building—an example of using structural funds to de-risk early infrastructure while building internal capability (BME VIK Research Infrastructure, n.d.).

FIEK combines (1) a partner-facing entry point and competence/innovation mapping with (2) internal enablement—contract templates, IP/COI hygiene, project support—and (3) education links (guest lectures, co-supervision, capstone/project courses embedded in labs like I4.0 demonstrators, 5G testbed, ZKK's labs). The competence-map portals make discovery easier and reinforce the "front door" (BME, n.d.-a; BME, n.d.-b).

These platforms delivered repeat-partner draw, demonstrators and prototypes in I4.0; a campus-scale 5G infrastructure supporting research and industrial pilots; and decarbonization/energy-transition projects anchored by ZKK's ecosystem—together lowering transaction costs for academics and firms (BME, 2020; BME, 2021; BME, 2023; Zéró Karbon Központ, n.d.).

Recurring friction points were IP/publication timing, multi-party administrative lead-times, and the need to recognize innovation outputs (prototypes, licenses, co-taught courses) alongside publications—issues reflected across FIEK communications and project narratives, and consistent with our earlier interview framework (BME, n.d.; BME, 2021).

Lessons of BME for policy and practice

- Launch visible, hands-on hubs (I4.0 demo lines, 5G, ZKK) to make collaboration concrete; these become magnets for capstones and repeat engagement (BME Ipar 4.0 Technológiai Központ, n.d.; BME, 2021; BME, 2023).
- Institutionalize the "front door" + ruleset (competence map, standard contracts, IP/COI) so deals move faster and risks are clear (BME, n.d.-a; BME, n.d.-b).
- Link research and skills by embedding projects in curricula (co-teaching/co-assessment on real systems) so outputs convert to outcomes (curriculum/process change) rather than one-off pilots (BME Ipar 4.0 Technológiai Központ, n.d.; Zéró Karbon Központ, n.d.).
- Blend funding with conviction. Early structural funds can de-risk infrastructure, but durable impact needs internal ownership and governance beyond grant cycles (BME VIK Research Infrastructure, n.d.).

(The findings were intended to be validated through interviews with responsible university stakeholders. However, due to ongoing institutional reorganisations, these interviews could not be conducted. The research therefore plans further attempts to validate the findings. First, the report will be shared with relevant stakeholders for feedback. Second, the broader research team will organise a group review session, to which key stakeholders will be invited.)

The nuanced comparison underscores that Hungary's UIC evolution is a complex, iterative process requiring ongoing institutional learning, policy alignment, and cultural transformation. The Hungarian path involves passing through transitional phases marked by external funding dependencies and policy challenges towards more endogenous, resilient innovation ecosystems capable of integrated mission fulfilment.

Addressing such tensions in the later policy recommendations (chapter 7) is essential to transform initial programme-driven impetus into embedded, organic university–industry innovation ecosystems, capable of sustained impact.

The organically evolving UICs also matter in Hungary

The partnerships that grow over years—rather than around single grants—tell us how collaboration actually performs when trust, routines and local problem-solving take the lead. They reveal real "conversion capacity": whether joint work reliably turns into prototypes that get used, and students who become high-performing employees. As such, they're a better barometer of Hungary's state of play than one-off pilots, and they offer practical cues for scaling UIC/UII nationally.

Semmelweis University (SOTE) and Richter Gedeon

This Budapest pharma–university axis blends discovery science with industry-grade development in a way that feels lived-in rather than staged. Joint labs, dual mentoring and targeted PhD/master tracks keep education close to real R&D problems, while curriculum updates follow the needs of regulated pipelines. Success shows up less in press releases than in steady prototype maturation, co-authored IP, and a recurring stream of graduates stepping straight into high-impact roles at Richter and across the health ecosystem.

MATE and Dunafarm

In agri-food, the MATE–Dunafarm relationship runs along the full value chain, from animal science and feed to processing, which makes the classroom and the farm blur into one learning space. Co-designed modules unfold on real sites, capstones chase live briefs, and mentors on both sides help students translate data and husbandry practice into tangible gains. You see conversion in improved production indicators on pilot farms, in repeated cohorts returning each season, and in a pipeline of hires who already speak the language of the barns and the plant.

University of Miskolc and Bosch

Around Miskolc's manufacturing hub, mechatronics education is braided tightly with shop-floor realities. A co-governed department and modern labs anchor co-taught courses, and student projects land on equipment that mirrors what sits inside Bosch plants—complete with named product owners on the company side. The payoff is visible in faster time-to-competency for new hires and in prototypes that move from classroom rigs to production settings without losing momentum.

Corvinus University and the MOL Group

Corvinus and MOL have built a talent and knowledge bridge that runs both ways: scholarships and graduate programmes pull students into energy-sector roles, while executive education and guest lecturing loop current business challenges back into curricula. Capstones don't just earn grades; the better ones get absorbed into internal projects, and MOL mentors turn up as assessors as often as lecturers. What endures is the rhythm—placements that stick after a year or two, refreshed programme elements, and a habit of co-design that keeps the partnership relevant as the industry shifts.

Transition from FIEKs to Competence Centres

The evolution from the FIEK (Higher Education and Industry Cooperation Centres) scheme to the more recent Competence Centre model reflects a gradual but visible shift in Hungary's approach to university–industry collaboration. While both instruments are rooted in the same policy ambition—to strengthen applied research, innovation capacity, and cooperation between higher education institutions and industry—they differ in how they conceptualise sustainability, governance, and systemic impact (Birkner et al., 2022; European Commission, 2024a).

FIEKs emerged as first-generation instruments designed to activate collaboration. Their underlying logic was that targeted public investment could "ignite" cooperation between universities and firms, leading to joint projects, shared infrastructure, and increased private-sector engagement in research and development. In many cases, this activation logic proved effective: FIEKs mobilised existing relationships, enabled rapid project initiation, and produced tangible outputs such as prototypes, publications, and collaborative platforms. However, their design remained largely project-based and time-bound, and many initiatives functioned as relatively isolated "islands" with limited systemic integration. The expectation that initial funding would generate self-sustaining collaboration often proved optimistic, particularly in a context where industry demand for structured R&D cooperation remained uneven (Birkner et al., 2022; OECD, n.d.).

Competence Centres can be interpreted as a second-generation response to these limitations. While maintaining the core features of public–private co-financing and university-led collaboration, they place greater emphasis on continuity, organisational embedding, and longer-term capability development. Instead of primarily initiating projects, they aim to stabilise and scale collaboration through more structured platforms with clearer governance arrangements and a stronger orientation towards sustained operation (European Commission, 2024a).

This transition is also visible in the logic of value creation. Whereas FIEKs were particularly strong in the early stages of the collaboration chain—mobilising inputs, launching activities, and generating outputs—Competence Centres attempt to address downstream challenges, such as translating outputs into organisational change, adoption, and longer-term impact. At the same time, the skills dimension, which remained largely implicit in earlier programmes, is increasingly recognised as a central component of university–industry integration. This is reflected in closer links between research and education, as well as growing attention to competence development and its measurement (European Commission, 2014; LMRO, 2021).

Despite these shifts, several structural challenges persist. Demand-side limitations remain significant, as relatively few firms actively seek deep and sustained collaboration with universities. At the same time, the reliance on public funding raises ongoing concerns about long-term sustainability, and pathways from innovation outputs to real-world adoption are often underdeveloped. Furthermore, while

governance structures have become more formalised, the broader complexity of multi-actor innovation ecosystems—particularly the integration of SMEs and regional actors—remains only partially addressed (OECD, n.d.; European Commission, 2020).

In this sense, Competence Centres represent an important evolutionary step: they build on the activation logic of FIEKs while introducing greater stability, coherence, and downstream orientation. However, they still operate within the same structural constraints that limited the transformative impact of earlier initiatives. As a result, they mitigate—but do not fully overcome—the tendency towards fragmentation and the emergence of "institutionalised islands" within the innovation ecosystem (European Commission, 2024a).

The sustainability challenge

The interview with a former senior official of the National Research, Development and Innovation (NRDI) Office provides a critical insider perspective on the design and implementation of university–industry cooperation (UIC) and integration (UII) programmes in Hungary. The reflections highlight a fundamental tension between strong initial policy interventions and the limited long-term sustainability of the resulting collaborations.

A central finding concerns the **fragility of sustainability**. Many programmes—such as FIEK-type initiatives—were designed as intensive, resource-rich interventions capable of mobilising institutions, firms, and significant human capacities within a relatively short time frame. While these interventions often succeeded in delivering tangible outputs during the funding period, they frequently failed to evolve into self-sustaining structures. The metaphor of "building a bridge across a canyon" captures this dynamic: although the infrastructure for cooperation was successfully created, the continued use, maintenance, and institutionalisation of that cooperation remained uncertain. As a result, many initiatives functioned as **temporary, project-based "islands"**, rather than as embedded elements of a broader innovation ecosystem.

This sustainability gap is closely linked to **structural demand-side limitations**. The policy logic assumed that initial public funding would "ignite" collaboration, after which market-driven dynamics would sustain it. However, the interviewee emphasises that this assumption overestimated the level of latent demand for formal R&D cooperation among firms. In practice, many collaborations were built on pre-existing relationships—geographical proximity or personal networks—which facilitated rapid start-up but constrained scalability and systemic impact. At the same time, a significant share of firms engage in what can be described as **"hidden innovation"**, developing solutions internally without relying on university partnerships. This results in a structural imbalance: while policy pushes the supply side (universities) towards collaboration, the demand side remains comparatively weak.

Another critical insight concerns the **limited integration of the skills dimension** in earlier UIC/UII programmes. The dominant orientation of these initiatives was towards research and innovation outputs—such as projects, prototypes, and publications—while systematic competence development received less attention. This imbalance is also reflected in doctoral education, where institutional incentives prioritise degree completion over teaching quality or labour-market relevance. Although initiatives such as cooperative doctoral programmes or DBA-type degrees attempted to bridge this gap, their systemic impact remained limited. The interview suggests that **skills development was not treated as a core driver of collaboration**, but rather as a secondary or implicit outcome.

The role of **quality assurance and governance frameworks** further complicates this picture. The Hungarian Accreditation Committee (MAB) operates under multiple and sometimes conflicting pressures, while institutional incentives often favour quantitative expansion over qualitative improvement. This contributes to a system in which participation in advanced programmes—such as doctoral education—is sometimes motivated more by credential acquisition than by competence development or industry relevance. At the same time, quality assurance mechanisms have limited capacity to address the complexity and diversity of university–industry interactions.

From a policy perspective, the interviewee highlights a paradox: **strategic frameworks themselves were not the primary weakness**. Earlier national R&D and innovation strategies (notably around 2014 and 2018) were considered robust in terms of priorities and policy design, including support for start-ups and innovative SMEs. However, their implementation was constrained by insufficient baseline data, weak monitoring systems, and limited analytical capacity. Over time, subsequent policy developments tended to simplify these frameworks, sometimes at the expense of depth and systemic coherence. In parallel, a growing emphasis on easily measurable indicators—such as publication rankings—has shifted attention away from more complex forms of innovation performance and ecosystem development.

These dynamics contribute to the emergence of what the interviewee describes as **"accountability islands"**: well-documented, reportable projects that fulfil formal requirements but are not deeply embedded in institutional or economic structures. Even performance-oriented governance models do not always differentiate effectively between types of impact, further limiting the system's ability to prioritise long-term transformation over short-term outputs.

Overall, the interview identifies a core systemic challenge: **the attempt to build a sustainable innovation ecosystem through project-based interventions without sufficiently addressing underlying structural conditions**. These include demand-side engagement, institutional incentives, governance arrangements, and the integration of skills development. While instruments such as FIEKs and Competence Centres were conceptually sound, their impact remained partial due to insufficient alignment with these deeper factors.

Importantly, the interviewee's current experience—leading a Talent Center in a STEM-focused higher education institution—adds a forward-looking perspective. From this vantage point, the **skills dimension emerges as a critical lever for sustainability**. Firms are more likely to engage in long-term cooperation when they perceive clear value in talent development, particularly in the form of applied and demonstrable competencies. This suggests that skills are not merely a by-product of innovation, but a central driver of effective university–industry integration. Embedding this perspective more explicitly into programme design could therefore significantly improve the long-term impact and sustainability of UIC/UII initiatives in Hungary.

3.4 Emerging China–Hungary UII Interfaces

Beyond domestically driven initiatives, recent developments also point to emerging China–Hungary linkages in university–industry cooperation, which may serve as concrete entry points for policy learning. These include both formal collaborations—such as partnerships between Hungarian universities and Chinese firms—and more organically evolving relationships embedded in regional economic dynamics.

Such cases are particularly relevant from a skills-oriented perspective, as they often involve the co-development of talent pipelines, practice-oriented training, and applied competencies aligned with industrial needs. In this sense, they provide a complementary dimension to programme-based initiatives such as FIEK, illustrating how UII can evolve not only through policy-driven interventions, but also through market- and investment-driven processes. At the same time, these emerging interfaces highlight the importance of stakeholder configuration in shaping outcomes. The involvement of Chinese firms, advisors, and institutional partners introduces new opportunities for knowledge exchange, but also raises questions related to governance, coordination, and contextual adaptation within the EU regulatory environment.

From a policy learning perspective, these developments can be interpreted as early-stage "translation arenas", where elements of Chinese UII practices interact with Hungarian and EU institutional frameworks. Their significance lies not in their scale, but in their potential to reveal how collaboration patterns, skills development approaches, and organisational solutions can be adapted under real-world conditions.

University–Industry Integration in Practice: The Szeged–BYD Context

The emerging relationship between the University of Szeged (SZTE) and BYD provides a timely example of how global industrial investment can create new opportunities—and challenges—for university–industry integration (UII) in Hungary.

A formal cooperation framework between the university and BYD was established in December 2025, with the stated aim of creating new practical training opportunities, strengthening talent development, and supporting applied collaboration between academia and industry (University of Szeged, 2025; Autopro, 2025). This development aligns with broader European priorities related to regional innovation ecosystems and smart specialisation (European Commission, 2020; Birkner et al., 2022), positioning the partnership as a potential anchor for local UII dynamics.

At the same time, the case illustrates several structural challenges that are highly relevant for UII policy design. First, a **temporal mismatch** can be observed between industrial investment cycles and academic adaptation processes. While industrial actors operate on accelerated timelines, universities require longer cycles for curriculum development, accreditation, and organisational change—an issue widely identified in university–industry cooperation contexts (European Commission, 2014).

Second, there is a **capability alignment challenge**. Responding to highly specialised industrial needs—such as those emerging in electric mobility and advanced manufacturing—depends on the availability of relevant competencies, infrastructure, and human capital. Where these are only partially in place, universities must invest in rapid capacity development or rely on external partnerships, which may slow down integration.

Third, the case highlights **multi-level governance complexity**. Effective UII requires alignment not only between the university and the company, but also with local government, national policy frameworks, and EU regulatory conditions. In the Hungarian context, the governance transformation of universities into KEKVA (public trust foundation) structures has created more flexible institutional frameworks, potentially enabling stronger engagement with industry. However, the extent to which service agreements and performance frameworks explicitly incentivise UIC/UII remains uneven and still evolving, limiting the systematic embedding of such cooperation.

Fourth, the case confirms the importance of the **skills dimension as a primary interface** between university and industry. Sustainable collaboration is more likely to emerge where cooperation delivers tangible value in talent development—particularly through applied, demonstrable competencies aligned with labour market needs (LMRO, 2021). While the SZTE–BYD agreement explicitly refers to expanding practical training opportunities, the long-term impact will depend on how deeply such skills-oriented elements are embedded into curricula and institutional practice.

Finally, the Szeged–BYD context also draws attention to **broader contextual factors**, including cultural differences in organisational practices, expectations regarding collaboration, and the need to operate within EU regulatory frameworks related to industrial policy, data, and procurement. These factors increase the importance of carefully designed context-sensitive adaptation strategies.

Overall, the case demonstrates that large-scale industrial investment can act as a powerful trigger for university–industry integration, but successful outcomes depend on the system's ability to convert opportunity into sustained collaboration. This requires coordinated governance, skills-oriented programme design, and adaptive implementation—key elements emphasised throughout this study.

Chapter 4. European Dimension: UIC Policy & Funding Landscape

4.1 EU-Level Programmes as Triggers for Hungarian UIC and UII

The European Union's policy architecture provides a dense enabling environment for university–industry cooperation (UIC) and university–industry integration (UII), combining research, innovation, education,

and regional development instruments. Horizon Europe, the Digital Europe Programme, Erasmus+, Cohesion Policy (including Smart Specialisation Strategies, S3), and European Institute of Innovation and Technology (EIT) initiatives together offer funding, strategic frameworks, networking and capacity-building tools that are directly relevant for Hungarian universities and their business partners (Birkner et al., 2022; European Commission, 2020, 2024a, 2024b, 2025a). Since 2023, the Commission has also begun to systematise UBC more explicitly at EU level: the dedicated overview of UBC initiatives (European Commission, 2023) and the integration of the former University–Business Forum into the annual Education & Innovation Summit signal a maturing, skills-aware approach that explicitly links UBC to the European Education Area. This reframing places talent, employability and lifelong learning alongside R&I, making UBC a mainstream expectation rather than a peripheral option.

Horizon Europe supports large, mission-driven consortia that connect universities, firms, and societal actors around priorities such as the European Green Deal and the Digital Decade. For Hungarian higher education institutions (HEIs), participation in such projects is both a resource and a reputational trigger for deeper UIC in research and innovation (European Commission, 2024b, 2025a). The Digital Europe Programme complements this by focusing on advanced digital technologies and digital innovation hubs, many of which are embedded in or closely linked to university ecosystems, thereby stimulating digital skills development and applied research collaboration (European Commission, 2024a). In parallel, the EIT's KICs operationalise tripartite partnerships (university–business–research) with entrepreneurship and adoption logics, offering portfolio-level governance templates that Hungarian HEIs can reuse.

Erasmus+ provides another major entry point, especially through strategic partnerships, Knowledge Alliances, and mobility schemes that embed entrepreneurship education, work-based learning, and internationalised curricula, all of which require structured cooperation with industry (European Commission, 2025a). Cohesion Policy and S3 frameworks encourage Hungarian regions to integrate universities into entrepreneurial discovery processes and regional innovation strategies, aiming to reduce regional research, development and innovation (RDI) disparities and strengthen university-based innovation ecosystems (Birkner et al., 2022; European Commission, 2020). This regionalisation aligns UBC with place-based missions and cluster logic, moving the focus from "university + big firm" dyads to ecosystem cooperation (SMEs, start-ups, municipalities), which is particularly salient for Hungary's smart-specialisation agenda.

The EIT, through its Knowledge and Innovation Communities (KICs), started from the HEInnovate platform and landed as the HEI Initiative, further catalysing institutional entrepreneurial transformation by providing diagnostic tools, funding schemes, and networks that incentivise HEIs to develop ecosystem-oriented strategies—an opportunity that is increasingly relevant for Hungary's evolving innovation landscape (EIT HEI Initiative, n.d.; OECD, n.d.). As an example, the Budapest Metropolitan University led the ABCD project within the framework of the HEI Initiative, and launched actions that nurtured corporate partnerships, initiated joint projects, and through entrepreneurship promotion filled the gap between HEIs and businesses. Taken together, these instruments act as triggers for UIC/UII in Hungary by (1) channelling significant financial resources into joint projects, (2) offering normative frameworks and partnership around green, digital, and skills/lifelong-learning priorities, and (3) exposing Hungarian HEIs to transnational innovation cultures and practices. However, Commission documents remain "soft-steering": they set direction and templates rather than mandating Member-State frameworks, so domestic translation and institutional capacity remain decisive.

Beyond their direct effects, these EU-level instruments also provide an important analytical reference point for interpreting international UII practices. Rather than drawing direct or normative comparisons between European and Chinese governance systems, this study adopts a functional perspective that interprets Chinese university–industry integration (UII) practices through an EU policy lens. This approach allows for the identification of relevant similarities at the level of operational mechanisms, while fully recognising differences in institutional and political contexts.

From this perspective, several dimensions of functional similarity can be observed. Both systems rely on central funding schemes to steer priorities and mobilise actors, even if the degree and mode of

centralisation differ. Both operate through framework-type regulation, where overarching strategic objectives are defined at system level while leaving room for local adaptation and experimentation. In addition, both contexts emphasise ecosystem-based coordination, bringing together universities, industry, and public actors around shared missions. Another important dimension is the role of learning-oriented policy instruments. In both the Chinese and EU contexts, programmes function not only as funding mechanisms, but also as platforms for institutional learning, peer exchange, and the diffusion of practices. These peer learning dynamics play a significant role in shaping how institutions interpret and implement policy objectives.

For the purposes of this study, these observations reinforce that policy learning should focus on functional mechanisms rather than institutional forms. The objective is not to replicate Chinese models, but to understand how comparable coordination and learning effects can be achieved within EU-compatible governance frameworks.

4.2 Integration Challenges and Alignment Opportunities for Hungarian HEIs

Despite this favourable EU-level environment, Hungarian HEIs face substantial integration challenges. Evaluations highlight that absorption capacity shortages, fragmented institutional strategies, and complex administrative procedures often limit the extent to which EU programmes translate into sustained ecosystem transformation (European Commission, 2024a; FKA/MTA, 2023; LMRO, 2021).

First, the **administrative complexity** of EU funding—combined with national regulatory layers—poses a heavy burden on universities with limited professional project-management capacity. This constrains their ability to participate in multiple programmes simultaneously and to maintain continuity once projects end (European Commission, 2024a; Kováts, 2020). Second, **institutional fragmentation and policy incoherence** mean that EU-funded projects are sometimes treated as isolated opportunities rather than as elements of long-term institutional and regional strategies (Birkner et al., 2022; OECD, n.d.). Third, there remains a rhetoric–practice gap: EU-level framing now embeds UBC in the education/skills agenda, but behavioural incentives, internal reward systems and procurement/IP pathways in many HEIs and firms are not yet aligned with structural, portfolio-level cooperation.

The recent political tensions with Hungary and the temporary exclusion of Hungarian universities under certain governance models from EU funds create uncertainty and further weaken long-term planning and investment in UIC/UII (FKA/MTA, 2023; Science|Business, 2023).

At the same time, EU thematic priorities offer clear **alignment opportunities**. Integrating the Green Deal sustainability agenda and the Digital Decade's digitisation goals into curricula, research portfolios, and skills development strategies allows Hungarian HEIs to position themselves as mission-oriented institutions and to leverage EU frameworks for domestic reform (European Commission, 2024b, 2025a). Policy learning from Chinese university–industry integration (UII) models—characterised by strong mission orientation and systemic coordination—can be combined with EU instruments to develop context-sensitive strategies for Hungary (Halász & Huang, 2025).

In practice this means treating UBC as part of institutional strategy (grant-strategy, curriculum reform, talent pipelines) rather than as project add-ons, and anchoring regional portfolios in S3 missions with municipal and cluster partners. Transnational experiences in Horizon Europe, Erasmus+ and EIT HEI projects (such as the ABCD initiative) broaden Hungarian HEIs' exposure to diverse institutional models, governance arrangements, and partnership practices, enriching their internal capabilities for building more robust UIC/UII ecosystems (EIT HEI Initiative, n.d.; European Commission, 2025a). In short, the EU development context is ambivalent for Hungary: it is a powerful enabler of UIC/UII, but its benefits depend on domestic absorptive capacity, governance quality and the stability of EU–national relations, not merely on programme availability.

4.3 Measuring Skills-Oriented UIC Impact and Adaptive Governance

A key shift in the European approach to UIC is the move from a narrow focus on R&D and technology transfer towards a broader understanding that includes **skills development, employability, and human**

capital formation. The European Commission's 2014 study on measuring the impact of university–business cooperation in the field of education provides a cornerstone for this shift (European Commission, 2014).

That study proposes a balanced, scorecard-type framework for assessing UBC, combining qualitative and quantitative indicators and explicitly recognising multiple stakeholder perspectives (students, HEIs, firms, and society). It highlights impacts such as enhanced graduate employability, entrepreneurship and transversal skills, curricular innovation, and strengthened regional innovation capacity, and stresses that these outcomes are often long-term, distributed, and difficult to attribute to single projects. The framework encourages the design of "success maps" that link inputs, activities, outputs, and outcomes into a logic model, enabling **ex ante** planning and **real-time monitoring** rather than purely retrospective evaluation (European Commission, 2014).

The 2023 UBC overview and the 2024 evaluation of UBC instruments extend this trajectory by calling for consolidation under an "educational innovation" umbrella, clearer coordination and digital platforms—useful signals for Hungary to formalise skills KPIs, micro-credential pathways and adoption metrics within UBC.

For Hungary, adopting and adapting such frameworks offers three main advantages:

1. **Skills focus:** It helps shift evaluation and funding logic away from a predominant emphasis on publications and patents towards labour-market relevance, skills adaptation, and lifelong learning, addressing concerns documented in the labour-market relevance review of doctoral education (LMRO, 2021).
2. **Predictive and adaptive governance:** By integrating UIC impact metrics into project design and institutional strategies, Hungarian HEIs and policy-makers can identify risks and bottlenecks earlier, adjust implementation, and justify strategic choices in a transparent manner.
3. **Comparability and legitimacy:** Using EU-endorsed frameworks enhances the credibility of Hungarian evaluations in the eyes of European partners and funders, and makes it easier to benchmark performance and learn from peers. Combined with Chinese UII lessons—where industry needs are more tightly integrated into educational planning—this equips Hungary to build a hybrid, best-fit model that is both skills-oriented and regionally embedded. (Halász & Huang, 2025).

4.4 Impact, Absorptive Capacity, and the Dual Role of the EU Context

Recent EU and national evaluations present a nuanced picture of EU programme implementation and UIC impact in Hungary. HEInnovate and related entrepreneurial initiatives have contributed to strengthening institutional entrepreneurial mindsets and introducing self-assessment and change-management tools, yet limited stable funding, constrained expert networks, and uneven follow-up mean that changes often remain partial (European Commission, 2024a; OECD, n.d.). Knowledge Alliances and similar Erasmus+ actions show strong potential for embedding innovation culture and skills development into curricula, but their alignment with broader green and digital priorities could be further strengthened (European Commission, 2014, 2024a). The Commission's 2024 stock-take of UBC since 2008 acknowledges fragmentation and recommends soft coordination, consolidation and a unified digital entry point—useful cues for Hungary to reduce programme "silos" and raise sustainability.

The OECD-led LMRO study underlines persistent mismatches between higher education outputs and labour-market needs, particularly at doctoral level, and calls for deeper, more structured engagement of HEIs with employers in curriculum design and skills planning (LMRO, 2021). University–Business Fora create important networking and agenda-setting spaces, but their impact is limited by the underrepresentation of business actors and discontinuity in follow-up mechanisms (European Commission, 2024a; Kováts, 2020).

Hungarian HEIs also face **cultural and organisational distance** from industry: differences in time horizons, incentive systems, and language continue to weaken mutual trust and reduce the effectiveness of EU-funded initiatives (Kováts, 2020). This distance is further complicated by political tensions that affect access to certain EU funds, creating uncertainty and undermining long-term partnership building (FKA/MTA, 2023; Science|Business, 2023).

Consequently, the EU development context both **triggers and constrains** UIC/UII in Hungary. It triggers change by providing resources, norms, and networks that push universities towards entrepreneurial, skills-oriented, and regionally embedded roles. It constrains transformation when domestic absorptive capacities are limited, governance arrangements are unstable, and political conflict disrupts programme access.

Critical recommendations emerging from this analysis include:

- strengthening institutional capacities for strategic grant management and evaluation,
- improving multi-level governance coordination between EU, national, and regional actors,
- expanding national expert networks that can connect EU instruments with local realities, and
- consciously integrating international learning—among others from Chinese UII models—into EU-aligned strategies.

Only under such conditions can EU development policies function as **net enablers** rather than partial hinderers of Hungary's university–industry cooperation, and at a higher level, integration.

5. Adaptation Strategy for Hungary: A "Best Fit" UIC/UII Approach

The aim of this chapter is not to "copy–paste" Chinese university–industry integration (UII) into Hungary, but to design a **best fit** adaptation that respects Hungarian and EU institutional realities while drawing inspiration from the systemic strengths of the Chinese model. The strategy builds on three pillars: (1) context-sensitive principles of adaptation; (2) hybrid institutional models; and (3) adaptive, multi-actor governance informed by complexity thinking.

5.1 Principles of Adaptation

5.1.1 Contextual fit rather than mechanical transfer

Chinese UII is characterised by strong state steering, mission-oriented coordination, and close alignment between industrial policy and educational planning. Hungary, as an EU member state, operates in a **multi-level governance environment**, with shared competences between the EU, the national government, regions, and autonomous higher education institutions (HEIs). A best fit approach therefore:

- Treats Chinese UII elements as design principles, not templates.
- Aligns any imported mechanisms with EU frameworks (Horizon Europe, Cohesion Policy, EIT, Erasmus+) and domestic drivers (financing schemes, calls) and constraints (university autonomy, EU conditionalities, funding restrictions).
- Recognises **regional diversity** within Hungary, avoiding "one-size-fits-all" institutional blueprints.

5.1.2 Complexity sensitivity

UII development can benefit from the approach which suggests that it is not a linear implementation task but a **complex adaptive process** involving multiple actors, shifting incentives, and path dependence. The adaptation strategy:

- Accepts that outcomes cannot be fully predicted ex ante.
- Prioritises experimentation, piloting, and incremental learning over comprehensive reform packages.
- Uses evaluation frameworks (e.g. the EC UBC impact scorecard) as **learning devices** rather than compliance instruments.

5.1.3 Stakeholder engagement and co-production

Chinese UII's strength lies in its tight coupling between government, HEIs, and industry at the policy and project levels. In Hungary, historical mistrust, cultural distance, and fragmented governance constrain similar coupling. The best fit model, therefore:

- Puts **co-design** of strategies, curricula, and projects at the centre;
- Treats employers not only as beneficiaries but as **co-investors and co-governors** in key initiatives;
- Includes **students and local communities** as explicit stakeholders, recognising the skills and regional-development dimensions of UII.

5.2 Proposed Hybrid Models for Hungary

Building on these principles, three hybrid models are proposed that combine Chinese-style systemic integration with EU-compatible governance and funding instruments.

5.2.1 Sectoral FIEK 2.0: Mission-oriented integration hubs

The first hybrid model is a reimagined **FIEK 2.0** (Felsőoktatási és Ipari Együttműködési Központok) scheme, moving from generic cooperation centres towards **sectoral, mission-oriented hubs**:

- **Sector focus** means that each FIEK 2.0 aligns with a priority domain at the intersection of EU missions and national strategies (e.g. green manufacturing, health technologies, smart mobility, agro-food innovation).
- **Integrated portfolios** can build on hubs host a **portfolio** of joint activities—applied research, talent programmes, lifelong learning, start-up incubation, and policy labs—rather than isolated projects.
- **Multi-source funding** is crucial**.** The centres blend **EU funds** (Horizon Europe, Interreg, Digital Europe, EIT HEI Initiative), national grants (NRDI), regional support, and industry co-financing, reducing vulnerability to any single funding stream.
- **Shared governance, including** boards with representatives from HEIs, firms, local government, and intermediary organisations, mirroring Chinese tripartite structures but respecting Hungarian legal and EU state-aid constraints.

FIEK 2.0 thus may act as a **translation device**: it translates EU and national strategic missions into tangible, place-based UIC/UII platforms.

5.2.2 Talent pipelines: Integrated skills ecosystems

The second hybrid model emphasises **continuous talent pipelines**:

- **Vertical integration means** the design of articulated pathways from vocational and bachelor programmes through master's and doctoral levels, with **stackable credentials** and work-based learning elements co-designed with industry.
- **Horizontal integration allows** Cross-faculty and cross-institutional programmes (e.g. regional honours colleges, joint industry academies) that mobilise academic diversity around sectoral challenges.
- **Embedded practice** can lead to systematic use of internships, dual programmes, project-based learning, and industry mentoring, building on Chinese practice schools but aligned with European quality and accreditation standards.
- **Doctoral and postdoctoral alignment can be expected from** stronger integration of doctoral training with industrial research agendas, responding to labour-market relevance issues identified in the LMRO study, while protecting academic standards and independence.

This model supports a **skills-centred UII**, where cooperation is not an add-on but structurally built into how students are trained and retrained.

5.2.3 Curriculum integration and UII "design rules"

The third model addresses curriculum-level integration:

- **Curricular co-governance help** establish programme-level advisory boards with employer representatives who have a real say in learning outcomes, course portfolios, and assessment modes.
- **The design rules** are to introduce a small set of mandatory UII "design rules" for new or renewed programmes (e.g. minimum share of practice-based credits; at least one co-taught or co-supervised course/project with external partners; regular use of real-life case work).
- **Innovation studios** provide space for cross-disciplinary co-creation where students from multiple programmes work on industry or public-sector challenges using design thinking and entrepreneurship methods.
- **Micro-credentials can validate** the development of short, flexible courses, co-branded with industry partners, allowing working professionals and students to upskill in response to rapidly changing sectoral needs.

Combined, these measures anchor UII in **everyday educational practice**, not only in high-level strategy documents.

5.3 Roles and Responsibilities

A best-fit adaptation requires clearly articulated roles and shared responsibility across levels. The following proposals address the respective roles and responsibilities to consider steps that occur as expert advice.

5.3.1 Government

To increase **strategic steering** it is essential to define a limited number of **mission areas** where UII is expected to deliver systemic change and align funding calls, regulatory reforms, and evaluation criteria accordingly.

As part of the **framework conditions**, simplification or support administrative procedures for EU and national funding are needed that improve predictability and ensure that governance reforms do not jeopardise access to EU programmes.

As **incentives** and safeguards, design incentives that reward long-term partnership building and skills outcomes (e.g. funding weight for UII performance), while safeguarding academic freedom and preventing capture by dominant corporate actors.

Multi-level coordination means to strengthen coordination among national ministries, regional authorities, and EU representations to avoid fragmented signals to universities and businesses.

5.3.2 Higher Education Institutions

Institutional strategies have to embed UII and talent development explicitly, with clear targets and internal funding mechanisms.

Governance and leadership are advised to involve the creation or strengthening the vice-rectorates/offices for innovation and industrial partnerships with sufficient authority to coordinate across faculties and manage large portfolio programmes (e.g. FIEK 2.0 centres). The leadership supported an institutionalised interface division and responsibility must have transversal responsibility across the HEI, to provide internal and external proficiency transparency and reliability (contributing to mutual trust),

Capacity building needs investing in professional staff (from project managers, knowledge brokers to teachers, and researchers) who can translate between academic, industrial, and EU policy languages.

Culture and trust are also central. They encourage academic staff engagement through recognition in promotion criteria, workload models, and internal awards that value UII-related teaching, R&D&I and industrial cross-references. The present one-track, Mode1-based tenuring system should be replaced

by a three-tiered approach, in which market experience (with Mode2 record) and skill-development expertise (higher education learning and teaching competency portfolio) provide alternative promotion opportunities.

5.3.3 Industry Partners

Strategic engagement should move from "opportunistic" project participation towards **multi-year strategic partnerships**, especially in the sectoral hubs and talent pipelines.

Co-investment could mean shared financial and in-kind contributions (equipment, staff time, data, real-life challenges) to strengthen co-ownership of initiatives.

Governance participation (partnership) results in active roles in boards, advisory bodies, and curriculum committees with clear responsibilities and accountability.

Internal alignment needs to adapt HR and innovation processes (e.g. recruitment, training, innovation scouting) to leverage university partnerships systematically, not just ad hoc.

5.4 Risk Analysis and Mitigation Strategies

The adaptation of Chinese UII ideas into the Hungarian–EU setting involves several risks. Some of them are due to external factors.

5.4.1 Political and funding risks

Continued or renewed limitations on the access to EU funding for certain Hungarian universities, or abrupt changes in national higher education governance.

Mitigation tool is to diversify funding sources (EU, national, regional, private), design **modular projects** that can survive funding shocks, and strengthen cross-border consortia to maintain international embeddedness.

5.4.2 Institutional overload and projectification

Overloading HEIs with fragmented projects and reporting obligations, leading to "projectification" without deep organisational change.

Mitigation tool is to prioritise fewer, larger UII portfolios (e.g. FIEK 2.0) with integrated evaluation frameworks; consolidate projects under coherent institutional strategies; streamline internal procedures.

5.4.3 Inequalities and lock-in

Concentration of UII opportunities in a few large universities and sectors, reinforcing regional and institutional disparities; lock-in to current dominant industries, reducing resilience.

Mitigation tool is to use Cohesion Policy and S3 tools to support **lagging regions and smaller HEIs**; encourage diversification of sectoral hubs and periodic strategic reviews to avoid technological and industrial lock-in.

5.4.4 Cultural distance and trust deficits

Persistent mistrust and different time horizons between academia and industry, leading to weak partnerships and symbolic involvement.

Mitigation tool is to invest in **relationship-building infrastructures** (joint advisory boards, long-term chairs/professorships co-funded by industry, secondments in both directions); incorporate trust-building and communication training into UII capacity-building programmes.

5.4.5 Mission drift and academic integrity

Over-commercialisation or excessive alignment with short-term industry needs, undermining academic standards and public-interest missions.

Mitigation tool is to establish clear ethical guidelines, conflict-of-interest rules, and participatory governance mechanisms that keep **public value and long-term societal missions** visible in UII decision-making.

Chapter 6. Impact Measurement Framework: Theory of Change & Pathways

This chapter develops an **impact measurement framework** for the proposed "best fit" adaptation of Chinese University–Industry Integration (UII) to the Hungarian and EU context. It builds directly on:

- the European UBC impact evaluation approach (scorecard and success maps),
- the hybrid UIC/UII strategy outlined in Chapter 5, and
- a Cynefin-inspired view of different domain dynamics (ordered, complex, aporetic).

The aim is to provide a practical, theoretically grounded toolkit for planning, monitoring, and adaptively governing UIC/UII initiatives in Hungary. It does not offer definitive, fact-based claims about impact, but rather a way to **estimate impact probabilities** and to show, through the concept of **conversions along the impact chain**, what can be done to improve those conversions and thereby **increase the likelihood of impact**.

6.1 Theory of Change and Logic Model

The starting point is a **Theory of Change (ToC)** that links the proposed hybrid models (sectoral FIEK 2.0 hubs, talent pipelines, curriculum integration) to desired outcomes and long-term impacts. The ToC is operationalised through a **logic model** (in European development contect often referred as Logical Framework Model (log-frame approach)) with five main layers:

1. Inputs
   - Financial resources: EU and national funding, industry co-investment.
   - Human resources: academic staff, professional support staff, industry mentors.
   - Institutional assets: labs, digital infrastructure, IP portfolios, regional networks.
   - Policy and regulatory frameworks: EU programmes, national strategies, accreditation rules.
2. Activities
   - Joint research and innovation projects within sectoral hubs.
   - Co-designed curricula, dual programmes, and practice-based courses.
   - Talent pipeline initiatives (internships, doctoral–industry programmes, lifelong learning).
   - Governance and coordination mechanisms (advisory boards, policy labs, working groups).
3. Outputs (short-term, directly attributable products)
   - Number of joint projects, contracts, and collaborative programmes.
   - Students participating in UII activities (internships, challenge-based courses, etc.).
   - New or revised curricula with explicit industry participation.
   - Established structures: FIEK 2.0 centres, innovation studios, micro-credential offerings.
4. Outcomes (medium-term changes in behaviour, capabilities, relationships)
   - Enhanced employability and transversal skills among graduates.
   - Increased trust and repeated collaboration between HEIs and firms.
   - Greater alignment of research and education with regional and national missions (green, digital, health, etc.).
   - Institutional changes in governance, academic incentives, and internal processes.
5. Impacts and Sustained Change (long-term, systemic effects)
   - Improved regional innovation performance and **reduced RDI disparities**.
   - Stronger, more resilient **university–industry ecosystems** embedded in EU networks.
   - Enhanced **labour market relevance** of higher education, especially at advanced skill levels.
   - A more **adaptive, mission-oriented** Hungarian higher education system capable of integrating external shocks and opportunities.

Taken together, these five layers clarify **how** the proposed hybrid UIC/UII interventions are expected to work overtime. Instead of treating projects as isolated events, the logic model makes explicit the **assumed causal pathways** from resources and activities to behavioural change and long-term systemic impact. This is the backbone of the impact framework: later indicators, feedback loops and governance mechanisms all attach to one or more elements of this chain.

The logic model does **not** assume a single linear pathway. Instead, it recognises multiple, interacting pathways:

- a **skills pathway** (curriculum integration → student experience → employability and human capital),
- an **innovation pathway** (joint research/innovation → knowledge diffusion → firm performance and regional competitiveness), and
- an **institutional pathway** (governance reform → cultural change → long-term UII capability).

Measurement, therefore, must capture **diverse effects across these pathways**, for different stakeholders and time horizons. These three pathways are analytically distinct but interconnected in practice. By explicitly separating a skills pathway, an innovation pathway, and an institutional pathway, the framework avoids over-simplification and helps to design different indicators and interventions for each domain while still recognising their mutual reinforcement (their interactions and their potential synergies may contribute to the impact of the other pathways).

At the same time, the study emphasises that skills and innovation should not be treated as parallel or loosely connected domains. Skills—particularly applied, demonstrable competencies—are not a by-product of innovation systems, but one of their primary drivers, directly influencing collaboration dynamics and long-term impact.

6.2. Stakholder Analysis

From an ex-ante impact assessment perspective, university–industry integration is shaped not only by policy design and funding instruments, but critically by the management of stakeholders whose roles, skills, incentives, and interactions significantly influence conversion processes and impact outcomes. The following stakeholder analysis highlights key interdependencies that need to be recognised and actively managed in order to increase the probability of sustained impact in the Hungarian UII context.

Stakeholder Analysis for University–Industry Integration (UII) in Hungary

Stakeholder	***Core Role in UII***	***Key Interests***	***Main Risks / Constraints***	***Policy / Operational Instruments***
National Government / NRDI Office	*Strategic direction, funding allocation, regulatory framework*	*Economic competitiveness, innovation performance, EU alignment*	*Fragmentation of programmes; weak demand-side response; over-reliance on measurable outputs*	*RDI strategies, funding schemes (FIEK, Competence Centres), performance framework (service-agreements).*
Municipalities / Regional Authorities	*Local ecosystem coordination, infrastructure, investment attraction*	*Regional development, employment, industrial base strengthening*	*Limited coordination capacity; weak integration with HEIs; dependency on external investments*	*Smart Specialisation Strategies (S3), local incentives, cluster development initiatives*
Universities / HEIs	*Knowledge creation, talent development, UII platform leadership*	*Funding, academic performance, reputation, student recruitment*	*Misaligned incentives (research vs teaching vs UII); slow adaptation cycles; capacity gaps*	*Curriculum development, cooperative education, research partnerships,*

				internal incentive systems
Industry (large firms)	*Demand generation, co-development, application and scaling*	*Talent pipeline, innovation capability, operational efficiency*	*Limited incentive for formal cooperation; internal innovation ("hidden innovation"); short-term focus*	*Joint R&D projects, dual training, internships, co-funded programmes*
SMEs / Start-ups	*Agile innovation, niche collaboration, ecosystem diversification*	*Access to knowledge, talent, funding, networks*	*Limited capacity; high transaction costs; weak integration into UII schemes*	*Incubators, innovation hubs, cluster programmes, targeted SME support*
Intermediary organisations (clusters, chambers, agencies)	*Brokerage, coordination, translation between actors*	*Network development, project facilitation, regional innovation*	*Limited authority; fragmented roles; dependence on project funding*	*Cluster initiatives, matchmaking platforms, advisory services*
Quality assurance / accreditation bodies (e.g. MAB)	*Standard-setting, programme validation, quality control*	*Maintaining academic standards, system legitimacy*	*Difficulty addressing complex, practice-based learning; focus on formal compliance*	*Accreditation procedures, evaluation frameworks, programme approval systems*
Students / early-career professionals	*Participants and beneficiaries of UII processes*	*Employability, skills development, career opportunities*	*Limited engagement in programme design; mismatch of expectations*	*Internships, project-based learning, ePortfolios, dual programmes*

6.3 Governing complexity and the Cynefin-Informed Domain Mapping along impact stages

To avoid treating all problems as if they were the same, the framework adopts a **Cynefin-inspired lens** (Snowden & Boone, 2007), distinguishing between **ordered**, **complex**, and **aporetic (confusion)** domains at different stages of the impact chain (this study does count with the chaotic domain, and does not distinct the simple and complicated domains, handled together as ordered). This directly influences the necessary interventions, and what and how to measure. The applied model and characteristics of managing complexity is in line with the OECD approach of governing complex systems (Burns, Köster, 2016).

Applying complexity theory in managing change within education environments requires a paradigm shift from linear, top-down reform towards embracing the dynamic, interconnected, and emergent nature of HE systems (Burns, Köster, 2016, Ch.2). Higher education institutions, like broader education systems, function as complex adaptive systems comprising diverse actors—faculty, students, administrators, regulators, and external stakeholders—whose interactions produce outcomes that cannot be predicted solely from individual components.

Key principles for managing HE change through a complexity lens include considering emergence through Interactions. Change emerges from nonlinear, recursive interactions among stakeholders across multiple levels—classrooms, departments, institutions, and the wider academic ecosystem (Burns, Köster, 2016, p.43). This demands acknowledging that isolated initiatives rarely scale sustainably without being embedded in a supportive network of interconnected interventions.

System-wide sustainable change requires reaching a "critical mass" of aligned, mutually reinforcing actions that generate inertial momentum, overcoming entrenched practices and path dependencies common in HE settings (Burns, Köster, 2016, pp.44-48). Targeting resources strategically to systems or units where momentum can be catalyzed is critical rather than dispersing effort too thinly.

Effective change involves coordinated actions at multiple levels—individual teaching practices, departmental policies, institutional governance, partnership ecosystems, and policy frameworks—that collectively influence the system's emergent dynamics (Burns, Köster, 2016, pp.50-52). This integrated approach respects the interdependencies within HE environments.

HE governance should be flexible and adaptive, promoting experimentation, encouraging learning from failure, and enabling continuous adjustment in response to emerging challenges (Burns, Köster, 2016, Ch.8). Building capacity among academic leaders, faculty, and administrators to navigate complexity and collaborate is essential.

Complexity theory embraces the inherent uncertainty and unpredictability in managing educational change, underscoring the need for reflective practice, open dialogue, and inclusive stakeholder engagement rather than rigid top-down control (Burns, Köster, 2016, Ch.3).

In summary, based on the policy paper of OECD, managing educational change in higher education through complexity theory means moving beyond simplistic cause-effect models to foster an ecosystem of aligned, dynamic, and context-sensitive change processes that build momentum for systemic transformation (Burns, Köster, 2016).

The **Cynefin model** is a conceptual framework designed to help decision makers understand different types of situations or problems based on the nature of cause-and-effect relationships. It categorizes contexts into five distinct domains, each requiring different approaches to management and decision-making:

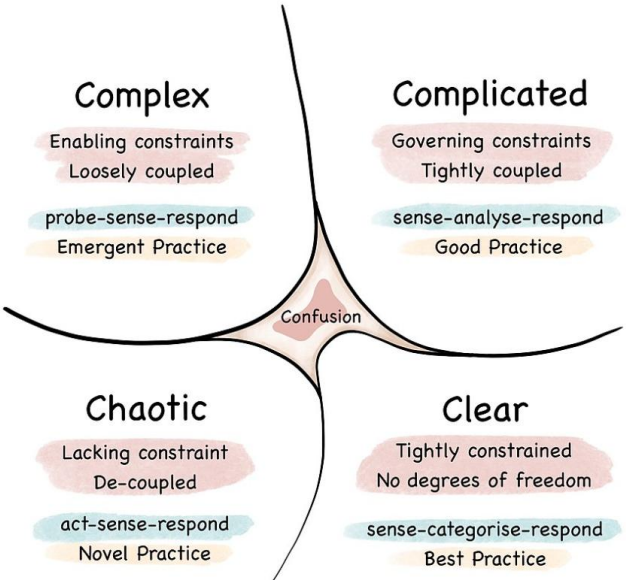
Clear (Simple) domain is where cause and effect are obvious and well understood. Best practices apply, and solutions follow established procedures and rules.

Complicated domain is where cause and effect exist, but they are not immediately obvious; expert analysis is needed. Good practices may guide decision-making here.

Complex domain is where cause and effect can only be understood in hindsight. *Patterns emerge* unpredictably through interactions. This domain requires flexible, negotiable boundaries, experimental approaches like safe-to-fail probes, sensing outcomes, and adapting (amplifying the attractors that work, and eliminating those that don't).

In the chaotic domain there are no perceivable cause-effect relationships; immediate action is needed to establish order. Rapid, novel responses are essential.

The confused (later aporetic) domain is characterised by the amorph central area where it is unclear which of the other domains applies. The situation needs to be broken down and routed to appropriate domains. This "Confusion" domain in the Cynefin framework is closely related to what Snowden later called as an "Aporetic" domain. This central domain represents situations where it is unclear which of the other domains (Clear (simple), Complicated, Complex, Chaotic) applies. It is often described as a liminal, or threshold state of puzzlement and paradox (aporia), where conventional ways of sense-making fail and leaders must deliberately create space to break down complexity before moving into other domains (cynefin.io, 2022; thecynefin.co, 2022).



Source: Wikipedia – The Cynefin Framework

Snowden and Boone emphasize that the framework encourages situational awareness to avoid oversimplification and complacency, especially where applying “best practice” can lead to catastrophic failure if complexity is misjudged (2007). The Cynefin framework’s distinction, between ordered (clear or complicated) and unordered (complex, chaotic) domains, enables context-sensitive governance and leadership strategies that align with the nature of challenges faced.

Combining this with the earlier tailored summary for higher education change management through complexity theory from Burns & Köster (2016), the presented approaches provide us the conceptual foundation of designing adaptive and differentiated policy interventions, as well their measurement for both prediction and backward justification.

6.4 Implementation Conditions Beyond Complexity

While a complexity-informed perspective provides an essential foundation for understanding UII implementation, it does not fully capture the range of conditions required for sustained impact. Insights from the Hungarian National Education Innovation System (NOIR) framework (Balázs et al., 2011) extend this perspective by conceptualising implementation not simply as adaptation under uncertainty, but as an innovation process shaped by multiple interacting system-level factors.

From this perspective, effective implementation depends on several enabling conditions. Governance and coordination across institutional and policy levels are critical, as is the presence of stable strategic commitment beyond project cycles. Implementation also requires a learning-oriented management approach, in which monitoring and feedback are embedded in decision-making processes, allowing continuous adjustment of interventions.

Equally important is the allocation and concentration of resources. Rather than dispersing funding across fragmented initiatives, impact-oriented implementation requires achieving a critical mass in areas where systemic change is expected. In parallel, capacity development—particularly the presence of intermediary and boundary-spanning roles—plays a decisive role in translating innovation into practice.

Finally, stakeholder engagement and legitimacy emerge as core conditions. The extent to which key actors understand, accept, and actively participate in UII processes directly influences the sustainability of outcomes. Taken together, these factors complement the complexity-based perspective by highlighting that adaptive implementation alone is not sufficient. In the logic of this study, sustained

impact depends on the alignment between learning processes and the structural conditions that enable successful conversion across the impact chain.

6.5. Applying a domain-based approach for the UIC-UII policy

For this study, we focus on three domains: Ordered (simple or complicated), Complex and Aporetic (confusion).

6.5.1 Ordered domains: Standardisation and compliance

Certain elements of UII operate in an **ordered domain**, where cause–effect relationships are relatively clear and stable—for example:

- Eligibility rules and financial procedures for EU and national funds.
- Accreditation requirements and basic quality-assurance criteria.
- Standard reporting obligations (project deliverables, financial audits).

Measurement implications

- **Standardise processes** (grant management workflows, contractual templates, IP frameworks) and associated indicators are welcomed.
- Use **routine administrative data** (number of funded projects, on-time reporting, audit results) as basic performance metrics.
- Invest in **training and digital tools** (project management systems, data dashboards) to minimise error and transaction costs.
- Avoid reinventing ordered-domain procedures at each institution or project.

Here, the role of the measurement system is mainly **compliance and efficiency**, ensuring that inputs and activities respect rules and that basic outputs are produced reliably. These points can be treated as **"good practice management"**: rules are known, processes can be codified, and performance is judged by reliability and efficiency. Making this domain visible prevents the framework from over-philosophising routine tasks and shows where **standardisation and automation** genuinely add value.

6.5.2 Complex domains: Ecosystem evolution and innovation

Most core dynamics of UII — trust-building, cultural alignment, curriculum including learning and teaching related mindset change, regional ecosystem development — lie in the complex domain. In this space, outcomes emerge from interaction and cannot be fully predicted in advance. They cannot be fully specified ex ante or reduced to linear cause–and–effect chains.

The recommended governance mode is **probe–sense–respond**:

- run pilots and controlled experiments (e.g. new joint programmes, governance models, challenge-based courses),
- monitor effects using mixed-method indicators (quantitative KPIs plus qualitative feedback and narratives),
- and then scale, adapt, or discontinue initiatives based on what works in context.

Sectoral FIEK 2.0 hubs, talent pipelines, and curriculum integration initiatives should therefore be treated as experiments with **built-in feedback loops**, not as fixed, once-and-for-all structures.

Evaluation in this domain prioritises learning and adaptability: indicators are used to identify patterns, tensions, and emergent successes, rather than to prove predetermined impact trajectories.

This point defines how the framework deals with those parts of UII that are inherently evolutionary and relational, rather than programmable. By framing hubs, talent pipelines and curriculum reforms as

complex-domain experiments, the chapter shifts the role of measurement from simple control to guided learning. Indicators here are designed to help actors *notice* what is emerging, make sense of it together, and adjust strategies accordingly. In other words, the list clarifies that in the complex domain, the impact framework is primarily a feedback and discovery tool, not a rigid performance scoreboard.

6.5.3 Aporetic domains: Uncertainty, contestation, and paradoxes

Some issues are **aporetic**—marked by conflicting values, unclear problem definitions, or deep political disagreement. Typically occurs when HEIs first meet the third mission challenge, or more directly the UIC expectations, and there are no established practices to respond to the call. In Hungary there are uncertainty factors that are unique to Hungary (the controversial EU relations), but others are typical internationally as well.

- Tensions between academic autonomy and strong state steering.
- Conflicts between EU conditionality and national sovereignty narratives.
- Debates about the role of universities: public good vs. economic competitiveness.
- Trade-offs between short-term industry needs and long-term academic missions.

Measurement implications

- The first task is **sense-making, not scoring**. Before choosing indicators, problems must be clarified and reframed.
- Use **dialogue-based tools**: scenario workshops, deliberative forums, policy labs, narrative inquiries with stakeholders.
- Avoid rushing to purely technical indicators (e.g. simplistic "relevance" scores) that mask value conflicts.
- Evaluation in aporetic domains is about **surfacing assumptions**, making trade-offs explicit, and opening up new solution spaces.

By consciously distinguishing ordered, complex, and aporetic elements, Hungarian decision-makers and HEI leaders can avoid **over-engineering** (treating complex problems as simple), and avoid **paralysis,** when treating manageable issues as intractable aporias.

This provides a realistic basis for designing **different measurement approaches** for different parts of the UII system.

6.6 Conversion Metrics and KPIs Aligned with Support Mechanisms

Building on the logic model and domain mapping, this section defines **conversion metrics** and **Key Performance Indicators (KPIs)** that track movement along the pathways from inputs to impacts, while remaining aligned with support mechanisms such as leadership, incentives, and feedback (to support conversion). KPIs have twofold characteristics. On the one hand they help reducing complexity, make system level aggregation/comparisons possible. On the other hand, it may result in oversimplification or misleadingly focusing only on KPIs.

6.3.1 The conversion logic

For each pathway (skills, innovation, institutional), we can define **conversion steps**, for example:

Skills pathway	Inputs (funding + staff time) → Activities (co-designed courses, internships) → Outputs (number of students in UII programmes) → Outcomes (employment rates, skills self-assessment, employer satisfaction) → Impacts (regional human capital indicators).

Innovation pathway	Inputs (research capacity, infrastructure) → Activities (joint projects, prototype development) → Outputs (patents, demonstrators, spin-offs) → Outcomes (firm productivity, diversification, innovation adoption) → Impacts (regional competitiveness, export performance).
Institutional pathway	Inputs (leadership time, governance reforms) → Activities (new offices, changed promotion rules) → Outputs (policies adopted, new roles created) → Outcomes (staff engagement in UII, cross-faculty collaboration) → Impacts (sustained UII capability, resilience to shocks).

Own edition

At each junction, **conversion metrics** ask: *what proportion of X becomes Y?* (e.g. share of programmes that actually embed UII design rules; share of collaborative projects leading to repeat cooperation; share of pilot activities that are institutionalised).

KPIs could be grouped into a small number of **groups**:

Engagement & volume KPIs (ordered domain)	• Number of active partnerships, projects, and programmes. • Participation rates (students, academics, companies). • Financial leverage (industry co-financing vs. public funding).
Quality, learning & relationship KPIs (complex domain)	• Student and employer satisfaction, perceived relevance of programmes, adaptive and responsive skills developed • Trust and collaboration indices (repeated collaborations, network centrality, diversity of partners). • Evidence of curriculum innovation, interdisciplinary teaching, joint governance.
Strategic alignment & transformative KPIs (complex/aporetic edge)	• Degree of alignment with green and digital missions in project portfolios. • Changes in promotion and incentive systems supporting UII. • Perceived balance between academic values and external demands.

KPIs should be integrated with leadership and incentive structures, not just monitored in isolation:

- Link some KPIs to the **institutional performance agreements** or national funding formulas (with caution and consultation).
- Use others as **internal steering tools** (dashboards for rectors, deans, heads of centres).
- Embed UII-related KPIs in **promotion criteria, recognition systems, and workload models** so that measurement translates into behaviour, not just reporting.

6.7 Feedback loops and adaptive governance

An impact framework only supports transformation if it is embedded in **feedback loops** and **adaptive governance**.

Multi-level feedback architecture should involve

- **micro-level,** where programme and project teams use short-cycle feedback (student surveys, partner debriefs, reflection workshops) to adjust teaching, collaboration formats, and communication,
- **meso-level** where faculties, FIEK 2.0 centres, and regional alliances use consolidated indicators to revise strategies, allocate resources, and prioritise partnerships,

- **and macro-level, where n**ational and EU-level bodies (ministries, NRDI, managing authorities) use evaluation results to refine calls, simplify rules, and adjust mission priorities.

Regular **"sense-making sessions"** (e.g. annual learning conferences, joint review panels) ensure that data turns into shared understanding and corrective measures, not just reports.

Adaptive governance practices could mean

- building **iterative cycles** into major initiatives: design → implement → evaluate → redesign,
- allowing for **controlled variations** across regions and institutions to see what works in different contexts (instead of forced uniformity),
- using evaluation **not only to judge success/failure**, but to identify promising patterns and scale them.

In this way, the measurement framework becomes a **governance instrument** that supports experimentation, rather than a static accountability tool.

6.8. The sequences of the domains depending on the preparedness of the governance of change

We can basically distinguish between:

- a **naive / instinctive** trajectory (system not prepared → aporia → pseudo-order → forced recognition of complexity → gradual differentiation), and
- a **professional / complexity-aware** trajectory (system starts from "this is complex" → carefully carves out ordered bits → runs experiments with built-in learning loops).

What happens to the aporetic domain in professional scenario? The short answer is that it doesn't disappear, but it changes role. It becomes more of a **warning signal** ("we're at the boundary of our current understanding / value consensus"), and less of a global state of confusion.

6.5.1 Two governance trajectories: Instinctive vs. professional, complexity-aware approach

The typical, largely **instinctive trajectory** of UIC/UII governance in multilevel systems is when actors first experience aporetic confusion, then superimpose a pseudo-ordered template, later discover underlying complexity, and eventually (in a positive scenario) learn to differentiate between ordered, complex and aporetic domains.

It is useful to contrast this with a more **prepared and professional scenario**, in which policy-makers and institutional leaders begin from an explicit recognition of complexity rather than from a denial of it.

(a) Instinctive, unprepared trajectory

- **Lived aporia dominates the start**: goals and expectations are unclear, values conflict, and roles across EU–national–institutional levels are also confused.
- **Top-down pseudo-order** is imposed to calm the system: a single logic model, over-specified calls for proposals, uniform KPIs, and standard recipes are promoted as if the problem were simple and generic.
- Implementation **runs into complexity**: local diversity, path dependencies and relational dynamics disrupt the planned chain of cause and effect.
- Over time, organisations that reflect on these experiences learn to **differentiate domains**: stabilising some routines as ordered, keeping others experimental (complex), and reserving some issues for ongoing deliberation (aporetic).

In this trajectory, the aporetic domain is the **starting condition**: the system feels confused, then tries to hide that confusion under a thin layer of faux simplicity, and only gradually learns to work with complexity more honestly.

(b) Professional, complexity-aware trajectory

A more professionally designed governance approach might invert the first steps:

- From the outset, key actors assume that UIC/UII is **inherently complex**: causal chains are long, context matters, and outcomes are emergent.
- **Ordered solutions are deliberately restricted** to well-understood, genuinely stable areas (e.g. eligibility criteria, financial procedures, basic data standards, standard IP clauses). The system does not pretend that one model fits all beyond these zones.
- In the core UIC/UII space, policy is designed as a **controlled experimental landscape**:
- parallel pilots and portfolio experiments,
- explicit probe–sense–respond cycles,
- and embedded feedback + learning loops at project, institutional and system levels.

Measurement is built in from the beginning as a **learning infrastructure**, not only as an accountability mechanism. Indicators are chosen to reveal patterns and tensions, not just to confirm expectations.

In this professional trajectory, the **aporetic domain still plays a role**, but differently:

It no longer addresses the whole system; instead, it appears at **boundaries and interfaces**:

  - when there is disagreement about whether a given issue is ordered or complex (e.g. “Is this partnership model mature enough to standardise?”),
  - when experimental results point in divergent directions,
  - or when deeper value conflicts surface (e.g. around autonomy, equity, or mission priorities).

Aporetic “moments” become **diagnostic signals** rather than permanent states: they signal that the current classification or design is inadequate, prompting **reframing, dialogue and design adjustment**, rather than defensive over-simplification.

In this second scenario, the system does not start in aporetic confusion and then pretend simplicity. Instead, it starts with **explicit complexity**, limits order to clearly justified areas (this means that identified (and justified) areas for standardisation can be enhanced while reducing complexity) and uses aporetic symptoms as **early warning signs** that something important is mis-specified or contested.

How this helps our measurement framework? We can connect this contrast back to our impact framework. In the instinctive scenario, the measurement system is often introduced as a **rigid ordered template** and only slowly repurposed into a learning tool. In the professional scenario, the measurement system is **designed from the start** to distinguish ordered vs. complex areas, to support experimentation, and to treat aporetic flare-ups as prompts for **sense-making** rather than as failures. While standardisation can gradually be enhanced.

We can summarise both trajectories in a table.

Table 2 Complex or simplified policy approach

Stage	**Instinctive trajectory**	**Professional, complexity-aware trajectory**
Initial framing	Lived aporia, confusion	Explicit assumption of complexity
First response	Imposed pseudo-order, single recipe	Limited ordering in clearly stable areas only

Stage	Instinctive trajectory	Professional, complexity-aware trajectory
Implementation	Hidden complexity breaks the template	Planned experimentation, probe–sense–respond cycles
Role of measurement	Primarily compliance, later repurposed for learning	Designed from the outset as learning + governance tool
Role of aporetic domain	Global state of confusion at the start	Localised warning signal at boundaries and value conflicts
Mature state	Gradual, often painful differentiation of domains	Parallel handling of ordered, complex and aporetic domains by design

The author's edition

Empirically, the Hungarian–EU UIC/UII landscape resembles the **instinctive trajectory** more than the professional one. Policy instruments and impact expectations have typically been introduced as **top-down, standardised solutions**, assuming linear cause–effect chains and broad transferability across institutions and regions. The complexity of local configurations—differences in regional capacity, organisational culture, prior relationships and political tensions—has tended to surface only during implementation, often in the form of resistance, project overload or disappointing outcomes.

The framework developed in this chapter aims to **reorient this trajectory**. It assumes from the outset that UIC/UII is a **complex, path-dependent process**; treats standardisation and ordered-domain metrics as useful but limited tools for clearly defined areas; and builds a structured space for **pilots, mixed-method feedback, and adaptive redesign**. In doing so, it seeks to move Hungarian UIC/UII governance closer to the **professional, complexity-aware scenario,** where complexity is acknowledged upfront, order is applied selectively, and aporetic signals are used as triggers for reflection rather than suppressed.

6.9 Ex-ante impact assessment, conversion analysis and probability of success

The logic model and domain mapping developed above do not only support ex post evaluation; they also enable **ex-ante impact assessment**. Before launching a UIC/UII intervention (e.g. a sectoral FIEK 2.0 hub or a new talent pipeline), policy-makers and institutional leaders can use the model to **predict likely impact patterns and success probabilities** and to identify where design improvements would have the greatest leverage.

6.9.1 Using the logic model as a predictive scaffold

Ex-ante assessment starts by mapping a proposed intervention onto the **five layers** of the logic model:

- Inputs → Activities → Outputs → Outcomes → Impacts

For each step, decision-makers ask:

- What do we expect to happen at this stage?
- How likely is it that the next step will follow from the previous one, given current conditions?

This translates into **conversion expectations**, for example:

- share of planned activities that will actually be implemented,
- share of implemented activities that will generate the intended outputs,
- share of outputs that will translate into behavioural or capability changes (outcomes),
- and share of outcomes that will contribute to measurable systemic impacts.

By making these assumptions explicit, ex-ante impact assessment turns vague optimism ("this will be good for innovation and skills") into a **structured set of conditional probabilities** along each pathway (skills, innovation, institutional).

The purpose of this step is not about predicting exact numbers but about making transparent **where** impact is expected to emerge, and **how fragile** each link in the chain is. It forces designers to confront weak assumptions and to think in terms of **bottlenecks and leverage points, as call for supportive measures** rather than generic hope.

6.9.2 Conversion rates and (improvable) probability of success

Within this perspective, the **probability of success** of a given intervention is a function of:

- the **baseline conversion rates** at each step of the chain, and
- the degree to which the intervention improves those rates compared to business as usual.

Examples:

- If many UIC projects in Hungary are launched but only a small share lead to **sustained partnerships**, the critical conversion is not "projects funded" but "projects → repeat collaboration".
- If new curricula are approved but rarely change how students **actually learn** or how employers **perceive graduates**, the conversion problem lies between "curriculum documents" and "student/firm behaviour" – not at the input stage.

Ex-ante, designers can:

- estimate **baseline conversions** (from prior programmes, evaluations, or expert judgment),
- define **target conversions** they seek to reach (e.g. doubling the share of pilots that become institutionalised), and
- assess whether the proposed design and support mechanisms are **plausibly sufficient** to shift those rates.

Why this matters? Instead of asking a general "will this programme work?", the framework asks **"which conversions are most fragile, and what do we do about them?"**. This is a more realistic and actionable notion of "probability of success".

6.9.3 Factors influencing conversion rates

Conversion rates at each stage are shaped by a mix of **design features, capacities, and contextual conditions**. Key influencing factors include:

Strategic alignment

- Fit between the intervention and EU/national missions (green, digital, regional priorities)
- Clarity of goals and theory of change shared by partners.

Institutional and human capacity

- Availability of professional project management, legal/IP support, and data infrastructure
- Time and skills of academics and industry staff to engage in UII.

Incentive structures

- Recognition of UII work in academic promotion and workload models.
- Tangible benefits for firms (access to talent, innovation, networks).

Trust and relationship quality

- History of collaboration or conflict between partners.
- Perceived fairness and transparency in governance and resource allocation.

Governance and coordination

- Clarity of roles across ministries, agencies, HEIs, and firms.
  Flexibility to adjust rules and procedures when pilots reveal unforeseen issues.

Domain type (ordered vs complex vs aporetic)

- In justified ordered areas, conversions depend on **clear rules and reliable processes**.
- In complex areas, conversions depend more on **experimentation, feedback, and adaptive learning**.
- Aporetic symptoms (contested values, unclear problem definitions) can stall conversions entirely if not recognised and addressed through **informal or institutionalised forms of dialogue**.

Ex-ante assessment uses these factors to **judge the realism of assumed conversions**: where capacities, incentives, trust or governance are weak, conversion assumptions must be downgraded or compensating design elements added.

The purpose of this analysis is to tie conversion rates to identifiable factors, possible supporting actions/mechanisms. This framework shows **how the probability of success can be improved** not abstractly, but through targeted adjustments in design (more support for project management, better incentive alignment, deliberate trust-building, clearer role definitions, etc.).

6.10. Synthesis

From Conceptual Learning to Context-Specific, Impact-Oriented Transformation

Chapters 3 and 4 have shown that Hungarian university–industry cooperation (UIC) and university–industry integration (UII) are shaped by two interlocking forces: (1) the internal dynamics, capacities and path dependencies of the Hungarian higher education and innovation system, and (2) the wider European policy and funding environment that simultaneously enables and constrains institutional change.

Chinese UII models, as explored in Chapter 3, offer a rich repertoire of **systemic coordination mechanisms, mission-oriented steering and deep integration of industry needs into educational planning**. At the same time, Chapter 4 highlighted that EU-level strategies and programmes—Horizon Europe, Cohesion Policy, EIT, Erasmus+—already push Hungary towards more entrepreneurial, skills-oriented, and ecosystem-based roles for universities, but **absorptive capacity limits, governance tensions, and cultural distance** slow down this transition.

This study has argued that meaningful learning from the Chinese experience is only effective if it is **not limited to conceptual admiration**. Learning must be **adapted to the domestic EU, national and organisational context**, and then translated into **concrete design and implementation choices**. Simply importing UII "best practices" without this adaptation leads either to superficial copying or to resistance. The proposed adaptation strategy therefore does not ask whether Hungary should follow a "Chinese" or a "European" path, but how to **compose a best-fit hybrid** that respects Hungary's EU-embedded, multi-level governance context while borrowing the most relevant features of Chinese UII.

Chapters 5 and 6 together specify how this best-fit hybrid can be **designed and steered**. The adaptation strategy does this in three main ways:

- by defining **principles of adaptation** (contextual fit, complexity sensitivity, stakeholder co-production) that guard against naïve policy transfer;
- by outlining **concrete hybrid models** (sectoral FIEK 2.0 centres, integrated talent pipelines, curriculum-level design rules) that operationalise UIC/UII at institutional and regional levels; and
- by clarifying roles, responsibilities, and risk-mitigation mechanisms across government, HEIs and industry, supported by an explicit use of ordered, complex and aporetic domain thinking.

On this basis, Chapter 6 has added a second, crucial layer: an **ex-ante impact measurement and governance framework** that makes this adaptation process **impact-oriented and manageable under conditions of complexity**. Three elements are central here:

1. A **logic model / logframe** that links inputs, activities, outputs, outcomes and impacts along several pathways (skills, innovation, institutional change). This model is not only descriptive: it serves as a **predictive scaffold** for ex-ante assessment. By attaching **conversion rates** to each step, it becomes possible to reason explicitly about the **probability of success**, to identify fragile links in the chain, and to see where design and support tools (capacity building, incentives, governance reforms) are most needed.
2. A **Cynefin-inspired treatment of domain types**—ordered, complex, aporetic—that prevents the framework from collapsing everything into a single, pseudo-ordered narrative. Ordered domains (e.g. eligibility rules, basic reporting, standardised procedures) can legitimately be managed through fixed rules and routine indicators. Complex domains (ecosystem evolution, trust-building, curriculum change) require **probe–sense–respond cycles**, mixed-method indicators, and feedback-driven adjustment. Aporetic situations (value conflicts, contested missions, EU–national tensions) call for **deliberative sense-making**, not just more KPIs. This study has also contrasted an **instinctive trajectory** (aporia → pseudo-order → painful discovery of complexity) with a more **professional, complexity-aware trajectory** that starts

from an explicit assumption of complexity, limits ordered solutions to genuinely stable areas, and treats aporetic "symptoms" as early warning signs at domain boundaries.

3. An **investment–impact perspective**, operationalised through **conversion funnels and ex-ante risk mapping**, which forces decision-makers to consider both sides of the equation. On the one hand, the **investment / cost / effort side**, what resources, capacities and governance changes are required to achieve given conversion improvements; and, on the other, the **impact side**, what types of skills, innovation and systemic effects are realistically attainable at the end of the funnel under different design scenarios.
   This perspective supports more honest choices between options: it clarifies that not all impact types can be maximised simultaneously and that some conversions (e.g. from pilot projects to institutionalised practice, or from new curricula to measurable employability gains) are structurally harder than others.

Taken together, these need an adapted UIC/UII model that **cannot be covered by a collection of isolated projects**, but as a **strategic capability of the Hungarian higher education system**—anchored in long-term missions, structured around integrated portfolios, and continuously adjusted through **evidence-informed, ex-ante, ongoing and ex-post evaluation**. Chinese UII provides **directional lessons** (stronger mission orientation, systemic coordination, tighter education–industry coupling), while the EU framework and the Hungarian context define the **boundary conditions** and available instruments. The conceptual models developed in this thesis—logic/logframe with conversion analysis, Cynefin-based domain mapping, and funnel-type investment/impact reasoning—act as **translation and navigation tools** that make emergent complexities more manageable without oversimplifying them.

The subsequent empirical follow-up (or future research) can test and refine this combined strategy and impact framework in practice. Through case studies of selected Hungarian HEIs, sectoral hubs and curriculum innovations, such work could examine:

- how far existing UIC/UII arrangements already approximate the proposed hybrid models;
- how the **instinctive vs. professional governance trajectories** play out empirically in different institutional and regional settings;
- which EU and national instruments are most effectively leveraged (or underused) in improving **conversion rates** along the skills, innovation and institutional pathways;
- how stakeholders perceive and navigate the **ordered–complex–aporetic dynamics** in design and implementation; and
- what kinds of **practical design rules, governance mechanisms and indicator sets** emerge as robust across different contexts for ex-ante assessment, ongoing feedback, and adaptive redesign.

In this sense, this study does not offer a final blueprint, but a **conceptual and methodological platform** for ongoing, context-sensitive policy learning: a way to move from abstract appreciation of Chinese and European experiences to **domestically grounded, impact-oriented transformation** of Hungarian UIC/UII.

7. Conclusions and Recommendations

7.1 Key Conclusions

This study has pursued a double ambition:

(1) to learn from Chinese university–industry integration (UII) as a powerful example of systemic coordination; and
(2) to translate that learning into a context-sensitive, impact-oriented framework for Hungarian university–industry cooperation (UIC) within the EU/national multilevel environment.

Three overarching conclusions emerged:

1. **No model travels "as is".** Chinese UII is a source of direction but cannot be interpreted as a template. Chinese experience demonstrates the value of mission-orientation, tight education–industry coupling and strong state coordination. However, without adaptation to EU legal constraints, Hungarian governance realities and institutional path dependencies, direct transfer would either remain symbolic or generate resistance. Learning must therefore be translated, not copied.

2. **Hungary's challenge is not a lack of instruments, but a lack of integrated, complexity-aware use.** EU and national tools—Horizon Europe, Cohesion Policy, EIT, Erasmus+, NRDI schemes—already offer rich opportunities for UIC/UII. However, fragmented strategies, uneven capacities and political tensions mean that these instruments are often used as project funding streams, rather than as levers for systemic change.

3. **Impact depends on conversion, not just on inputs.** UIC/UII success hinges on conversion rates along several pathways (skills, innovation, institutional change): from funded projects to implemented activities, from activities to meaningful participation, from participation to changed behaviour and capabilities, and from these to durable systemic impacts. The proposed logic model, Cynefin-based domain mapping, and ex-ante conversion analysis together show that improving a few critical conversions (for instance from pilots to institutionalisation, or from new curricula to demonstrable employability gains) can matter more than simply increasing the number of funded initiatives.

These conclusions position UIC/UII as a strategic, system-level capability, not as a side activity. The following sections translate these insights into structured recommendations and an implementation-oriented roadmap.

7.2 Targeted Recommendations

To enhance clarity and practical applicability, the recommendations of this study are structured at two complementary levels. **Strategic recommendations** define system-level directions for policy and governance, while **operational recommendations** translate these directions into concrete actions linked to specific conversion processes and implementation pathways.

This distinction reflects the central argument of the study: impact in UIC/UII emerges not from isolated interventions, but from the alignment between strategic intent and effective implementation.

7.2.1 Strategic Recommendations for Policymakers (EU, national, regional)

Start from complexity, not from pseudo-order. Design UIC/UII programs with the explicit assumption that outcomes are context-dependent and emergent. Use ordered tools (clear rules, standard procedures) only where cause–effect relationships are stable, and reserve space for experimentation elsewhere.

Use missions to focus, not to command. Define a limited number of mission domains (eg green manufacturing, health tech, smart mobility) where UIC/UII is expected to deliver systemic impact. Align funding calls, regulatory flexibilities and evaluation criteria accordingly, while avoiding over-specification of institutional responses.

Reward conversion, not just volume. Complement traditional indicators (number of projects, funds absorbed) with conversion-sensitive metrics: eg share of pilots institutionalized; share of joint programs leading to repeat partnerships; share of students in UII activities with measurable skill gains. Use these metrics in performance dialogues and program reviews.

Stabilize framework conditions. Ensure predictable and transparent governance conditions, including stable access to EU funding and clear regulatory environments. Long-term institutional investment in UIC/UII depends on trust in the stability of the system.

These recommendations define strategic directions; their effectiveness depends on how they are translated into operational practices at institutional and program level.

7.2.2 Operational Recommendations for Higher Education Institutions

The following operational recommendations translate strategic directions into institutional practices:

- **Make UIC/UII an institutional, not only a project agenda.** Embed UIC/UII in university strategies, with clear pathways (sectoral hubs, talent pipelines, curriculum integration) and internal resource allocation, rather than relying solely on external project funding.
- **Differentiate governance by domain.** Treat grant management, IP routines and reporting as ordered domains to be standardized and professionalised. Treat ecosystem-building, teaching innovation and partnership development as complex domains, governed through pilots, feedback loops and adaptive refinement.
- **Align incentives with desired conversions.** Promotion criteria, workload models and internal funding mechanisms should explicitly reward conversions such as pilot-to-programme transitions, sustained partnerships, and demonstrable skills outcomes.
- **Invest in boundary-spanning capacities.** Strengthen roles such as knowledge brokers, project managers, legal/IP experts and data stewards who can navigate across institutional, regulatory and industry boundaries. These roles are central to improving conversion rates.

7.2.3 Operational Recommendations for Industry Partners

From an operational perspective, industry actors play a critical role in shaping conversion processes:

- **Engage for the long term, not only for projects.** Move from opportunistic participation to multi-year strategic partnerships, especially in priority sectors.
- **Co-invest and co-govern.** Contribute financial and in-kind resources, and participate in governance structures. Shared ownership increases alignment and trust, thereby improving conversion outcomes.
- **Use UIC/UII to transform internal practices.** Integrate university partnerships into HR, innovation and capability development strategies. Impact is higher when firms adapt themselves through collaboration.

These recommendations position industry not as a client, but as a co-architect of UIC/UII ecosystems.

7.3 Roadmap for Implementation and Continuous Evaluation

The following roadmap operationalises both strategic and operational recommendations over time:

Short term (1–2 years): Select pilot sectors or regions; map existing initiatives; identify conversion bottlenecks; introduce basic domain differentiation and feedback loops.

Medium term (3–5 years): "Consolidate and scale selectively" Institutionalize successful pilots; develop hybrid monitoring systems; integrate conversion insights into funding and evaluation schemes.

Long term (5+ years): "Normalise adaptive governance" Embed complexity-aware governance; use ex-ante conversion analysis systematically; engage in international benchmarking and policy learning.

7.4 Enabling Mutual Learning Through Chinese Participation

Building on the study's policy learning perspective, there is scope to consider carefully designed forms of Chinese participation as a means of enabling mutual learning in university–industry integration (UII) within the Hungarian context. Rather than implying the transfer of institutional models, such engagement

can serve as a structured interface for knowledge exchange, allowing experience developed in different governance and innovation contexts to inform local adaptation.

Possible forms of engagement include advisory roles, joint academic and research initiatives, study visits, and participation in pilot programmes. These formats provide direct exposure to implementation practices, organisational solutions, and skills development approaches that are difficult to capture through secondary analysis alone. At the same time, they create opportunities for reciprocal learning, as Chinese actors engage with EU-based regulatory, quality assurance, and multi-level governance frameworks. For such cooperation to be effective, it needs to be explicitly linked to implementation and learning objectives. In the logic of this study, this implies connecting international engagement to concrete conversion points—for example, supporting the transition from pilot initiatives to institutionalised programmes, or from prototype development to real-world adoption.

At the same time, such engagement requires careful consideration of contextual constraints, including EU regulatory frameworks related to data protection, intellectual property, and procurement, as well as broader geopolitical sensitivities. When appropriately designed, selective and purpose-driven participation can act as a catalyst for policy learning, strengthening the capacity of Hungarian institutions to translate international experience into locally embedded practice.

7.5 Future Research and Development Options

Finally, the study opens several promising lines for further research and practical development.

AI-assisted monitoring and sense-making. Explore how AI tools can help process large volumes of project data, text reports and network information to detect patterns, weak signals and emergent clusters in UIC/UII—especially in the complex domain.

Data-driven mapping of innovation ecosystems. Combine administrative, bibliometric, patent, and collaboration data to create more fine-grained pictures of how Hungarian UIC/UII ecosystems evolve over time and how they compare with Chinese and other European cases.

Cross-national comparative studies of adaptation trajectories. Investigate how different EU member states (and regions in China) move along the instinctive vs professional trajectory of domain handling, and what institutional conditions enable a more complexity-aware approach.

Micro-level studies of conversion mechanisms. Conduct in-depth case studies on specific conversions (e.g. pilots → institutionalisation; new curricula → employability gains) to understand the micro-mechanisms, including the roles of incentives, leadership and boundary-spanning professionals.

The purpose is that these directions emphasise that the study is not an endpoint, but a platform for ongoing experimentation that can benefit from AI, richer data and cross-national learning.

Research of Futures: Iterative Alignment of Impact Pathways and System Dynamics

The relevance of Research of Futures, emerging from this study is expected to move beyond linear evaluation models and adopt an iterative approach that aligns impact-oriented interventions with evolving system dynamics. In complex university–industry integration (UII) contexts, impact expectations cannot be treated as fixed targets; rather, they need to be continuously recalibrated in relation to changing conditions, stakeholder behaviour, and emerging opportunities.

This implies a form of **parallel iteration** between two dimensions. On the one hand, project- and policy-level interventions are designed and adjusted based on expected impact pathways, including targeted improvements in conversion processes. On the other hand, research efforts focus on understanding and anticipating changes in the broader environment—such as labour market transformations, technological developments, and shifts in institutional behaviour—that influence the feasibility and relevance of these pathways.

The interaction between these two dimensions creates a dynamic feedback loop, in which intervention design and system understanding co-evolve. In this perspective, future research is not separated from implementation,

but becomes an integral part of **impact management**, supporting continuous learning, adaptation, and refinement of policy and institutional strategies.

8. Rethinking Quality Assurance in Complex UII Contexts

This study highlights the need to reconsider the role of quality assurance (QA) in university–industry integration (UII), particularly in contexts characterised by complexity, multi-actor collaboration, and long impact chains. While traditional QA approaches—based on standardisation, compliance, and predefined criteria—remain essential in ordered domains such as financial management, accreditation, and regulatory oversight, they are not sufficient to capture the quality and effectiveness of UII processes.

In complex UII systems, quality is not primarily a function of procedural compliance, but of demonstrated outcomes. This requires a shift towards evidence-based QA approaches that assess whether intended changes **occur**—especially in relation to skills development, collaboration dynamics, and the real-world application of outputs.

From the perspective of this study, QA becomes a key mechanism for validating conversion processes along the impact chain. It provides evidence on whether activities lead to meaningful outputs, whether outputs translate into behavioural or capacity changes, and whether these changes result in sustained outcomes. In this sense, QA supports not only accountability but also learning and adaptation. This implies a dual QA logic. Standardised procedures remain necessary in ordered domains, while evidence-based validation mechanisms are required in complex domains. Instruments such as competency frameworks, authentic assessment methods, ePortfolios, and external stakeholder validation offer more reliable insights into effectiveness than compliance indicators alone.

Positioned in this way, QA evolves from a control function into a system-level capability that supports impact management. It enables institutions and **policymakers** to identify what works, understand why it works, and improve conversion processes over time. In complex UII contexts, quality is therefore not prescribed but demonstrated through verified impact pathways.

9. Reflective Addendum: Expert Feedback and Confirmatory Insights

The expert feedback received on the draft study provides important confirmation of its core analytical direction, while also highlighting several areas where emphasis, clarification, or illustration can further strengthen interpretation and practical relevance. Rather than introducing new conceptual elements, these remarks largely reaffirm the study's central premise: that effective university–industry cooperation and integration (UIC/UII) depend on the alignment of skills development, innovation processes, governance arrangements, and context-sensitive implementation.

A first key observation concerns the relationship between skills development and research and innovation (R&I). The expert remarks support the study's skills-oriented approach, while suggesting that this perspective should be more explicitly connected to the R&I dimension. This reinforces the interpretation that skills and innovation are not separate domains, but interdependent components of a shared system, where talent development, applied research, and industry collaboration mutually reinforce each other.

The importance of grounding the analysis in the Hungarian context was also emphasised. The suggestion to include concrete examples of China–Hungary university–industry collaborations, as well as organically evolving domestic partnerships, aligns with the study's intention to connect conceptual insights with observable practice. Such examples help illustrate how integration dynamics unfold beyond formal programme structures and funding cycles.

Several comments pointed to the value of a more explicit stakeholder perspective. This confirms the relevance of mapping the roles and interactions of key actors—government, universities, industry, and intermediary organisations—in shaping UIC/UII outcomes. The study's governance-oriented approach

is thus strengthened by recognising the need to make these interdependencies more visible and actionable.

The interpretation of Chinese policy and governance was also validated and nuanced by expert input. In particular, the characterisation of the system as “centre-integrated” rather than purely top-down reinforces the study’s argument that effective coordination combines strategic direction with local initiative. This perspective supports the transferability logic developed in the study, which emphasises adaptation rather than replication.

The feedback further highlighted the significance of pedagogical transformation, especially the integration of research-oriented and applied talent development. This aligns closely with the study’s focus on skills as a central driver of sustainable UIC/UII and confirms the importance of mechanisms that connect learning environments with real-world application.

The role of complexity in implementation was explicitly endorsed. Experts emphasised that understanding what constitutes “complex” in practice—and linking this to concrete implementation approaches—is essential. This directly supports the study’s use of domain-sensitive (ordered, complex, aporetic) frameworks and its emphasis on iterative, feedback-driven development processes.

An additional important insight concerns the functional parallels between European and Chinese approaches. While differing in governance style, both systems rely on programme-based and portfolio-based development logics. This observation reinforces the study’s comparative framing and supports the feasibility of context-sensitive adaptation.

The possibility of more active Chinese participation in Hungarian UIC/UII initiatives was identified as a particularly significant consideration. This includes advisory roles, joint platforms, and structured knowledge exchange. At the same time, the feedback also points to the need for careful consideration of contextual constraints, including regulatory and geopolitical factors—an aspect already reflected in the study’s emphasis on risk-aware adaptation.

Quality assurance emerged as another area where expert views strongly align with the study’s conclusions. In complex domains, traditional standardisation-based approaches are insufficient, and greater emphasis must be placed on evidence-based validation of outcomes. This confirms the study’s argument for a dual approach to quality, combining standardisation in ordered domains with more flexible, evidence-driven mechanisms in complex settings.

Finally, the feedback underlined the importance of clearly distinguishing between strategic and operational recommendations, as well as ensuring that empirical work—particularly interviews—captures both the skills dimension and the China-related comparative perspective. These remarks support the study’s effort to maintain a balance between conceptual clarity and practical applicability.

Overall, the expert comments do not challenge the main analytical framework of the study; rather, they reinforce its key assumptions and highlight its relevance. They also point towards directions for further empirical validation and contextual refinement, particularly through continued stakeholder engagement and iterative learning processes.

An additional informal expert discussion with the Innovation Director of one of Hungary’s largest research universities, conducted in the context of a development project on the impact prediction of social innovations, further reaffirmed a key methodological insight of this study. The discussion highlighted that impact forecasting in complex university–industry and innovation ecosystems cannot be treated as a fully rational or deterministic exercise. The high number of interacting variables, their interdependencies, and their conditional influence on outcomes make precise ex-ante prediction inherently limited. Instead, the emphasis should shift from predicting impact to managing it. In the conceptual language of this study, this implies a deliberate focus on the management of conversion points across the impact chain, where targeted interventions can improve conversion rates and thereby increase the probability of achieving sustained, meaningful impact.

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Annex 1: Case-relevant examples for the impact chain of the Hungarian adaptation of Chinese UIC/UII

Logic level	Typical question	Case-relevant examples for Hungarian adaptation of Chinese UIC/UII
Inputs	What resources and conditions do we put in?	**Policy & governance inputs:** Government decision to treat UII as a strategic priority; launch of sectoral FIEK 2.0–type centres; alignment with EU missions and programmes (Horizon Europe, Cohesion Policy, EIT, Erasmus+). **Financial inputs:** NRDI and EU funds earmarked for integrated UIC/UII portfolios; co-financing commitments from firms and regional authorities. **Human & organisational inputs:** UII "champions" in ministries and HEIs; professional staff (project managers, knowledge brokers, legal/IP experts, data stewards); academic time allocated for UII design. **Knowledge inputs:** Synthesised lessons from Chinese UII; EU UBC impact evaluation frameworks and prior Hungarian evaluations.
Activities	What do we actually do with those inputs?	**Policy design & adaptation:** Co-design workshops using Chinese UII lessons to sketch Hungarian FIEK 2.0 models; drafting UII-sensitive funding calls; defining curriculum "design rules". **Institutional & programme activities:** Establishing or reshaping sectoral hubs; co-developing integrated talent pipelines (dual programmes, internships, industry PhDs); running curriculum redesign projects with industry and students. **Evaluation & learning:** Building logic models and conversion funnels for pilots; running surveys and learning reviews; joint workshops to classify issues as ordered/complex/aporetic and choose governance tools.
Outputs	What immediate, tangible products are created?	**Structures & agreements:** Number of FIEK 2.0-like centres formally established; new or updated UII framework agreements, IP and internship contracts. **Programmes & courses:** New or redesigned degree programmes with explicit UII components; number of challenge-based courses, dual-study tracks, internships launched. **People & participation:** Academic staff trained in UII/complexity-aware design; students enrolled in UII-intensive programmes; industry mentors and partner organisations actively involved. **Tools & frameworks:** Documented logic models, conversion funnels, indicator sets; internal guidelines on domain-sensitive governance for UII.
Outcomes (short/medium term)	What changes in behaviour, capabilities, relationships?	**Skills & education outcomes:** Improved employability, transversal and entrepreneurial skills of students in UII programmes; faculty adopting practice-based, co-taught, project-based pedagogy as normal. **Relationship & trust outcomes:** Higher rate of repeat collaboration between HEIs and firms; more cross-faculty and cross-institutional collaboration around sectoral hubs. **Institutional outcomes:** UII integrated into university strategies, promotion criteria and internal funding rules; stable UII support structures created

Logic level	Typical question	Case-relevant examples for Hungarian adaptation of Chinese UIC/UII
		beyond project cycles. **Governance outcomes:** Ministries and agencies using ex-ante conversion analysis when designing calls; regular joint sense-making forums (policy labs, annual reviews).
Results (programme / system level)	What consolidated effects appear at sector / regional / system level?	**System / regional results:** Increased UIC/UII density in pilot sectors/regions (more structured partnerships, talent pipelines, joint projects with continuity); improved conversion rates along key chains (e.g. more pilots institutionalised, more UII graduates in relevant jobs). **Policy results:** National and regional strategies use UII as a core mission instrument; funding and evaluation schemes start rewarding conversion and learning, not just project volume. **Field-level results:** A critical mass of Hungarian HEIs operates with parallel domain handling (ordered, complex, aporetic); the instinctive governance trajectory (aporia → pseudo-order → painful discovery of complexity) is replaced by a more professional, complexity-aware trajectory in key initiatives.
Impacts (long-term)	What long-term structural changes are achieved?	**Economic & innovation impacts:** Stronger regional innovation ecosystems in priority sectors; more high-value firms, start-ups and scale-ups linked to universities; improved national competitiveness in selected mission domains. **Human capital & social impacts:** A workforce with higher skill levels and better labour-market alignment; reduced regional RDI and skills disparities as UII models spread beyond a few flagship institutions. **HE system impacts:** Hungarian universities widely recognised as adaptive, mission-oriented and well-integrated with industry, while maintaining academic integrity; complexity-aware governance becomes normal practice (ordered/complex/aporetic domains handled in parallel). **Governance & legitimacy impacts:** Increased trust between universities, industry and government; stronger legitimacy of public investment in HE and research due to transparent impact pathways and conversion logic.

Annex 2: Simplified logframe for Hungarian adaptation of Chinese UIC/UII

Level	Short definition	One key example
Input	Resources, capacities, mandates	NRDI + EU mission-oriented funding + dedicated UII teams in selected HEIs
Activity	What is done	Co-design and pilot of sectoral FIEK 2.0 hubs and integrated talent pipelines

Level	Short definition	One key example
Output	Immediate products	New UII-intensive programmes, signed long-term HEI–industry agreements, UII governance/indicator frameworks
Outcome	Behaviour/capability change	Higher student participation in UII, more repeat partnerships, UII embedded in strategies and incentives
Result	Aggregated programme / system effect	Denser UIC/UII ecosystems and improved conversion rates in pilot sectors/regions
Impact	Long-term structural change	Stronger regional innovation and human capital; Hungarian HE system operating with mature, complexity-aware UII governance

Annex 3. Table of comparing the UIC related ISO/TS 44006 typology and the typology of the extensive literature review of Ankrah and Tabbaa (2015)

Dimension	ISO/TS 44006 – UBC	Ankrah & Al-Tabbaa – UIC
Label used	*University-business collaboration (UBC)* *ISO_TS_44006_2023(en)*	*Universities–industry collaboration (UIC)*
Type of document	ISO technical specification / management guideline for practice.	Academic systematic literature review (Scandinavian Journal of Management, 2015).
Core definition	Collaboration between a university and business partners to achieve innovation, knowledge development, capacity building, workforce development, employment promotion, etc.	Interaction between higher education and industry aimed mainly at encouraging knowledge/technology exchange.
Overall purpose	Give **guidance on applying 12 collaborative principles** (from ISO/TR 44000) to improve UBC capability and sustainability.	**Synthesize fragmented research** on UIC (1990–2014) and develop an **integrated process framework** for forms, motives, enablers, outcomes.
Main structure / frame	12 principles, each with "What – Why – How": relationship management, visions & values, UBC objectives, collaborative leadership, governance & processes, collaborative competence & behaviour, trust & mutual benefit, value creation, information & knowledge sharing, risk management, relationship assessment & optimization, exit strategy.	Five key themes: (1) forms of UIC, (2) motivations, (3) formation & activities, (4) enablers & inhibitors, (5) outcomes; integrated into an overarching UIC process framework.

How collaboration types are classified	Annex A: four **functional areas** of UBC, each with types: (1) collaboration in education, (2) research collaboration, (3) valorization, (4) management.	Uses an **organizational-form typology** (adapted from Bonaccorsi & Piccaluga): (1) personal informal, (2) personal formal, (3) third-party mediated, (4) formal targeted agreements, (5) formal non-targeted agreements, (6) focused structures.
Examples of collaboration types	*Education*: curriculum co-design/delivery, internships, dual education, lifelong learning. *Research*: joint R&D, consulting/contract research, mobility of professionals. *Valorization*: licensing, academic and student entrepreneurship. *Management*: governance roles, shared resources, industry support (endowments, scholarships).	*Personal informal/formal*: consultancy, conferences, internships, joint supervision, sabbaticals. *Third-party*: TTOs, liaison offices, government agencies, industrial associations. *Formal agreements*: contract research, licensing, joint programmes, sponsored R&D. *Focused structures*: incubators, science parks, consortia, cooperative research centres.
Treatment of motivations	Motivations are implicit: improve innovation, knowledge development, capacity building, talent and social innovation; linked to "Why" under each principle, especially value creation and knowledge sharing.	Explicit **motivation typology** using Oliver's six contingencies (necessity, reciprocity, efficiency, stability, legitimacy, asymmetry), with separate patterns for universities and industry (e.g. asymmetry for industry only).
Process / lifecycle view	Management-cycle orientation: design & plan (relationship management, visions, objectives), enable & lead (leadership, governance, competences), operate & create value (trust, value creation, info/knowledge sharing), control & close (risk management, assessment & optimization, exit strategy).	Alliance-formation orientation: stages of identification → contact → assessment & selection → negotiation → agreement; then operationalization, enablers/inhibitors, outcomes, and feedback loops (conceptual framework).
Value & outcomes	Broad definition of value (training, research, societal service, financial ability, reputation, IP); gives guidance on **determining, managing and evaluating value creation**, plus relationship assessment and exit.	Synthesizes empirical evidence on benefits and drawbacks for both sides; emphasizes perceptions vs initial expectations and calls for better measurement of UIC outcomes.
Primary audience / use	Practitioners in universities and businesses (and policy bodies) who want **operational guidance** and a checklist for designing, managing and auditing UBC relationships.	Researchers and reflective practitioners needing a **theoretical/empirical map** of UIC (concepts, mechanisms, evidence, research gaps).

Annex 4. List of Abbreviations

Abbreviation	Meaning
AI	Artificial Intelligence
EHEA	European Higher Education Area
EIT	European Institute of Innovation and Technology
EIT HEI Initiative	European Institute of Innovation and Technology – Higher Education Institutions Initiative
ERA	European Research Area
EU	European Union
FIEK	Felsőoktatási és Ipari Együttműködési Központ (University–Industry Cooperation Centre)
FIEK 2.0	Second-generation, sectoral and mission-oriented FIEK model proposed in this thesis
HE	Higher Education
HEI	Higher Education Institution
HES	Higher Education System
HEInnovate	Higher Education innovation self-assessment and development framework (European Commission/OECD)
KPI	Key Performance Indicator
NRDI	National Research, Development and Innovation Office (Hungary)
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
RDI	Research, Development and Innovation
S3	Smart Specialisation Strategy
UBC	University–Business Cooperation
UIC	University–Industry Cooperation
UII	University–Industry Integration

(Add or delete abbreviations depending on what actually appears in your final manuscript.)

Annex 5. Glossary

Aporetic domain
A situation or problem space characterised by conflicting values, unclear problem definitions or deep political/ethical disagreement. In the thesis, aporetic domains mark issues (e.g. autonomy vs. steering, EU conditionality vs. national sovereignty) where standard indicators and technical fixes are insufficient, and deliberation and reframing are required.

Cohesion Policy (EU)
The European Union's main regional development policy, aimed at reducing disparities between regions and supporting economic, social and territorial cohesion. It provides a key funding and policy framework for regional innovation strategies, often involving universities and industry through S3 and related programmes.

Complex domain
In the Cynefin-inspired framework, a domain where cause–effect relationships are not fully knowable in advance and outcomes emerge from interaction (e.g. trust-building, ecosystem evolution, curriculum change). Appropriate governance mode is probe–sense–respond: experiment, observe patterns, adapt.

Conversion funnel
A visual representation of how many "units" (projects, students, partnerships) survive each stage of a pathway from input to impact (e.g. funded projects → implemented activities → participants → behavioural change → systemic impact). Narrowing segments show where major losses occur and where design or support interventions could improve success rates.

Conversion rate
The proportion of elements that successfully move from one stage of the logic chain to the next (e.g. pilots that become institutionalised; students in UII programmes who gain measurable skills; prototypes that are adopted by firms). This study treats improving key conversion rates as central to raising the overall probability of success.

Cynefin framework (adapted)
A sense-making framework distinguishing ordered, complex and aporetic domains (among others). This study uses it to argue that UIC/UII cannot be governed with a single logic: some parts can be standardised (ordered), others must remain experimental (complex), and some require ongoing political/ethical negotiation (aporetic).

Dual study programme
A study format combining academic coursework and structured work-based learning in firms or other organisations, usually under a formal agreement. In the thesis, it is a key instrument in integrated talent pipelines.

EIT (European Institute of Innovation and Technology)
An EU body that supports innovation ecosystems through Knowledge and Innovation Communities (KICs) and targeted initiatives, including the EIT HEI Initiative, which funds HEIs to strengthen their entrepreneurial and innovation capacities.

EIT HEI Initiative
Programme of the EIT that supports higher education institutions in developing institutional entrepreneurship, innovation and UIC/UII strategies, often through pilot projects, capacity building and ecosystem development.

FIEK (University–Industry Cooperation Centre)
Hungarian acronym for Felsőoktatási és Ipari Együttműködési Központ, referring to earlier national schemes funding university–industry cooperation centres. This study proposes a FIEK 2.0 concept:

sectoral, mission-oriented hubs aligned with EU and national priorities, integrating education, research and innovation.

FIEK 2.0 (proposed)
A second-generation model of FIEK: sector-specific, mission-driven university–industry hubs that host a portfolio of activities (joint R&D, talent programmes, innovation support) and operate under joint governance, blending EU, national, regional and industry resources.

HEInnovate
A self-assessment and development framework for higher education institutions, developed by the European Commission and OECD. It supports HEIs in reflecting on their entrepreneurial and innovative potential and is used in this study as a reference for institutional change and evaluation.

Higher Education Institution (HEI)
Universities, colleges, and other recognised providers of higher education (ISCED levels 5–8). In the thesis, HEIs are treated as key actors in innovation ecosystems, not only as providers of education.

Impact
In the logic model, long-term systemic change attributable, at least in part, to UIC/UII initiatives: changes in regional innovation performance, economic structure, human capital, governance quality and public trust.

Input
Resources and conditions fed into an intervention: funding, staff, infrastructure, mandates, and knowledge (including lessons from Chinese UII and EU evaluation frameworks).

Institutional pathway
One of the three main pathways in the thesis' logic model. It tracks how interventions change institutional strategies, governance, incentives and capacities, resulting in a more adaptive, mission-oriented UII capability within HEIs and the system.

Knowledge Alliance
An Erasmus+ action supporting structured cooperation between higher education institutions and enterprises aimed at innovation, new teaching methods, and improved skills. It is a key example of EU-level support for UIC/UII.

Logic model / Logframe
A structured representation of how an intervention is expected to work, linking inputs, activities, outputs, outcomes and impacts. In this thesis, logic models are combined with conversion rates to support ex-ante impact assessment and identify bottlenecks.

Mission-oriented policy
Policy approach that organises efforts around clearly defined societal or technological missions (e.g. climate neutrality, healthy ageing). This study treats both Chinese UII and EU missions (Green Deal, Digital Decade) as mission frameworks guiding UIC/UII design.

NRDI (National Research, Development and Innovation Office)
Hungary's central public body for funding and coordinating RDI policies and programmes. It is a major funder of UIC/UII initiatives, including earlier FIEK schemes and potential FIEK 2.0 models.

Ordered domain
Domain where cause–effect relationships are relatively stable and knowable (e.g. eligibility rules, standard financial procedures, basic reporting). Here, standardisation and compliance-oriented indicators are appropriate.

Outcome
Short- to medium-term changes in behaviour, capabilities and relationships resulting from outputs (e.g. improved student skills, repeated HEI–firm collaboration, new governance practices).

Output
Immediate, tangible products of activities (e.g. created centres, signed agreements, new programmes, number of participants, documented indicator frameworks).

Probe–sense–respond
A governance pattern appropriate for complex domains: experiment (probe), interpret results (sense), and adapt design or scale up/down (respond). It contrasts with the plan–implement–evaluate logic of ordered domains.

Sectoral hub
A multi-actor platform focused on a specific sector (e.g. smart mobility, green manufacturing, digital health), integrating universities, firms and often public authorities. FIEK 2.0 hubs are conceptualised as sectoral hubs.

Skills pathway
One of the three main pathways in the logic model. It follows how UIC/UII interventions influence teaching and learning, leading to changes in student skills, employability, and human capital formation.

Smart Specialisation Strategy (S3)
An EU framework under Cohesion Policy encouraging regions to identify and build on place-based strengths and priorities through entrepreneurial discovery processes, often involving universities and firms.

Talent pipeline
A coordinated sequence of education and training opportunities (often spanning vocational, bachelor, master and doctoral levels) co-designed with employers. It aims to ensure a steady supply of graduates and professionals with sector-relevant skills.

Theory of Change (ToC)
An explicit articulation of how and why a set of interventions is expected to lead to desired changes. The ToC in this study informs the logic model and conversion analysis for UIC/UII.

UIC (University–Industry Cooperation)
Broad term for collaborative relationships between universities and firms, including joint research, contract work, internships, guest lectures, innovation projects and advisory roles. Often project-based and activity-level.

UII (University–Industry Integration)
A deeper, more systemic form of UIC in which education, research and innovation functions are structurally coupled with industry needs and strategies. UII includes institutional and policy integration (governance, missions, funding) and is the central transformational concept of the thesis.

University-based innovation ecosystem
The network of actors, institutions and rules that surround a university (or group of universities) and enable innovation, entrepreneurship and knowledge transfer, including firms, public agencies, intermediaries and civil society.

University–Business Cooperation (UBC)
Term often used in EU policy to denote cooperation between higher education institutions and business/industry. In this thesis, largely overlaps with UIC, but UII is reserved for deeper, systemic integration.

Annex 6. Interview

(Prepared by the author with a former senior official of the NRDI Office – on UIC/UII funded programmes in Hungary)

Interviewer:
If you look back at university–industry cooperation programmes in Hungary, what do you see as their main strengths and weaknesses?

Interviewee:
The biggest weakness is clearly sustainability. Many of these programmes were designed as strong initial interventions—like building a bridge across a canyon. And in some cases, they succeeded: they mobilised significant resources, even large communities. But after the bridge was built, the question remained—who keeps using it, and who maintains it?

In practice, many of these initiatives remained isolated "islands." They worked during the funding period, but they did not always translate into long-term, self-sustaining systems.

Interviewer:
Why do you think this lack of sustainability emerged?

Interviewee:
The underlying assumption was that initial funding—let's call it "oil"—would ignite the system, and then it would continue on its own. That was a reasonable idea. But in reality, the system did not have enough internal demand or structural readiness.

Most partnerships were built around existing relationships. Universities worked with companies that were already nearby or personally known. That made collaboration easier to start—but it limited scaling and systemic impact.

Interviewer:
So the issue is partly structural?

Interviewee:
Yes. The policy toolkit for sector-level steering is quite limited. Institutions are under pressure to attract R&D investment, but the deeper issue is that relatively few companies actually demand R&D support.

There is a phenomenon we could call "hidden innovation"—companies innovate internally, but they do not necessarily engage with universities or formal R&D programmes. So the supply side is pushed, but the demand side is weaker than expected.

Interviewer:
And what about the skills dimension in these collaborations?

Interviewee:
That was not a strong focus. The programmes were primarily oriented towards R&D and innovation outputs, not towards systematic skills development.

Even at doctoral level, there are structural issues. We do not really assess teaching quality among PhD holders. The system rewards the degree itself more than the educational contribution.

There have been attempts—like DBA programmes in Pannon or Debrecen, or the cooperative doctoral programmes—but they did not fundamentally transform the system.

Interviewer:
Is this linked to quality assurance?

Interviewee:
Yes, partly. The Hungarian Accreditation Committee (MAB) is under pressure from multiple directions. Institutional incentives often push towards quantity rather than quality. Many participants are primarily motivated by obtaining the doctoral title.

In principle, MAB could play a stronger role in shaping quality and relevance, including in university–industry collaboration.

Interviewer:
How do you see the role of national strategies?

Interviewee:
The first major R&D and innovation strategy, adopted around 2014, was actually quite strong. It clearly identified priorities such as start-ups and innovative SMEs, and there was political support behind it.

But there were weaknesses. For example, there was no solid baseline. Monitoring existed as a function, but not as a strong analytical system. The target of reaching around 1.8% R&D expenditure was important, but the tracking mechanisms were not robust enough.

A later strategy, around 2018, was also relatively well-developed. The policy framework itself was not the main problem—it was quite robust.

Interviewer:
What changed later?

Interviewee:
Later developments simplified or weakened this strategic depth. For example, the Neumann Plan reduced complexity but also reduced substance.

There is also a broader issue: reporting towards the EU is not always taken seriously enough, and the politically motivated policy focus often shifts towards easily measurable indicators—like Q1/Q2 publications and ranking —rather than deeper innovation capacity and performance.

Interviewer:
What are the consequences of this?

Interviewee:
It has a negative effect on the innovation ecosystem. Instead of strengthening fundamentals, the system produces “accountability islands”— projects that are well-documented and reportable, but not deeply embedded.

Even performance-oriented approaches—such as in the HUNREN system—do not always differentiate sufficiently between types of impact.

Interviewer:
If you had to summarise the core issue?

Interviewee:
The core issue is that we tried to build a system through projects, without fully addressing the underlying structures—demand, strategy and proper implementation arrangement that is able to respond complexity and longterm impact expectations, incentives, skills, and governance.

The initial ideas—like the types of collaborations as FIEK and Competence Centres —were fundamentally sound. But without stronger integration into institutional and economic logic, they remain partial solutions.

Interviewer:
Given your current role, how do you see now the potential of the skills development focus in university–industry cooperation?

Interviewee:
From my current perspective—leading a Talent Center in a STEM-focused university—the skills dimension is absolutely central. If anything, I would say that earlier programmes underestimated its importance.

What we see now is that without a strong skills focus—particularly applied, demonstrable competencies—collaboration does not sustain itself. Companies engage when they see value in talent development, not only in research outputs.

In that sense, skills are not a by-product of innovation—they are one of its primary drivers. If we had embedded this more consciously into earlier programmes, some of the sustainability challenges might have been mitigated.