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Motivations, benefits, and challenges of university-industry partnerships in Kazakhstan

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ABSTRACT

In recent years, with the knowledge economy agenda and demands for public accountability, the importance of the engagement of universities with industry has gained prominence globally. In Kazakhstan, policymakers have emphasized developing university-industry partnerships (UIPs) to foster innovation and align higher education with labor market demands. In response to this policy agenda, the government has invested in university-industry collaborations (e.g., SPIID programs). This qualitative study explores the motivations, benefits, and challenges of UIPs in Kazakhstan. Data were gathered through interviews with the senior leadership and faculty members of universities and their industry partners. Our findings show that despite the challenges faced by the partners at the individual, intra-organizational, and inter-organizational levels, healthy developments have been made in forging university-industry links that contribute to the improvement of educational programs, the employability of graduates, and the capacity-building of faculty. However, with the predominant focus of UIPs on human capital development, fostering research and innovation, technology transfer, and commercialization appears to take a backseat. This problem is, to some extent, rooted in universities' shortage of resources, underdeveloped research capacity, inadequate organizational support, and the industry's lack of trust and disinterest in collaborating with universities. The most notable challenge is the initiation and management of UIPs under the statist model of the Triple Helix, where the government remains a driving force for determining the types and purposes of partnerships. In addition to addressing organizational issues by university and industry stakeholders, effective partnerships require more efficient government support without restricting universities' autonomy.

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1. Introduction

The paradigm of a knowledge-based economy has brought into focus the importance of university-industry partnerships (UIPs) worldwide. These partnerships are found pivotal for economic growth and competitiveness, as they have the potential to enhance the relevance of academic programs to industry (Kvilhaugsvik, 2022), foster innovation in technology and services (Bellini et al., 2019; Yu & Lee, 2017), stimulate knowledge spillovers (Garcia-Vega & Vicente-Chirivella, 2020), and promote regional entrepreneurship (Etzkowitz, 2012; Profiroiu & Brişcariu, 2021).

The role UIPs play in the progress and growth of modern societies has made them a significant part of national policies across the globe. For example, in the UK, entrepreneurial activities that stimulate knowledge transfer through industry collaborations are increasingly recognized as a key objective for higher education institutions (HEIs) and are supported by government policies, funding, and infrastructure investments (Degl'Innocenti et al., 2019). In the US, policymakers prioritize the economic returns from university-based research and its distribution at national and regional levels (Mowery & Ziedonis, 2015). The EU has adopted a smart specialization policy to enhance local entrepreneurship's competitiveness by integrating existing capabilities with innovative technologies from UIPs (Lilles et al., 2020). Similarly, emerging economies are institutionalizing and incentivizing a "third mission" for universities. For example, Qatar views university-industry-government collaborations as a means to transition from a hydrocarbon-based to a knowledge-based economy, allocating 5% of its GDP to develop education and an additional 2.8% to support research partnerships (Abduljawad, 2014). Russia, through the National Technology Initiative, aims to foster innovation by creating university-industry consortia and enhancing the quality of technical education and training (Dezhina, 2018). In Malaysia, universities are encouraged to engage strategically with industry, guided by ministerial directives emphasizing staff mobility to expand universities' expertise in producing teaching and knowledge relevant to industry (Azman et al., 2019).

Despite government interventions, developing UIPs is complex and encounters a range of barriers at individual, organizational, and structural levels. Studies indicate that many obstacles to UIPs originate from the view of knowledge transfer as a linear process, where universities are assigned the role of knowledge producers and industries are considered knowledge utilizers. However, knowledge transfer is a more integrated process whereby universities and industries co-create new knowledge and collaborate in its application (Nielsen & Cappelen, 2014; Rossi & Rosli, 2015). Moreover, the development of UIPs is context-bound, leading to various forms and outcomes of university-industry collaboration across different settings. This context-dependent nature makes research on UIPs critical for designing effective strategies for their development. In this study, we focus on UIPs in Kazakhstan, a post-Soviet Central Asian country that, due to its historical, economic, and political background, represents a pertinent case for such investigation.

As a former Soviet republic, Kazakhstan inherited a centrally planned higher education system characterized by vocational orientation, close ties of higher education institutions (HEIs) to specific industries, and mandatory job placement upon graduation. In contrast to Western countries, Soviet HEIs played a minimal role in research, with the majority of research conducted by institutes affiliated with the Soviet Academy of Sciences and industrial ministries. The government-directed research was often disconnected from market needs (Ahn et al., 2018).

In the early years of independence, Kazakhstan faced a colossal economic crisis that resulted in a funding deficit for the higher education sector (Pomfret, 2005). To overcome the crisis, the country began its transition to a market economy. However, the large-scale privatization process of the state-owned companies severed the historical links between HEIs and industry. Today, in response to the changing economic landscape and growing global competition, Kazakhstan focuses on developing a knowledge-based economy. As part of this strategy, the higher education system underwent scrutiny. Kazakhstan joined the Bologna Process to enhance the quality of higher education and its relevance to the industry, improve universities' research productivity, and strengthen their role in regional socio-economic development (Ahn et al., 2018). Unlike most post-Soviet states, Kazakhstan merged universities with research institutes of the National Academy of Sciences, the successor to the Soviet Academy of Sciences (Lovakov et al., 2022). This reform underscores Kazakhstan's unique position in the post-Soviet transformation and reflects its efforts to adapt to global competition by boosting university research output.

In its pursuit of building a knowledge-based economy, Kazakhstan also pays significant attention to UIPs. A systematic approach to developing UIPs in Kazakhstan was first introduced with the implementation of the 2010–2014 State Program of Industrial-Innovative Development of Kazakhstan (SPIID). The program invested in establishing cutting-edge research infrastructure in select HEIs, allocated research grants to increase business innovation activities and attempted to build a system of practice-oriented learning among university students. The 2015–2019 State Program of Industrial-Innovative Development of Kazakhstan (SPIID-2) was a logical continuation of the first program with a more detailed focus on university-industry collaborative research projects and degree programs for industry employees. To promote UIPs, the government introduced competitive public research funding, with distribution based on the commercialization potential of the research or the composition of the research team, necessitating the inclusion of industry collaborators. Moreover, specific state grants have been provided to foster technology commercialization.

Significant progress towards fostering UIPs was made through key legislative changes. These include the approval of the Law on Commercialization of Scientific Activities in 2015 and the adoption of the Code of the Republic of Kazakhstan "On Subsoil and Subsoil Use" in 2018, which mandates that large corporations deduct 1% of their profits for financing research and scientific-technical projects. Further, in 2018, HEIs were granted greater academic and administrative autonomy, enabling them to develop their own strategic plans, tailor education programs to meet labor market demands, and engage industry professionals in teaching and supervising student research (Prime Minister, 2020). In parallel, the government required universities to undergo an annual ranking of educational programs, administered by the Atameken Chamber of Entrepreneurs, with employer partnerships as a key assessment criterion (Atameken, 2018). At present, UIPs are being developed within the framework of two national projects: the 2021–2025 Quality Education "Educated Nation" and the 2021–2025 Technological Breakthrough through Digitalization, Science, and

Innovation. The projects emphasize strengthening the research capacity of faculty and students, increasing the share of commercialized research projects financed by the state, and improving legislation to further reduce bureaucracy in science.

While the government of Kazakhstan has introduced numerous initiatives to link universities and industry, the media and policymakers in the country state that UIPs rarely achieve results that can be commercialized (Asmaganbetova et al., 2021). There is also a limited understanding of the motives driving universities and industries to collaborate, the benefits they gain, and the challenges they face. Therefore, drawing on insights from the faculty and senior leadership of four public universities and their industry partners, this paper examines motivations, benefits, and challenges for current UIPs in Kazakhstan. The following research questions guided the study:

(1) What are the motivations of universities and industries for developing UIPs?
(2) How do universities and industries benefit from UIPs?
(3) What challenges do universities and industries face in developing UIPs?

This study contributes to the broader literature on UIPs by discussing the role of the government in such partnerships. More specifically, our findings suggest that government interventions risk failing or even stifling innovation development in developing countries if they are not accompanied by adequate institutional reforms, efficient support programs, appropriate evaluation, and funding. Universities and industries can gain valuable insights from this study to enhance their collaboration strategies, fostering a more balanced and substantive partnership. Policymakers can use our findings to evaluate the effectiveness of current policies, identify areas for improvement, and explore alternative approaches to promote more open, meaningful, and innovation-driven partnerships.

2. Literature review

Today, universities and industries alike seek to achieve a competitive advantage through UIPs. Motivated by market orientation, political pressures, global rankings, and funding uncertainty, HEIs view UIPs as avenues to obtain additional financing for research infrastructure (Garcia et al., 2019), create employment opportunities for students (Azman et al., 2019), align university education programs with labor market requirements (Bermejo et al., 2021), commercialize academic research (Nielsen & Cappelen, 2014), and enhance their reputation (Mirza et al., 2020).

Conversely, industries—primarily motivated by financial gains—partner with HEIs to obtain innovative solutions for their core and non-core technologies, access cutting-edge knowledge, and enhance internal R&D capabilities (Broström, 2012). Moreover, the industry uses UIPs to leverage funding for specific projects, access university research facilities, and recruit talented personnel (Sinnewe et al., 2016; Weerasinghe & Dedunu, 2021).

The development of effective and long-term UIPs is hindered by various multi-level barriers on both sides—university and industry. These barriers include bureaucracy, differences in partners' organizational cultures, issues over intellectual property rights, inefficient support infrastructure, low trust, insufficient funding, lack of incentives, industries' limited absorptive capacity, and universities' limited research capabilities (Awasthy et al., 2020; Boardman & Bozeman 2015; Lilles et al., 2020; Mirza, 2020, Sjöö & Hellström, 2019; Tartari et al., 2012). In developing economies, these challenges are more pronounced and require greater effort, investment, and time from both partners. Furthermore, historical factors, such as the legacy of post-Soviet countries, are found to hamper the adoption of market-oriented practices. Studies from this region show that the lack of a strong tradition of university-industry research collaboration, reliance on government funding, and a risk-averse culture in former Soviet republics reflect the Soviet model of their national innovation systems (Bychkova, 2016; Chankseliani et al., 2022; Inzelt, 2015, Marozau & Guerrero, 2016) and, as such, stifle the transition to demand-driven innovation ecosystems.

In the academic literature, there is an ongoing debate about the role of government in building national innovation systems. Proponents advocating for increased government involvement in university-industry collaboration claim that research and development activities have enormous risks, which individual industries and universities cannot bear without substantial government support (Tseng et al., 2020; Zhimin et al., 2016). Research in this area demonstrates that, in Australia, the allocation of state grants specifically aimed at fostering UIPs is associated with an increase in patenting activity (Nugent et al., 2022). In both China and the US, trilateral cooperation has been shown to enhance innovation and regional entrepreneurship (Etzkowitz, 2012; Kim et al., 2012; Li et al., 2020). Government support is also evident in the creation of a legislative environment that facilitates UIPs. For instance, the Bayh-Dole Act, enacted in the US in 1980, created favorable conditions for technology commercialization by establishing a uniform intellectual property (IP) policy among federal research funding agencies. However, in the post-Soviet context, some countries still lack effective regulations and incentives promoting UIPs (Goldberg et al., 2011; Inzelt, 2015; Jonbekova et al., 2020; Kuchumova et al., 2023; Valehov & Streitwieser, 2022).

Scholars critical of excessive government involvement claim that UIP policies are often contradictory and restrictive. Government interventions that homogenously require all universities to excel in teaching, research, and entrepreneurship simultaneously are criticized as utopian (Azman et al., 2019; Degl'Innocenti et al., 2019). Furthermore, the instruments designed by governments to assess UIPs are condemned for the lack of validity as, in most cases, knowledge transfer indicators are not tested empirically. Rather, they are based on literature reviews, expert opinion, and best practices. In many countries, such assessment tools become symbols of success in UIPs and are pursued by universities for their own sake (Rossi & Rosli, 2015).

The debate over the government's role in UIPs is especially pronounced in countries, where HEIs operate within a framework heavily influenced by government policies, regulations, and funding, which impose institutional constraints. Examples include employment rules and bans on creating university spin-offs, as seen in Malaysia (Azman et al., 2019), or restrictions on academic

freedom, as in Armenia, Belarus, and Kazakhstan (Goldberg et al., 2011; Inzelt, 2015; Marozau & Guerrero, 2016). Research also suggests that the top-down approach often fails to develop genuine collaboration, instead leading to ceremonial conformity (Dezhina, 2018).

Therefore, government interventions in these contexts should be supported not only by improvements in economic incentives, information infrastructure, and research organization but also by educational reforms (Goldberg et al., 2011). Without these changes, such interventions risk merely imitating models from so-called "innovative" countries without fostering meaningful UIPs.

3. Conceptual framework

Our study is informed by the Triple Helix model, which recognizes the need for "a proactive but not totalizing" role of the government in developing UIPs (Leydesdorff & Etzkowitz, 1998, p. 196). The model empowers universities to take advantage of academic autonomy and advance their strategic agenda in UIPs (Etzkowitz, 2008). It provides researchers with a systematic approach to analyzing UIPs (Ranga & Etzkowitz, 2013). There are three main configurations in the positioning of the university, industry, and government. The statist configuration is characterized by a leading role of the government and insufficiently developed cooperation between industry and academia. The laissez-faire configuration is defined by limited state involvement with industry playing the driving force and universities acting as a provider of human capital. The balanced model represents the configuration where the university, industry, and government act in partnership. Importantly, the Triple Helix conceptual framework defines the roles of the government, universities, and industry in each step of the transformation process, thus enabling scholars to contextualize and explain factors and concepts pertaining to UIPs (Etzkowitz, 2008). The theoretical foundations of the framework have been constantly enhanced by a plethora of global studies. They collectively turned the framework into a flexible instrument that is capable of providing a thorough understanding of triadic interactions among key stakeholders in any context (Cai & Etzkowitz, 2020; Cai & Liu, 2015).

In this study, we use two additional frameworks. The first is a Lewinian approach to managing barriers hindering UIPs that helped us examine challenges rooted at the individual, intra-organizational, and inter-organizational levels (Bjursell & Engström, 2019). Bjursell and Engström (2019) argued that policymakers tend to focus either on the potential benefits of UIPs or on developing new interventions. Consistent with this view, we propose to look at UIPs "as emerging in an environment characterized by barriers" or in other words, to concentrate more on how to address existing challenges rather than introducing yet another facilitating policy (Bjursell & Engström, 2019, p. 3). Drawing on the results of an empirical study aimed at identifying collaboration challenges from the perspectives of academics, Bjursell and Engström (2019) attempted to systematize hindering forces. At individual, intra-organizational, and inter-organizational levels, the authors singled out six categories of barriers: competence-related barriers concerning the ability of individuals to perform in collaborative projects, concept-related barriers focusing on the definition of collaboration, performance-related challenges dealing with expectations and rewards, resource-related barriers emphasizing the resources needed for collaboration, system-related barriers concerning organizational systems, and value-related barriers referring to concepts of the researcher's identity. Bjursell and Engström (2019) found that barriers at individual and organizational levels are interconnected, which means that by addressing barriers at the organizational level, it is possible to stimulate UIPs at the individual level.

The third framework is Bychkova's (2016) modes of UIPs at universities with limited economic and academic autonomy. Bychkova (2016) pointed out that there are five possible responses of universities to the government's pressure to collaborate with industry: passive conformity, compromise, avoidance, defiance, and manipulation. This framework helped us interpret the responses of Kazakhstani universities and their industry partners to the top-down UIP policy scheme employed by the government.

Table 1
Sample characteristics: University stakeholders.

Characteristic	Category	University				Total (n=55)
		A	**B**	**C**	**D**	
Gender						
	Male	6	10	10	4	**30**
	Female	9	4	5	7	**25**
Job position						
	Faculty	11	8	14	6	**39**
	Department leaders *(deans, vice deans, directors, or administrators)*	2	3	1	2	**8**
	Senior leaders *(rectors and vice rectors)*	2	3	-	3	**8**
Length of experience in HE						
	< 15 years	6	6	3	3	**18**
	> 15 years	9	8	12	8	**37**
Area of specialization						
	STEM	11	10	12	6	**39**
	HASS	2	1	3	2	**8**

Note:
*STEM – science, technology, engineering, and mathematics
**HASS – humanities, arts, and social sciences

4. Methodology

This qualitative study involved 55 participants representing four public universities (coded as A, B, C, and D) situated in Southern, Eastern, and Central Kazakhstan. These universities are well-established. Two of them (C and D) have a strong presence in all academic fields, while universities A and B are more STEM-oriented. The four universities involved in the SPIID programs. Universities A and C are located in the country's industrial centers for extraction and metallurgy. Universities B and C are located in two of the largest cities in Kazakhstan with a significant number of businesses. The location of the former university is also a home for headquarters or representative offices of major national natural resource enterprises and knowledge-intensive companies. The missions of the four universities focus on delivering quality education and producing high-standard research. In addition to that, two universities, A and D, explicitly emphasize their focus on advancing the country's technological future and economic development by integrating education, science, and industry, or by transforming into an entrepreneurial university. By selecting these four universities, we sought to offer a more exhaustive overview of the present status of UIPs as seen from the standpoint of public universities. Participants were selected using purposeful maximum variation sampling (Creswell, 2013), to ensure diversity in gender, specialization, job position, and experience in higher education (Table 1). Data was collected through semi-structured interviews conducted between September and December 2020.

The perspectives of university stakeholders were complemented with insights from seventeen industry representatives (Table 2). The industry participants were selected from among those partners identified by university stakeholders during the interviews. Invitation letters were sent to the companies, and those willing to participate were interviewed between January and February 2021. The industry participants represented various sectors, allowing us to compare university partnerships across them.

Initially planned as face-to-face, all 72 interviews were conducted remotely via Zoom or WhatsApp due to the COVID-19 pandemic. Each interview lasted about an hour. The participants were free to select the interview language. The overwhelming majority, 66 out of 72, chose to be interviewed in Russian, while the remainder opted for English. Since the research team members who conducted the interviews were proficient in both languages, there was no need for translation, though some Russian quotes were later translated into English for this paper.

The data collection began after obtaining approval from the research ethics board. Participation was voluntary, with participants informed about the study's purpose, significance, and potential risks and benefits. Before the interviews, they signed consent forms. They were made aware of their right to reject audio recording, abstain from answering any questions, or withdraw from the study without facing any repercussions.

After transcribing the interviews, the audio recordings were deleted. Prioritizing participants' confidentiality, the interview data were de-identified by assigning a unique code to each participant prior to data analysis. For example, the participant code P50, Uni D, Public, Faculty, HASS, Philology refers to participant number fifty, who is affiliated with public university D, holds a faculty position, and specializes in HASS, specifically Philology. Access to the data was restricted to the research team, and any identifiable information was excluded from this paper.

Data analysis was conducted using both deductive and inductive approaches. The former involved initially developing a list of codes based on the analytical framework, relevant prior literature, and research questions. The Triple Helix model guided the

Table 2
Sample characteristics: Industry stakeholders.

Characteristic	Category	Total (n=17)
Gender		
	Male	9
	Female	8
Job position		
	Senior leadership	8
	Human resources	6
	Professional staff	3
Location		
	Central	6
	South	4
	North	4
	East	3
Sector		
	Mining	6
	Mining/Metallurgy	3
	Information Technology	2
	Machine Building	1
	Water Resources	1
	Construction	1
	Chemistry	1
	Telecommunication	1
	Engineering	1

examination of existing forms of UIPs in Kazakhstan, leading to the development of such codes as statist, laissez-faire, and balanced configurations. The Lewinian framework aided in analyzing and structuring UIP-related barriers, resulting in such codes as individual, intra-organizational, and inter-organizational challenges. Bychkova's framework played a crucial role in analyzing the sampled universities' responses to government pressure for collaboration with industry, inspiring codes such as passive conformity, compromise, avoidance, defiance, and manipulation. The deductive codes derived from existing literature encompassed financial incentives, graduate employability, market-driven curricula, commercialization and technology transfer, access to resources, need for human resources, lack of resources, and bureaucratic issues, among others.

The inductive part of the analysis was based on Corbin and Strauss' (2015) three-stage – open, axial, and selective – coding. The researchers began the open coding process by reading through the transcripts, going line by line, and labeling pieces of text with words and phrases. Rather than looking at the text through the lens of preconceived ideas, the researchers allowed the codes to emerge from the data. The codes were descriptive and represented labels that encapsulated the key idea behind the passage of data. In the axial coding phase, the researchers grouped open codes that shared similar attributes and characteristics to form categories (Corbin & Strauss, 2015). They compiled all the open codes into a single file and carefully examined them multiple times to identify underlying dimensions that could link several codes together. This led to the creation of several categories. In the final stage, the researchers merged the key categories to create overarching themes presented in the next section in line with the research questions.

5. Findings

The analysis revealed that educational partnerships with industry were the most widespread across all four universities, including student internships, curricula refinement, dual education programs, branch campuses, and the involvement of industry professionals in teaching. UIPs in Universities A and B also provided faculty members with capacity-building opportunities, specifically to expand their professional experience at industrial sites.

However, the number of research partnerships with industry across the universities was generally low, with most involving contract research and a few joint research projects. Universities A and B appeared more active in research partnerships, likely due to their focus on STEM fields. Reference to academic entrepreneurship was rare and encompassed primarily examples of knowledge commercialization through professional training organized for industry stakeholders at Universities A and B. The commercialization of research results was almost non-existent, with participants from only two universities, A and C, mentioning a single example of spin-offs developed at their institutions. Overall, the existing UIPs in research resembled one-way knowledge transfer from universities to industry, with knowledge exchange predominantly limited to educational and capacity-building collaborations.

5.1. What are the motivations of universities and industries for developing UIPs?

Our findings show that the primary drivers prompting public universities to collaborate with industries encompass updating curricula to meet labor market needs, improving graduate employability, and contributing to regional development. In alignment with the statist configuration of the Triple Helix model, these motives are shaped by government regulations, which enforce universities to collaborate through accreditation requirements and ranking systems. Improving university rankings necessitates consistent efforts to foster collaborations with industry, enhance employment rates, augment research capacity, and boost the quantity of scholarly publications. An annual independent assessment of educational programs, conducted by the National Chamber of Entrepreneurs "Atameken" in conjunction with the Ministry of Science and Higher Education for the past five years, serves as the basis for ranking academic programs of Kazakhstani universities. Collaboration with industry is mandated in Atameken's assessment criteria.

> At present, the employment rate is being closely scrutinized by Atameken and the Ministry of Education. Recently, several universities in Shymkent city and the Turkestan region have been closed down owing to their significantly low employment rates. (P49, Uni D, Public, Dean, HASS, Management)

Universities are also motivated to engage in UIPs by the desire to contribute to regional development. It appears that universities have adopted the discourse of policy documents positioning HEIs as one of the key players in the national innovation system. 21 university representatives, including faculty members, department heads, and senior leaders, believed that technology and knowledge transfer to the industry is essential to ignite regional development.

> I would like to point out that the socioeconomic development of a region first depends on the commercialization of knowledge and the creation of innovative firms in the context of the Triple Helix model. Today, universities need to partner with external stakeholders to work in this direction. (P53, Uni D, Public, Senior leadership)

Owing to the high dependence on state study grants and student tuition as primary funding sources, all four universities mentioned curricula updates to suit the labor market and improving graduate employability as major motives for UIPs. The motivation related to regional development was voiced more prominently at Universities A and D. The reason for this is their strategic missions that focus on forging the country's technologically advanced future and economic development.

In turn, the industry stakeholders view UIPs primarily as a means to secure a competent and skilled workforce. This partially mirrors the laissez-faire configuration of the Triple Helix model, wherein universities are perceived solely as suppliers of human capital, rather than equal stakeholders in UIPs. Although most industry representatives noted that university education, specifically equipping students with content knowledge, was at a moderate level, the development of graduates' professional skills relevant to industry was low. As such, engaging in educational partnerships is regarded crucial for preparing ready-for-work graduates and,

consequently, saving time for their retraining. The findings reveal that the industry's engagement in partnerships manifests in curricular approval, part-time teaching, guest lecturing, dual education, and internships, among other things.

A few companies (5 out of 17) also sought to foster core technologies through contractual and collaborative research that was mainly mentioned by senior leadership within companies from STEM fields. This can be attributed to the fact that senior leaders are responsible for setting the strategic direction of the organization and recognize that technology plays a pivotal role in shaping business strategies and achieving organizational goals. Aligning with the university participants, four industry stakeholders noted that UIPs were somewhat compelled by governmental regulations that require companies engaged in the natural resources sector to allocate a portion of their profits to fostering science and technology. Moreover, the Civil Protection Law mandates collaborations between companies operating hazardous production facilities and expert organizations like universities to address safety concerns.

> We are subsoil users. Our primary obligation is to allocate funds for research on an annual basis. If we do not use these funds or invest in our development, we will be penalized. This is a motivation for us [to collaborate] … We have collaborated with them [universities] before. However, we spent less money on collaborations back then. Now, we are obliged to spend these funds as required. (P12, Company P, Professional staff, STEM, Mining)

To sum up, partnerships between the four public universities and industries are primarily driven by government interventions and regulations rather than their intrinsic willingness to collaborate. Government interventions substantially influence the formation of the vertical model of the innovation ecosystem in Kazakhstan.

5.2. How do universities and industries benefit from UIPs?

University stakeholders emphasized that engaging in partnerships with industry yields three major benefits: the alignment of educational programs to industries' needs, advancement of research, and enhancement of capacity-building. The alignment of education programs to the labor market needs prevailed among all four universities. Educational UIPs helped students gain professional knowledge and skills relevant to the labor market and hands-on experience at the workplace. The universities' efforts to enhance education programs can be linked to their aspirations to score higher in the national ranking system, which is contingent on the successful employment of graduates. High rankings improve the reputation of universities, thus enabling them to attract more students, industrial partners, and funds. This dynamic appears to operate within a self-reinforcing cycle, as heightened rankings entail augmented financial support from the government and industry. This influx of resources culminates in the university attaining a higher status.

> Based on recent data, our university, along with two other Kazakhstani universities, has secured a position among the top 460 universities in the world. This is probably mainly attributed to research advancements driven by significant financial support… Universities that maintain close collaborations with enterprises and are in demand within the industry receive substantial benefits, leading to an elevated status. (P21, Uni B, Public, Faculty, STEM, Mining)

Universities highlighted that the second major benefit of collaborating with industries was the advancement of university research. According to the participants, research partnerships offer access to valuable resources like industrial equipment, facilities, and funding through business contracts (18 out of 55) and state research grants (14 out of 55).

> I participated in a collaborative research project with a company that specializes in manufacturing innovative construction materials…Within the scope of our project, we engaged in comprehensive theoretical and experimental investigations of those materials. Our research delved into their environmental interactions, identified their inherent advantages, assessed the potential benefits for the company upon their utilization, and examined their ecological impact. (P11, Uni A, Public, Faculty, STEM, Engineering)

An overwhelming majority of the discussions on the aforementioned research activities were led by STEM faculty members, with only 2 HASS peers engaging in such conversations in contrast to 24 STEM faculty members who shared their active involvement in research. This can be attributed to the inherent characteristics of their respective fields. STEM fields are closely tied to industry demands for new products, innovations, and solutions. There is a strong need for UIPs to address these demands, leading to a greater emphasis on business contracts and collaborative research initiatives. By contrast, HASS disciplines may have a broader range of research interests that may not align closely with industry needs.

The third most frequently mentioned benefit by university stakeholders was the capacity-building of university faculty through placement at industry sites (10 out of 55). This benefit was particularly pronounced in STEM fields, given the rapid pace of technological development.

> Our faculty can participate in internships at [company name], which has a direct impact on the educational process. Earlier, we experienced a period of stagnation where the faculty relied on outdated materials that were no longer relevant in the industry. We were unaware of the latest industry developments and relied on knowledge that became obsolete 30 years ago. To avoid falling behind the times, we are actively working toward involving the faculty and students in internships at the production site. (P12, Uni A, Public, Dean, STEM, Geology and Mining)

Only a few university stakeholders, primarily from Universities A and B, mentioned the organization of professional training for industry personnel as a benefit through which they not only transfer but also commercialize their knowledge.

The interviews with university stakeholders demonstrated that the gained benefits differed across the four universities. Universities

A and B exhibited greater involvement in UIPs and appeared to derive greater advantages from these collaborations when compared to Universities C and D. Both these universities have more favorable circumstances for engaging in UIPs, specifically location and greater orientation to STEM fields. Moreover, in developing UIPs, Universities A and B had greater support from senior leadership who have work experience in the industry. Despite being situated in regions abundant with companies, participants from Universities C and D complained more about organizational challenges in UIPs. Therefore, their lower engagement in UIPs resulted in a smaller number of benefits, specifically in research advancement and capacity-building. The interviews revealed that University C contends with the challenge that companies in the area have restricted funds at their disposal to fund research endeavors.

> Unfortunately, there are no situations when they [industry] would give us money to order our services. They lack resources. (P31, Uni C, Public, Faculty, STEM, Engineering)

> Nowadays, any enterprise is reluctant to invest in science because it requires a significant amount of money, involves risks, and necessitates trial and experimentation. (P38, Uni C, Public, Faculty, STEM, Construction)

Industry stakeholders highlighted access to talented students who can potentially become skilled personnel as a primary benefit of UIPs (9 out of 17), followed by the opportunity to align educational programs with industry requirements (4 out of 17) and address industry-specific challenges (3 out of 17).

> Being a loyal partner to many universities allows us to attract the most talented graduates in our field. This is probably the main advantage [of collaboration]. (P06, Company F, Senior leadership, STEM, Construction)

Through UIPs, industries gain access to students, which allows them to monitor their professional qualities. This helps industries identify and employ students who best match their needs and expectations upon graduation. Universities A and B have industry partners who provide stipends and scholarships to promising students. These incentives are offered under the condition that the selected students undertake to work with the company for several years after completing their studies. For employers, this arrangement is a means to secure the most talented students for their workforce.

5.3. What challenges do universities and industries face in developing UIPs?

The obstacles to the effective development of UIPs were analyzed through a Lewinian framework (Bjursell & Engström, 2019). According to it, at the individual level, UIPs were challenged by competence-, concept-, resource-, and value-related barriers. Competence-related barriers included the partners' perceived low interest in UIPs, as self-reported by 20 university representatives and 4 industry partners. They blamed each other for being reluctant to develop meaningful collaborations. Based on university stakeholders' perspective, industries are reluctant to participate in UIPs owing to their preference for maintaining the status quo as long as they achieve satisfactory revenue levels. Introducing new products involves additional bureaucracy and changes in production processes, which industries are averse to.

> Enterprises tend to be bureaucratic. They are generally uninterested in making changes to their structure and production processes. Introducing new products and fostering new developments require efforts and financial and non-financial resources. Companies are reluctant to embrace these changes and investments. (P14, Uni A, Public, Senior leadership)

As the university participants noted, given that the country generally lacks a robust knowledge-intensive manufacturing sector and relies heavily on a commodity-based economy, industries perceive little need for research assistance from universities. Thus, industries in the country often opt to import necessary equipment and materials rather than invest in local development from scratch. The lack of motivation for collaboration was also associated with industry professionals' unwillingness to teach at universities owing to the related paperwork and low salaries.

Industry participants reproached universities for their superficial attitudes to partnerships, especially when they contacted the industry merely to comply with ministerial and accreditation requirements. The universities' low motivation to develop meaningful partnerships is related to concept-related barriers. Following industry participants, universities and faculty do not see UIPs as requiring regular attention, but rather attention only under some external pressure.

The next most widely discussed group of barriers at the individual level related to the lack of resources, as indicated by 23 university participants and 7 industry representatives. Similar to university participants who were challenged to develop UIPs because of high teaching loads, the industry was reluctant to accept students for internships as it requires assigning a supervisor from the industry who would be occupied with interns and unable to continue their regular work. Both university and industry stakeholders shared the belief that successful collaboration requires the industry to be receptive, enthusiastic, and actively engaged in the partnership.

> Based on our experience, when a company expresses interest… in hosting interns, our students receive certain advantages. The company assigns someone in their workshop to supervise and train the interns. However, if we take the initiative and say, "We have a contract with you, please accept our interns," there is a possibility that the interns may end up dusting and pushing paper. Unfortunately, we cannot influence the situation in any way. (P32, Uni C, Public, Faculty, STEM, Energy Systems)

Finally, value-related barriers to collaboration are associated with the faculty's ideology vis-à-vis the academic profession. As noted by three university participants, academic work is about teaching and research. New demands on academic careers, such as technology transfer and commercialization requiring entrepreneurial skills, were expected to be delivered by intermediaries.

At the intra-organizational level, UIPs were challenged by system-, resource-, and competence-related barriers. As the university

participants noted, the bureaucratic structure of HEIs (13 out of 55), inadequate funding for research (13 out of 55), poor research infrastructure (7 out of 55), low salaries (9 out of 55), and lack of support from intermediaries (3 out of 55), were major barriers to UIPs. Although noted by participants from all four universities, the issues of organizational bureaucracy (excessive paperwork and lengthy decision-making) and low assistance from support structures—commercialization offices and techno-parks—were repeatedly mentioned by participants from Universities C and D.

> There is an issue in the university – bureaucracy – which may result in us not being able to provide the required documents to the industry on time, potentially compromising the conclusion of a contract. (P44, Uni C, Public, Faculty, STEM, Mining)

> I wish the Ministry could do something to reduce our bureaucratic work. The number of reports we have to produce should be limited. There should be a normative document that states exactly and very clearly what we should submit and when. The faculty will then have time to cooperate with the industry more effectively. We live in a digital world, why do we still produce paper documents? I do not understand. The Ministry should do something about this. (P50, Uni D, Public, Faculty, HASS, Philology)

The analysis showed that personal connections played a significant role in establishing and maintaining UIPs in Kazakhstan. As UIPs encompass substantial financial resources and demand accountability, familiarity with a partner is important for enhancing credibility and instilling greater confidence among stakeholders in relation to the success of collaborative efforts, as highlighted by 18 university stakeholders. Although professional connections are critical in doing business and developing collaborations in different countries, they come to the fore in Kazakhstan because of the lack of support from newly established intermediaries on university campuses, often lacking research or industry experience.

The resource-related barriers at the intra-organizational level are linked to insufficient research funds that predominantly come through ministerial research grants, especially at University C, as reported by 7 out of 15 participants. The industry's investment in research is inadequate as they tend to avoid long-term investments and prioritize quick results. According to university participants, industries find it more cost-effective and convenient to acquire pre-developed technology from abroad, instead of investing time and resources in extensive research with no guaranteed results.

> There are three main problems. The first and foremost is the refusal of our industrial enterprises to co-finance new developments. They are businessmen, and for many of them, the purpose of scientific research is unclear. They can simply buy technologies from abroad. Why finance a product that can only be implemented three years later, and that too, only if the research yields positive results? Whether or not the hypothesis can be confirmed remains uncertain. (P43, Uni C, Public, Faculty, STEM, Engineering)

Another hindrance, mentioned mostly by faculty members from Universities B and D, was the relatively low salaries, which demotivate industry professionals from teaching and supervising student internships. This applies to faculty salaries and the compensation for internship supervisors. Owing to its location in one of the most expensive cities in the country, the expenses for food and accommodation of University B's faculty can potentially exceed their relatively modest wages. The average pay for faculty members ranges from 240,000 KZT/520 USD for lecturers to 480,000 KZT/1,040 USD for full professors (Chernenko, 2023), while the cost of a relatively comfortable lifestyle is around 400,000 KZT/870 USD (Sokhareva, 2023). The faculty and industry supervisors at University D, which is situated in a region with one of the lowest average monthly salaries, may receive lower wages when compared to their counterparts at other sampled universities. Additionally, heavy teaching loads further limit the time the faculty can dedicate to UIP-related activities.

At the intra-organizational level, UIPs were also hampered by competence-related barriers associated with industry stakeholders, mainly from small enterprises, and their poor awareness of research conducted at Kazakhstani universities. Industry participants suggested that universities have to be more proactive in sharing their achievements with a broader public. They agreed with university participants that eliminating higher education bureaucracy, providing better funding and incentivizing research (reducing teaching loads) are critical for promoting UIPs at the intra-organizational level.

At the inter-organizational level, UIPs were challenged by competence-, performance-, and system-related barriers. Competence-related barriers were most widely mentioned and encompassed interaction/communication challenges and trust issues. These challenges were mostly expressed by industry participants who complained about difficulties in contacting universities and receiving timely responses. According to some of them, administrative personnel at universities are constantly changing, which causes issues in developing long-term partnerships.

> There is a constant change in the personnel at universities. Those who are responsible for some kind of collaboration can change and new employees are not aware of existing collaborations. (P14, Company Q, Professional staff, STEM, IT).

Trust issues were predominantly expressed about UIPs in research. Following industry participants, universities have a low capacity to conduct high-quality research leading to technological innovations. As noted by five industry participants, most university faculty lack knowledge of the latest scientific developments and have insufficient expertise in narrow specializations that are crucial for addressing specific industry problems. This opinion was mainly expressed by the STEM industry—such as mining and metallurgy—which are in constant search for increasing labor safety and productivity standards. Some industries, predominantly big ones from eastern and central parts of Kazakhstan, are inclined to partner with foreign (Russian) universities to train their personnel and research institutes in gaining consultancy/expertise related to their core technologies.

> The quality [of collaborative projects] is average. If we compare it with that of Russian universities, the quality there is certainly higher. I still believe that the quality depends on the teaching staff. Interacting with a Russian university shows that the level of knowledge among the teaching staff there is higher than that of ours. (P12, Company P, Professional staff, STEM, Mining)

> We have our own university, which is located in the Russian Federation: [name of university]. We are part of [name of university] and send our specialists there for professional development. This includes pursuing higher education, such as master's programs. They study remotely but travel there to take exams and submit course papers. (P08, Company K, Senior leadership, STEM, Mining)

The universities acknowledged the low trust they experienced from the industry. The industry is hesitant to invest in university research because of the fear of loss. Trust issues are also rooted in a performance-related barrier or the partners' discrepancies in understanding the outcomes of collaboration. For example, the industry emphasizes its preference for achieving tangible and practical results associated with technological and economic benefits and expresses hesitation to engage in collaborations that do not yield such outcomes.

> To request co-financing [from the industry], they [universities] need to spark our interest with projects that will have a direct impact on technology and safety in mining operations. We are not interested in studies that do not contribute to technological advancements and safety in mines. (P15, Company R, Senior leadership, STEM, Mining)

The system-related inter-organizational barriers include problems with the semi-autonomous situation of HEIs, inefficiency of funding programs, untransparent distribution of state research grants, and the lack of clear mechanisms in allocating funding coming from subsoil users for research. Moreover, the findings show that the faculty from HASS fields faced greater difficulties in forging partnerships with industry than their STEM counterparts. Our participants from the HASS fields acknowledged that they lagged in obtaining state grants, establishing business contracts with industries, and participating in UIP-targeted programs such as SPIID. An explanation for this could be the government's view that STEM disciplines are the most significant contributors to the knowledge economy the country strives to build. Hence, the development of STEM disciplines is drawing more attention and support.

Overcoming these individual, intra-organizational, and inter-organizational challenges is crucial for creating a thriving UIP landscape. For this, government interventions promoting UIPs should be accompanied by systemic governance, institutional reforms, economic incentives, and managerial support.

6. Discussion

Our findings show that UIPs offer universities the potential to align their education programs to labor market needs, advance research endeavors, and strengthen their capacity-building initiatives. In turn, through partnerships with universities, industries have an opportunity to bolster their pool of skilled personnel and, to a lesser extent, address specific technological challenges. The current manifestations of UIPs in Kazakhstan tend to exhibit a predominant emphasis on human capital development by preparing students for future employment and aligning the academic curricula with industry needs. By contrast, the focus on knowledge co-creation, innovation, technology transfer, and commercialization appears to take a backseat. The participants scarcely mentioned developing and implementing any advanced technological solutions that would address critical industry issues, drive the industry forward, or reshape its landscape. Such endeavors as developing new products, conducting joint explorative research, co-authoring publications with industry, or academic entrepreneurship were given less consideration when compared to the development of human capital. This mirrors findings from similar research previously conducted in developing countries (Azman et al., 2019; Goldberg et al., 2011; Kuchumova et al., 2023).

Further, our study shows that in Kazakhstan, the primary motivation for universities to collaborate with industry stems from government regulations. The government enforces accreditation requirements and ranking systems emphasizing the significance of UIPs and employability, thus imposing these collaborations on universities to a certain extent. From the Triple Helix framework perspective (Ranga & Etzkowitz, 2013), this finding indicates that the current situation with UIPs in public universities showcases the statist configuration model characterized by the dominant role of the government and insufficient cooperation between the industry and academia. Thus, the government serves as the main catalyst for UIPs, which tend to adopt a compliance approach rather than being fueled by self-driven initiatives (Bychkova, 2016).

In line with Nielsen and Cappelen (2014) our results show that the main impetus for Kazakhstani industries to participate in UIPs is the need for skilled human capital. However, unlike studies in developed countries, which highlighted industries' motivation to access cutting-edge knowledge and innovative solutions (Broström, 2012; Sinnewe et al., 2016), only a few industry stakeholders in our study mentioned these factors. This raises concerns about the overemphasis on employability, which risks creating tension between the roles of universities and the expectations of industry. Universities should not focus solely on preparing graduates to meet constantly changing labor market needs; ideally, they should cultivate holistic personal and professional identities, capacity for continuous learning, critical thinking, and innovative problem-solving. Overemphasizing employability narrows universities' educational mission, undermines academic freedom, and stifles the country's long-term capacity for innovation. Thus, the current government interventions, the Atameken national ranking, and industry expectations seem to divert Kazakhstani universities from their core mission. A trilateral dialogue involving universities, industry, and the government is needed to clarify the expectations of university graduates and develop relevant assessments of universities' performance. Additionally, the limited motivations of industry partners within UIPs may undermine the broader objectives of knowledge creation and innovation, reducing UIPs to mere recruitment channels.

Since most Kazakhstani companies do not necessarily require cutting-edge technologies or new knowledge because of a lack of knowledge-intensive production processes, various incentives (tax deductions, subsidies, low-rate credits for R&D, innovation awards) are needed to spark their interest in innovation. As our findings show, industries' disinterest in innovative solutions stems from their inclination to avoid long-term and resource-intensive investments. Developing new products demands substantial finances and time and entails bureaucracy, which industries prefer to avoid. This situation is exacerbated by low trust in local researchers, seen as incapable of producing industry-relevant innovations. Moreover, beyond economic incentives, industries need to overcome the fear of taking risks to become more innovative, which is crucial for sustainable development.

This study, along with several others (Bjursell & Engström, 2019; Garcia et al., 2019), pinpointed a range of individual, intra-organizational, and inter-organizational barriers to UIPs. According to Bjursell and Engström (2019), barriers at the individual level, such as partners' limited research capabilities and mutual blaming, could be addressed by eliminating intra-organizational challenges to UIPs, particularly a high level of bureaucracy in higher education, insufficient organizational support, inadequate resources, poor research infrastructure, high teaching loads, and low salaries in academia. Moreover, the creation of more favorable organizational conditions for UIPs could improve inter-organizational links by reducing communication challenges and promoting trust between the partners.

The reviewed literature indicates that intellectual property issues are among the major hindrances to collaboration in several countries (Garcia et al., 2019; Mirza et al., 2020). However, our participants did not mention this, potentially indicating that UIPs in Kazakhstan have not yet reached a stage where intellectual property concerns come to the fore. Another factor contributing to the lack of discourse on intellectual property could be the relatively underdeveloped state of the patent system in Kazakhstan.

A distinct aspect of this study is the emphasis participants placed on government support, specifically UIP-targeted programs and state research grants, as a crucial facilitator of university-industry collaboration in Kazakhstan. This highlights the government's role as a primary driver of UIPs, aligning with the statist configuration (Ranga & Etzkowitz, 2013). However, our findings also reveal a limited number of sustainable partnerships, particularly in knowledge co-creation and knowledge/technology commercialization, raising concerns about the efficiency of these interventions. While they make universities more attractive to industry, government interventions also create power asymmetries between universities, the industry, and the government. These asymmetries are evident in employability expectations imposed on universities and government dominance in research and innovation.

One of the reasons for this is the limited autonomy of local universities. Despite greater autonomy granted in 2018, public universities still experience formal rather than functional autonomy. This lack of true autonomy, combined with the enduring Soviet-era governance model, continues to shape a culture of dependence on top-down directives. Moreover, any initiatives must comply with government regulations and metrics, often inflexible or irrelevant to UIPs. As a result, current government interventions and incentives, including SPIID programs and ministerial research grants, have limited impact in fostering deep, sustainable collaborations. Financial incentives and regulatory pressures often push toward short-term goals, which may lead to superficial partnerships focused on immediate outcomes like graduate employment, equipment procurement, or less ambitious research. This suggests that poorly designed government interventions may risk mimicking successful policies without establishing open, genuine, and sustainable UIPs.

Our study shows that Kazakhstan is a country that currently represents the statist configuration of the Triple Helix model but with the intention to transition gradually toward the balanced model. This intention is reflected in ongoing reforms, such as restructuring research institutes, running HE reforms, and introducing UIP-related interventions. Our findings indicate that Kazakhstan's way to the balanced model will not be straightforward. In the framework of the Triple Helix model, university and industry partners still seem to need governmental support, especially in terms of favorable legislation and regulations, timely institutional reforms, adequate evaluation metrics, relevant incentives for both university and industry, and sufficient funding. Moreover, the partners need to recognize that knowledge production and transfer is a collaborative process requiring time, effort, support, and initiative at different levels from all of them. Apart from that, a critical perspective should be raised on the inclusivity of UIPs. Current UIPs are dominated by large corporations, often sidelining small businesses, local communities, and underrepresented sectors. This focus on high-profile corporate collaborations can limit the wider societal impact, excluding stakeholders that may also contribute to innovation and regional development. In this sense, a more inclusive approach would ensure that smaller entities and communities can access the benefits of UIPs and contribute to broad-based developments.

Another contribution of this paper to the development of the Triple Helix model is demonstrating that within a single country, UIP configurations can vary, and thereby incorporate elements of all three Triple Helix configurations. This variability depends not only on the type and sphere of partnerships (Etzkowitz, 2008; Leydesdorff & Etzkowitz, 1998) but also on each stakeholder's perspective. For example, in Kazakhstan, from the university stakeholders' viewpoint, UIPs often align with the statist configuration. Contrastingly, the industry's perspective on student preparation and employment reveals elements of the laissez-faire configuration. However, recent government policies, such as the law on subsoil use and the granting of financial and academic autonomy to universities, indicate a push towards a balanced model. Our findings once again highlight the flexibility of the Triple Helix model, showing it can incorporate various configurations and adapt to different stakeholder perspectives. This further broadens its applicability for further research, including the comparison of stakeholder viewpoints.

As our findings highlight a gap between the intended goals of UIPs and the actual practice on the ground, additional research can explore the reasons behind this gap, analyze the influence of government policies on UIP implementation, and investigate potential strategies to foster a more technology-oriented UIP ecosystem.

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CRediT authorship contribution statement

Dilrabo Jonbekova: Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Gulfiya Kuchumova:** Writing – original draft, Methodology, Formal analysis, Conceptualization. **Tatyana Kim:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation. **Dinara Mukhamejanova:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Dilbar Gimranova:** Investigation, Data curation. **Yerkin Abdildin:** Investigation, Data curation. **Dinara Alimkhanova:** Formal analysis, Data curation.

Declaration of competing interest

The authors declare no conflict of interests.

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