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UNIVERSITY AND BUSINESS ENVIRONMENT IN THE CREATIVE HELIX: THE IMPACT OF CLUSTERS ON COLLABORATION AND EMPLOYABILITY OF GRADUATES

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Abstract. This study examines the role of clusters in enhancing collaboration between universities and businesses, and their impact on graduate employability. Drawing on the Creative Helix model and cluster theory, the research investigates how regional innovation ecosystems facilitate knowledge transfer, innovation, and workforce integration. A quantitative methodology used a structured questionnaire for three stakeholder groups: academic staff, students, and business representatives. Exploratory factor analysis and reliability tests supported the instrument's validity and revealed five key factors shaping the university-business interface within clusters. The findings highlight that clusters stimulate cooperation, improve curriculum relevance, and increase graduates' readiness for the labour market. The research contributes to the theoretical understanding of cluster-based collaboration and offers practical guidance for universities and regional policy-makers aiming to strengthen employability through structured partnerships. The paper's originality lies in its integrative framework connecting regional development, higher education, and labour market needs, offering empirical evidence from an emerging economy. The study underscores the value of clusters as strategic tools for economic and educational transformation. This evidence is bounded by the study's regional focus, sectoral coverage and reliance on self-reported questionnaires. Future research should integrate policy-maker perspectives and longitudinal or administrative employment data across multiple regions.

1. Introduction

Collaboration between academia and business is of particular importance, given that universities have the function of preparing human resources that will subsequently enter the labour market. Universities can also facilitate access to knowledge through scientific publications and constitute an essential channel for transferring know-how to the business environment.

Innovative clusters are key drivers of economic growth and innovation, providing a supportive environment for business expansion and fostering collaboration among companies, universities, research centres, suppliers, and customers (Kramer et al., 2024; European Commission, n.d.). Membership in such an agglomeration becomes a real competitive advantage for companies due to rapid access to research results and the implementation of innovative products in production.

This research explores University-Business Collaboration (UBC) in the context of regional development, framed by the Creative Helix model derived from the Triple Helix theory, where universities, industry, and government interact to foster innovation and knowledge transfer. The primary purpose of this research is to investigate the relationship between the "Ştefan cel Mare" University of Suceava (Romania) (abbreviated hereinafter as USV) and the Romanian business environment, through the characteristics of cluster partnerships, the factors that contribute to the sustainability of the university and the specific correlations of academic-economic partnerships within the Creative Helix cluster (USV, 2024). The areas of activity with the greatest visibility in the clusters' operationalisation and the potential clustering directions are also pursued, including developing alternative technologies, IT, and renewable energy resources.

The fundamental objective of the research is to explore the issue of creative-innovative clusters, but also to position the university within the collaborative cluster model in the context of intelligent, sustainable and inclusive development (Neamtu et al., 2020). The emphasis is on the role of clusters as strategic instruments of regional development, in which the university becomes an essential actor through involvement in partnerships, knowledge transfer and support for innovation. Also, students' employability and integration into the labour market are analysed as key dimensions of the university's impact on the socio-economic environment. The paper is structured in three essential sections, starting with the theoretical framework, which analyses the fundamental concepts regarding the university's role in the context of the Triple Helix and cluster models and the dimensions of cooperation between academia and business. The second part includes the research methodology, which presents the investigation plan, the instruments used and the targeted respondent categories. This is followed by the section on interpreting and analysing the collected data, which discusses the results obtained and correlates them with the objectives and hypotheses formulated. Finally, the paper presents the main findings, the theoretical and practical implications of the research, and the general conclusions, accompanied by verifying the hypotheses and suggestions regarding future action directions and deepening the topic.

Despite extensive work on UBC and cluster policies, there is a lack of knowledge about how cluster-enabled UBC mechanisms translate into measurable graduate employability outcomes in emerging economies. The paper addresses this gap using multi-stakeholder survey data from Romania and exploratory factor analysis.

The research questions of the paper are:
- RQ1: How are UBC activities within clusters associated with graduates' time-to-employment and job-study match?
- RQ2: What barriers/facilitators to UBC are perceived by students, firms, and civil society?
- RQ3: Which smart-specialisation domains show the highest perceived cluster impact?

The contributions begin with an integrative framework that links clusters, UBC, and employability, drawing on multi-actor evidence from an emerging region, and a validated latent construct for UBC, including barriers and outcomes. This paper contributes with the following aspects:

- Operationalisation of employability through clear indicators, namely time-to-first-job, employment in 6 months, job-study match, and internship participation.
- Empirical evidence on drivers and barriers of university-business collaboration in creative industries, in the context of Creative/Quadruple Helix.
- Integration of the perspective of governance and proximity (cluster organisations, boundary spanners), connecting the UBC literature with the specifics of creative industries.
- A set of applied recommendations with measurable KPIs for universities, companies and intermediary actors.

We measure employability impact via time-to-first-job (months), employment within six months (yes/no), and job-study match (5-point scale), linked to exposure to internships and WIL activities. PCA-based factors (with KMO/Bartlett and Cronbach's α) summarise UBC mechanisms/barriers; analyses focus on associations, with details in Section 2.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature on university-business collaboration, clusters and employability. Section 3 presents the methodology, data and measures. Section 4 reports the empirical results. Section 5 discusses the findings and implications. The final section concludes and outlines avenues for future research.

2. Literature review

2.1. Theoretical synthesis: Triple/Quadruple Helix, open innovation, and the role of cluster organisations

UBC is widely framed by the Triple Helix (university-industry-government) and Quadruple Helix theories, which incorporate the role of civil society/users in co-creating and legitimising innovation (Starkbaum et al., 2024; González-Martínez et al., 2023). In this view, UBC is a core mechanism of open innovation (purposeful, inbound and coupled knowledge flows across organisational boundaries) rather than a peripheral activity (Johnston, 2022). Empirical accounts demonstrate that effective UBC relies on multiple proximities (spatial, social, organisational, and technological) that bridge the divide between the "two worlds" of firms and academia, facilitating knowledge translation (Johnston, 2022).

Clusters are geographically proximate agglomerations of interconnected firms, specialised suppliers, service providers, related industries, and supporting institutions, such as universities and associations, that compete and cooperate within a field (Porter, 1998). Building on this baseline, the Triple Helix Triangulation (THT) highlights innovation and entrepreneurship as engines of regional competitiveness, emphasising how effective network governance and place-based capabilities convert knowledge flows into jobs and investment (Peris-Ortiz et al., 2016). These perspectives complement the Triple/Quadruple Helix and position cluster organisations as governance nodes that translate UBC into measurable upgrading.

In European regions, cluster organisations function as intermediaries and orchestrators that lower coordination costs, establish shared narratives, and curate partner portfolios, thereby accelerating knowledge diffusion and firm learning (Kramer et al., 2024; European Commission, n.d.). In moderate-innovation contexts, universities can act as anchors for digital transformation and entrepreneurial upgrading of SMEs, provided that UBC is embedded in place-based strategies and smart specialisation priorities (Marra et al., 2022). The broader

Quadruple Helix evidence confirms that multi-actor co-creation strengthens ecosystem resilience and can translate into tangible innovation outcomes when governance aligns incentives and mitigates collaboration risks (Marchesani & Ceci, 2025; Dirkse van Schalkwyk & Steenkamp, 2024). This perspective aligns with recent Quadruple Helix practices for responsible innovation (Starkbaum et al., 2024).

2.2. Models of university-business collaboration

A spectrum of UBC models exists, ranging from contract research and consultancy to joint R&D, shared laboratories, mobility programmes (including internships and secondments), and networked cluster projects. Recent studies differentiate patterns by antecedents and governance, using fuzzy cluster analyses to identify distinct openness profiles among collaborating firms (e.g., low, insecure, and responsive open innovators) driven by motivations, barriers, and knowledge transfer channels (Băban & Băban, 2025). In moderate-innovation regions, mixed-methods evidence suggests that firm size, sector, and leadership commitment to digitalisation, along with sustained UBC ties, collectively explain innovation performance (Marra et al., 2022). At the network level, cluster collaboration complements bilateral UBC by providing shared assets (brokerage, IP templates, internship clearinghouses) and by coordinating cross-firm learning that feeds back into firm-level innovation routines (Kramer et al., 2024; Kim et al., 2022). Evidence from moderate-innovation regions indicates that model choice and depth vary by firm size and sector, as well as digital leadership (Marra et al., 2022).

Beyond contract research, consultancy and joint R&D, UBC often operates through Work-Integrated Learning (WIL), co-creation platforms and project-based learning, where firms co-design challenges with students and faculty (e.g., Demola-type initiatives; Aalborg's PBL) (Mirigliano, 2024; Aalborg University, n.d.). Such channels align curricula with market demand while generating applied prototypes, internships and hiring pipelines (Geuna & Muscio, 2009; Nampala et al., 2024). Use cases are illustrative, not evaluative, and show how governance choices shape knowledge translation.

2.3. Determinants of effective UBC

Relational and cognitive proximities are central determinants: social proximity via prior ties and network membership eases partner access; organisational and technological proximity increase absorptive capacity and reduce translation losses (Johnston, 2022). Firm-level resources (R&D intensity, leadership, digital readiness) and university interface quality (liaison offices, boundary spanners) condition collaboration depth (Marra et al., 2022). At the ecosystem level, cluster orchestration (agenda-setting, convening, road-mapping, and narrative building) aligns incentives and sustains repeated interactions (Kramer et al., 2024). Cross-national evidence also highlights the importance of policy stability and funding continuity in maintaining collaboration density during downturns (National Centre for Universities and Business [NCUB], 2024).

Effective UBC depends not only on resources and proximities but also on the entrepreneurial university infrastructure (like TT offices, liaison roles, template IP/NDA workflows and boundary spanners), which lowers transaction costs and raises collaboration depth (Perkmann et al., 2013). In contexts with funding or regulatory frictions, the continuity of dedicated interface units is pivotal to sustaining repeated interactions and fostering trust.

2.4. Barriers and governance challenges

A recent systematic review of 86 studies synthesises barriers into three lenses: (1) Triple/Quadruple Helix misalignments (divergent goals, time horizons), (2) relational deficits (trust, social capital), and (3) process frictions (IPR negotiations, bureaucracy, weak liaison structures), with proposed mitigations including early-stage expectation alignment, standardised IP toolkits, and dedicated boundary spanners (Rossoni et al., 2024). Qualitative UBC research further documents the "two worlds" paradox and shows how matching proximities, particularly social and organisational, can offset it (Johnston, 2022). In cluster settings, orchestration failures (e.g., top-down, one-size-fits-all interventions) and inadequate measurement can undermine the quality of collaboration. Conversely, curated partner portfolios and transparent KPIs (such as participation breadth, internship-to-job conversion rates, and co-publications/patents) enhance accountability (Kramer et al., 2024).

Consistent with prior evidence, barriers cluster around goal misalignment and time horizons, administrative frictions (including dual bureaucracy and unclear contact points), and relationship deficits (such as a lack of trust and low visibility). Standard mitigations include expectation alignment at project outset, standardised IP toolkits, and named liaison officers, which convert ad-hoc ties into institutionalised routines (Bruneel et al., 2010; Tartari & Breschi, 2012).

2.5. Outcomes: innovation performance, startups and regional upgrading

At the firm level, cluster collaboration and data-enabled openness are associated with stronger market and financial performance through the expansion of open-innovation practices (Kim et al., 2022). Cross-country evidence links university-industry R&D collaboration to startup productivity and innovation transfer, reinforcing the entrepreneurial-university logic (Kuzior et al., 2024). At the ecosystem level, UBC is embedded in regional strategies that support the digital upgrading of SMEs and strengthen local knowledge ecosystems (Marra et al., 2022). Pattern-oriented analyses reveal heterogeneity in how firms configure antecedents and channels, explaining variance in collaboration intensity and benefits (Băban & Băban, 2025). Finally, macro indicators suggest that collaboration density is sensitive to policy/funding shocks, highlighting the value of cluster-based intermediation and stable programmes to safeguard UBC during turbulence (NCUB, 2024; Kramer et al., 2024). In addition, university-enterprise collaboration directly contributes to the development of innovation capabilities in SMEs, not only through technical outcomes, but also through organisational routines and learning processes (van der Poel et al., 2024).

The paper's finding that internship participation is associated with faster transition to employment aligns with longstanding evidence that internships/WIL improve early labour market outcomes and reduce skill mismatches (Gault et al., 2010; Moghaddam, 2011). This convergence strengthens the external validity of the employability mechanism embedded in cluster-enabled UBC. This association is also consistent with the literature on the development of generic skills necessary for insertion, reported by students in business programs (Hapenciuc et al., 2016; Bordeianu & Morosan-Danila, 2014; Tymon, 2013). Beyond the formal curriculum, extracurricular enterprise/entrepreneurship components strengthen early employability and entrepreneurial intentions (Beaumont et al., 2025; Rogers-Draycott et al., 2024; Taikulakova et al., 2024).

2.6. Synthesis and implications for the present study

This review motivates an integrative framework that (i) positions cluster organisations as governance intermediaries bridging Helix actors; (ii) treats proximities and interface quality as key determinants of collaboration quality; and (iii) links UBC mechanisms to measurable outcomes (innovation performance, startup productivity, employability). These insights guide our study design and measurement strategy; the specific hypotheses are presented in the Methodology section (Johnston, 2022; Marra et al., 2022; Kramer et al., 2024; Rossoni et al., 2024; Kuzior et al., 2024; Kim et al., 2022; Marchesani & Ceci, 2025; Dirkse van Schalkwyk & Steenkamp, 2024).

Consistent with European benchmarking, Romania is classified as an Emerging Innovator, with innovation performance substantially below the EU average. At the same time, targeted cluster-oriented initiatives have begun to improve intermediation and access to university talent and funding intelligence. Illustratively, the Clusters Meet Regions events in Iasi (2023) and Cluj-Napoca (2025) catalysed multi-actor coordination and showcased good practices; nevertheless, stakeholders continue to call for leaner administrative procedures and clearer liaison points, in line with the national Research, Innovation and Smart Specialisation Strategy (SNCISI 2021–2027) (European Cluster Collaboration Platform, 2023, 2025; European Commission, n.d.; Ministry of Research, Innovation and Digitalisation, 2023).

To evaluate cluster-mediated UBC performance, the paper adopts a compact KPI set: knowledge outputs (co-publications, patents), collaboration intensity (number and breadth of UBC agreements, networking events, internship placements), capability building (joint training, micro-credentials), economic signals (startup/spinoff formation, project funding won) and employability metrics (internship-to-job conversion, time-to-first-job, job-study match). These indicators link governance choices to outcomes, enabling replication across regions (Kramer et al., 2024; European Commission, n.d.).

3. Methodology

In defining the research strategy and structuring the socio-statistical analysis, we acknowledged a fundamental principle from sociological theory and practice: research cannot be fully standardised, as it is influenced by inherently subjective elements such as human thought, creativity, intuition, and the researcher's individual value system.

Given this context, the methodological choice made for this study and the research direction adopted necessitate the application of methodological triangulation. Based on the principle of corroborating multiple theoretical and methodological perspectives and consulting various data sources, this approach is essential for capturing the complexity and dynamic nature of socio-human realities and constructing an accurate and comprehensive understanding of the phenomenon under investigation.

The research explores the interdependence between USV and the business environment, through partnerships based on Helix and cluster models. The study seeks to identify the facilitating factors and the barriers to collaboration and assess the impact on regional development, knowledge transfer, and graduate employability. Additionally, the research addresses several secondary objectives, focusing on the following aspects:

- O1. The involvement of universities in clusters is essential for their success.
- O2. Establishing the existence of a business sector and university collaborative relationship.

- O3. Analysis of motivations and constraints in the university and the business sector collaboration.
- O4. Identifying the determining factors of the UBC.
- O5. Evaluation of the perception of economic actors on the collaboration with the university.
- O6. Identification and analysis of the main barriers that limit the UBC.

The research was based on a complex empirical approach, structured on three levels of analysis (R1 – civil society, R2 – students and graduates, R3 – business environment), each targeting a specific category of respondents, in order to comprehensively capture the interdependent relationships between USV and the business environment in the context of Helix and cluster type partnerships. In total, 872 questionnaires were sent, of which 532 responses were validated, ensuring a solid database for interpretation. The socio-demographic characteristics of the respondents were analysed through descriptive statistics, highlighting a diversity of fields of activity, company sizes and graduates' professional experience levels.

Sampling was carried out using the simple random method without replacement to ensure the representativeness and accuracy of the results obtained. The sample size was calculated using the standard statistical equation:

$$n = t^2 \times p \times (1-p) \div e^2, \tag{1}$$

where *n* represents the required sample size, *t* is the theoretical value corresponding to the desired confidence level (1.96 for 95%), p denotes the estimated proportion of the population with the characteristic of interest (commonly 0.5), and e is the accepted margin of error (between 1% and 5%). The resulting sample size for this study was 384, ensuring a 5% maximum error margin at a 95% confidence level.

The first study (R1) aimed to identify the determining factors in establishing cluster-type structures and the involvement of the academic environment in creative-innovative partnerships. The target audience was represented by civil society representatives from the northeast region, especially managers, entrepreneurs, and USV graduates. The questionnaire was sent to 385 people, between April 26 and May 14, 2024. The final sample for R1 included 146 respondents, selected according to the criteria defined in the methodology, of whom approximately 65% declared themselves familiar with the term cluster, confirming their relevance for the research objectives: 42% of respondents have a bachelor's degree, 24% of people have a high school education, 21% have a master's degree, 11% have post-secondary education, and 2% have doctoral studies.

54% of respondents are between 21 and 30 years old. Also, 32% are between 31 and 40 years old, 11% are over 41 years old, and 3% are under 20 years old. 64% of our respondents come from urban areas, and 36% from rural areas. 56% of the total respondents are employees with management and executive positions, 22% are students, 11% are entrepreneurs, 9% are economists in public institutions, and other categories represent 2%.

The second study (R2) focused on students and graduates of USV, to evaluate their perception of UBC, employability and professional insertion. R2 gathered 209 valid responses from students and graduates. Most of the respondents, 66% (137 people), are between 18–25 years old, followed by those aged between 26–35, with a percentage of 24% (50 people), while a percentage of 10% is given by respondents aged between 36–50 (22 people). Of the 209 respondents, 52% (109) come from rural areas and 48% (100) from urban areas. Thus, it can be seen that the percentages are relatively close.

The third study (R3) was dedicated to the business environment, tracking the existing types of collaboration with the university, the level of involvement and the perceived barriers in developing partnerships. R3 included 99 companies, operating mainly in areas such as services (43%), manufacturing industry (29%), and trade (11%). The responding companies' characteristic fields are IT, tourism, transport, construction, medical and agriculture. Of the total number of responding companies, 37% have an average number of employees, i.e., between 10–50, and 28% of the responding companies have between 1 and 9 employees. The lowest percentages regarding the average number of employees were recorded in the categories: 101–250 employees (14%), over 250 employees (11%) and 51–100 employees (10%). More than half of the responding companies, respectively 54%, registered a turnover of less than 500,000 euros in 2024. Also, 28% of the responding companies registered a turnover of over 1,000,000 euros, and the remaining 18% had a turnover between 500,000 and 1,000,000 euros.

Through its integrated approach, the research provides a detailed and balanced picture of the perceptions, needs and barriers from the perspective of all stakeholders engaged in the regional innovation ecosystem, giving robustness and relevance to the conclusions formulated.

The importance of the research topic is founded on the following *general hypotheses* of the study:

- HG1. Participating in cluster partnerships and Creative Helix structures significantly influences the UBC.
- HG2. Transferring knowledge, technology and specialised human capital from the university to the economic environment increases employability and supports regional innovation.
- HG3. The positive perception of collaboration with the university is conditioned by public institutions' involvement and regional policies favourable to innovative partnerships.
- HG4. Priority areas of smart specialisation (such as health, agriculture, IT&C, biotechnologies, construction) represent catalytic factors for regional development through clusters.

Specific hypotheses were formulated within each study to test these general hypotheses and adapted to the profile of the respondents and the investigated objectives.

Study R1 (*civil society and the economic environment*):

- **H1.1:** *Providing qualified personnel, adapted to the labour market requirements, contributes significantly to creating and consolidating clusters in the North-East region.*
- **H1.2:** *Technology transfer and the involvement of personnel with research, development and innovation skills are determining factors in the efficient evolution of cluster structures.*
- **H1.3:** *The active involvement of universities in clusters is essential for their success and sustainability.*
- **H1.4:** *The priority areas for regional development through clusters are: health and medical sciences, food industry and agriculture, IT&C, biotechnologies and construction.*
- *Study R2* (*USV students and graduates*):
- **H2.1:** *It is possible to identify, at the level of the USV student community, a set of factors that describe their perception of the efficiency and impact of university-business partnerships on professional insertion and skills development.*
- **H2.2:** *Significant factors facilitate the integration of USV graduates into the labour market in the context of collaboration with the economic environment.*
- **H2.3:** *Most respondents consider the university's collaboration with the business environment beneficial, but also identify certain limitations or perceived barriers.*

- *Study R3 (business environment):*
- **H3.1:** *It is possible to identify, at the business community level in Suceava, a set of factors that describe the perception of economic actors on collaboration with the university.*
- **H3.2:** *Business environment representatives identify a series of significant barriers that limit efficient cooperation with USV.*

The primary data gathering instrument was a questionnaire, administered online via the Google Forms platform. Its design was aligned with the research objectives and thematically structured according to the respondent categories targeted across the three study levels.

The questionnaires included various types of items: introductory questions (with the role of familiarising respondents with the research topic), content questions (reflecting the hypotheses and objectives formulated) and socio-demographic identification questions. In terms of typology, closed questions (dichotomous and multiple-choice), open-ended, mixed questions, and scaled items, built on the Likert scale, were used to measure the respondents' perceptions, attitudes and degree of agreement. Each questionnaire was adapted to the category of respondents corresponding to each study.

To structure and synthesise the data collected through the questionnaires, *factor analysis* using the Principal Components Method (PCA) was applied across all items in the three studies. This analysis simultaneously targeted three key dimensions of UBC: innovation, cluster partnerships, and employability. The goal was to identify a limited number of significant factors capable of summarising the variables and revealing the latent data structure. The method's principle is to extract the fewest components that retain as much information from the original data as possible (Gabor, 2010). Methodological validity was confirmed by Bartlett's and Kaiser-Meyer-Olkin tests. At the same time, the KMO value (Table 1) validated the appropriateness of factor analysis for the dataset (Bratianu & Vatamanescu, 2017), justifying its use in the study (Table 2).

Table 1. KMO and Bartlett test

		Dimension 1	Dimension 2	Dimension 3	Dimension 4	Dimension 5
Kaiser-Meyer-Olkin measure of sampling adequacy		0.762	0.721	0.771	0.794	0.930
Bartlett's test of sphericity	Approx. Chi-Square	534.694	410.692	417.399	643.265	1178.593
	Df	28	28	36	78	21
	Sig.	0.000	0.000	0.000	0.000	0.000

The results were interpreted using the Varimax rotation method, which maximises the variance within each component to optimise the factor structure. The reliability of the variables included in the questionnaire was assessed through an internal consistency analysis (Table 2), with Cronbach's Alpha indicating a high level of consistency.

Table 2. Internal consistency analysis of survey variables

	Questionnaire 1	Questionnaire 2	Questionnaire 3
Cronbach's Alpha	0.717	0.899	0.952

The data were processed using SPSS 22, and the results were interpreted with the specialised literature, integrating models of UBC (Etzkowitz & Leydesdorff, 2000), knowledge transfer dynamics (Perkmann et al., 2013), and the contribution of clusters to regional development (Porter, 1998).

4. Results of the research

This section presents the PCA results, which aim to identify key factors and barriers affecting collaboration between USV and the business sector. For clarity, the findings are organised into five subsections: student and graduate perceptions, business perspectives, collaboration barriers, the role of clusters, and the partnerships with the RDI sector.

4.1. Analysis of the university and the business environment collaborative relationship from the perspective of students/graduates

The correlation matrix (Appendix, Table A1) reveals meaningful relationships between variables describing UBC, with correlation strengths ranging from weak to moderate. This suggests interconnected but distinct dimensions of interaction. The explained variance shows that the first factor alone contributes 32% and the first two factors explain 59% of the total variance. After applying the Varimax rotation, two distinct components emerged regarding students' perceptions (Appendix, Figure A1a). The first emphasises activities grounded in practical experience, such as internships, round tables, workshops, collaborative projects, and interactions with entrepreneurs. The second highlights initiatives to facilitate labour market integration, including academic projects, career counselling, and participation in job fairs.

The correlation between students' involvement in these activities and their employability was analysed to assess the impact of collaboration on professional insertion. The results show that students active in internship programs and networking events registered a higher employment rate in the first six months after graduation, especially in local companies. Figure 1 illustrates the distribution of graduates according to the time it took to get their first job after completing their studies.
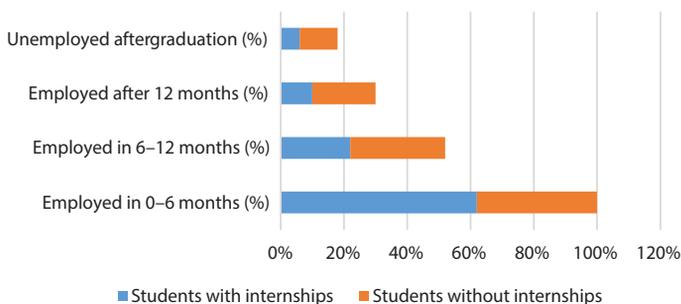

Figure 1. Distribution of graduates according to the time required for employment

The analysis shows that 62% of graduates who completed internships during college were employed within six months of graduation, compared to only 38% of those who did not have such experience. These data confirm the importance of UBC in facilitating professional insertion.

4.2. Analysis of barriers to strengthening the university and the business environment relationship from the perspective of students/graduates

The second part of the analysis explores the barriers to strengthening university-business relations, as perceived by students and graduates. The correlation matrix (Appendix, Table A2) shows primarily significant associations among these barriers, with weak to moderate intensity, highlighting nuanced yet consistent patterns in their perceptions.

The correlation matrix determinant is 0.134, above the 0.001 threshold, confirming the suitability for factor analysis. The first factor explains 32% of the variance, while the first two account for 54%. Varimax rotation identified two components in students' and graduates' perceptions of barriers (Appendix, Figure A1b). The first relates to poor dialogue and coordination, including mistrust, differing goals, lack of support programs, and misaligned expectations. The second includes internal organisational barriers, such as cultural gaps, limited innovation resources, and conflicting priorities, indicating weak strategic interest in collaboration.

4.3. Analysis of the university collaborative relationship from the perspective of the business environment

Appendix Table A3 highlights statistically significant correlations between variables describing UBC, with weak to moderate intensity, reflecting diverse but interrelated forms of interaction.

The first factor explains 32% of the variance, while the first two combined account for 61%. Varimax rotation revealed two components in the perception of the business environment (Appendix, Figure A1c). The first reflects stable collaboration based on shared goals, past partnerships, trust, and geographic proximity. The second captures a pragmatic view, driven by access to funding, institutional flexibility, commercial orientation, and the involvement of students and faculty in applied activities.

Mutual trust is also a determining factor, significantly influencing the partnership's perception of the business environment. On the other hand, firms more interested in funding opportunities and the university's flexibility are less concerned with long-term relationships and are instead motivated by immediate economic benefits. Figure 2 illustrates the main motivations identified.
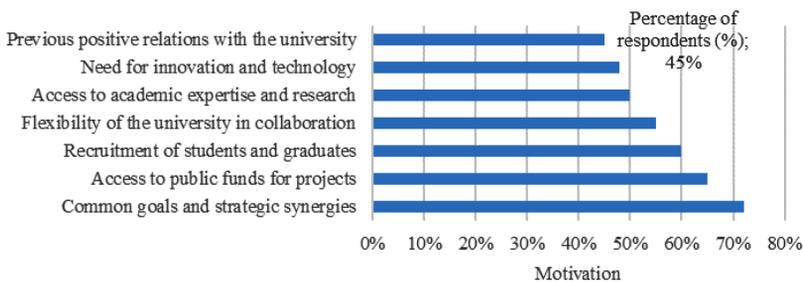

Figure 2. Business motivations for collaborating with the university

The data analysis suggests that the business community perceives collaboration with the university as beneficial, but conditional on certain essential aspects, such as previous relationships, shared objectives and mutual trust. At the same time, many companies view

collaboration more as an economic opportunity than a strategic partnership. Removing institutional barriers and improving communication channels could significantly strengthen this relationship and maximise the benefits for both parties.

4.4. Analysis of barriers to strengthening the university and the business environment relationship from the perspective of the business environment

The fourth part of the analysis focuses on barriers to UBC from the perspective of the business sector. Although such partnerships offer clear benefits, the data reveal key obstacles grouped into two categories: perceptual and institutional, reflecting differences in vision, and administrative and structural, related to bureaucracy and internal processes. Appendix Table A4 shows significant correlations between these variables, with low to moderate intensity, indicating consistent yet distinct challenges to collaboration.

The first factor explains 27% of the variance, and the first two account for 54%. Varimax rotation revealed two components in how businesses perceive barriers to collaboration (Appendix, Figure A1d). The first reflects a negative image of the university, marked by a lack of funding information, theoretical focus, differing values, low research visibility, and unclear contact points. The second includes operational barriers (bureaucracy, absence of liaison roles, confidentiality concerns, limited student integration, and poor communication), highlighting administrative issues that hinder partnerships. From the companies' perspective, these obstacles are mainly related to administrative and functional difficulties that hinder the development of effective partnerships.

Another significant factor hindering the development of collaboration is the discrepancy between academia's and companies' expectations (see Table 3). The university emphasises research and innovation, while most companies are more interested in immediate results and facilitating graduates' entry into the workforce. These discrepancies highlight the need for a better-defined collaboration framework that aligns the objectives of both parties and creates sustainable synergies.

Table 3. Differences in expectations between the university and the business environment

Aspect	University expectations	Business expectations
Role of the university	Research and innovation centre	Labour force provider
Long-term collaboration	Development of joint projects	Immediate economic benefits
Curriculum flexibility	Integration of academic research	Rapid adaptation to market demands
Perceived barriers	Lack of business involvement	University bureaucracy

The data analysis suggests that the barriers to UBC are complex and interconnected. On the one hand, there are perceptual and institutional obstacles, such as a lack of trust and differences in strategic objectives. On the other hand, administrative and bureaucratic barriers make it difficult to initiate and maintain partnerships. To overcome these challenges, it is necessary to create effective communication and collaboration mechanisms, reduce bureaucracy and develop support programs that facilitate the integration of the business environment into university activities. It is also essential to better inform companies about the benefits of collaboration and available funding opportunities.

4.5. Analysis of the importance of partnerships between the cluster business environment and the research-development-innovation environment

The fifth dimension explores how the business environment values partnerships with the Research, Development, and Innovation (RDI) sector. Appendix Table A5 reveals significant correlations between the related variables, with weak to moderate intensity, reflecting a multifaceted view of collaboration relevance.

The correlation matrix determinant is 0.005, above the 0.001 threshold. The first factor explains 48% of the variance, and the first two account for 78%. Varimax rotation revealed two components in how businesses perceive partnerships with the RDI sector (Appendix, Figure A1e). The first reflects strategic benefits – product innovation, access to research, and competitiveness. The second focuses on internal capacity building through skilled personnel, knowledge, and technology transfer. These components highlight two complementary dimensions: one innovation-driven, the other centred on enhancing organisational capabilities via academic collaboration.

Universities are central to these ecosystems, providing knowledge, human resources and infrastructure for developing innovative products and technologies. Within the Romanian economic context, cluster development can enhance university-business relations, significantly impacting key strategic sectors. The analysis of the collected data identified three key areas where clustering can drive positive outcomes: alternative technologies and renewable energy, the IT industry and digitalisation, and manufacturing and automation (see Figure 3).

Pie chart legend:
- IT and digitalization — 23%
- Agri-food — 12%
- Tourism and eco/bio-tourism — 14%
- Textile industry — 11%
- Renewable energy and green technologies — 10%
- Furniture and woodworking industry — 9%

(Additional pie segments: 8%, 7%, 6%)
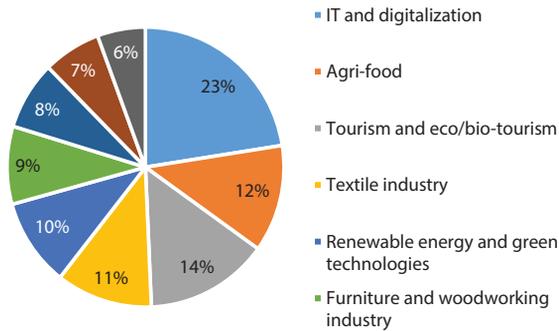
Figure 3. The main areas of cluster development in Romania

The companies' responses were analysed to evaluate local firms' willingness to collaborate with universities through cluster structures. The findings indicate that while most firms view clustering as a valuable opportunity, they also recognise specific challenges (see Table 4).

Table 4. Business environment's perception of clustering

Aspect assessed	Percentage of agreement (%)
Clustering improves access to innovation	72%
Partnerships within clusters are more efficient than individual collaborations	68%
Clustering facilitates access to European funds	65%
Administrative barriers hinder cluster development	58%
Lack of effective coordination reduces cluster efficiency	54%

These results indicate that firms recognise the potential of clusters, but are concerned about the administrative challenges and the need for better coordination of collaborative initiatives.

If we analyse the average score obtained, we can identify the areas where a cluster's action would have a majorly impact on regional development. The health and medical sciences field obtains the highest score, followed by the food industry and agriculture, which have minimal differences. From the perspective of the factors that influence the evolution and development of a cluster, the most important seem to be infrastructure and workforce. Among the advantages of joining a cluster partnership, the most notable advantages seem to be: "Active involvement in workforce training" and "Research and innovation"; the development of joint projects for products as a significant advantage of clusters; the transfer of know-how, followed by marketing and public relations and the establishment of contacts with new clients. *USV contributes to the clusters' creation and growth in the region, through its role as a mediator of science and technology*, through collaboration with enterprises and capital companies, in order to improve the technological transfer process, but also by the fact that it centralises research and training efforts by creating cluster-specific institutions. In this sense, they also participate in the development of the cluster by seeking solutions to current problems.

5. Discussions

The results obtained from applying the three socio-statistical surveys and the factor analysis using the principal components method confirmed the hypotheses initially formulated, highlighting the proposed theoretical model's logical coherence and empirical validity.

The university and the business sector cooperation, investigated through a three-dimensional approach (innovation – cluster partnerships – employability), proves to be a complex process, conditioned by strategic factors and affected by perceptual and institutional barriers. According to the data, university-business cooperation is a central pillar of regional development and a defining element of Helix or cluster-type innovative ecosystems.

The results obtained at the level of the R1 study validate several fundamental hypotheses regarding the functioning of clusters. H1.1 is confirmed by the fact that the provision of qualified personnel, adapted to the labour market requirements, is perceived as essential for the formation and sustainability of cluster-type structures. H1.2 is also supported by the importance of technology transfer and the involvement of personnel with research and innovation skills within these partnerships. In addition, H1.3 is confirmed by the emphasis placed on the active role of universities in ensuring the success and continuity of clusters, and H1.5 is confirmed by the identification of areas with strategic impact in the development of the North-East region: health, food industry, IT&C, biotechnologies and construction. Thus, integrating universities into innovative networks reduces the gap between research and industrial applicability (Porter, 1998).

Regarding USV students and graduates, the R2 study confirms hypothesis H2.1, according to which UBC activities (such as internships, workshops, job fairs, joint projects, etc.) are appreciated as relevant to professional development and facilitate insertion into the labour market. The data confirm that practical experiences such as internships support graduate employability, reinforcing existing theoretical models on human capital development (Tymon, 2013; Becker, 1993).

Also, H2.2 is validated by identifying concrete factors that support the transition of graduates to employment, and H2.3 is confirmed by recognising the benefits of collaboration,

but also by mentioning barriers such as differences in objectives, misaligned expectations or the lack of functional connection structures. An important role in supporting this process is attributed to the university's Career Counselling and Guidance Centre, which respondents consider essential in developing skills and facilitating contact with the labour market.

On the other hand, the R3 study, addressed to the business environment, confirms hypothesis H3.1, by identifying a set of factors favourable to collaboration with the university, such as the existence of shared objectives, mutual trust, previous collaboration experience, the university business orientation, flexibility and the possibility of employing students or teaching staff. The study indicates that 43% of the responding companies collaborated with the university in various forms, from student recruitment to applied research projects. The main reasons for collaboration were access to qualified human resources (56%), funding opportunities for joint projects (38%) and the development of innovative solutions through strategic partnerships (27%). These factors define a pragmatic relationship, oriented towards concrete results and mutual benefits. At the same time, hypothesis H3.2 is validated by highlighting the significant barriers perceived by companies – in particular bureaucracy, lack of initiative from the university environment and lack of resources (time, funds, staff) – that limit the development of sustainable partnerships. These findings are aligned with earlier findings, highlighting that universities and companies often operate in different paradigms, making it difficult to establish common objectives (Bruneel et al., 2010).

Regarding cluster partnerships and the role of research-development-innovation, the principal components analysis highlighted two significant dimensions: on the one hand, maximising the competitiveness of organisations through access to research results and new product development; on the other hand, reducing technological gaps through the employment of qualified personnel and transfer of know-how. These findings fully support the proposed theoretical model and reveal that the university's involvement in collaborative and innovative partnerships generates direct benefits for both the academic and economic environment. Thus, integrating universities in innovative networks reduces the gap between research and industrial applicability (Porter, 1998).

Comparing our results with those of other studies, we found that students who completed internships and attended networking events were more likely to be employed within six months (62% vs. 38%). This finding is consistent with the view that structured UBC creates early labour-market advantages through practice-oriented learning and partner brokerage. Prior work links UBC channels to firm learning and opportunity creation, suggesting why local employers absorb interns more quickly when interfaces function as intended (Johnston, 2022; Ratten, 2016).

The salience in our data of relational/organisational proximity, as well as a straightforward liaison/interface, aligns with proximity-based explanations of SME-university ties in open innovation: social proximity eases access. In contrast, organisational/technological proximity reduces translation losses and enables deeper collaboration (Johnston, 2022). In moderately innovative regions, the depth of collaboration is further conditioned by firm size, sector, and leadership commitment to digitalisation (Marra et al., 2022).

Respondents' emphasis on cluster-mediated access to projects, training and internships is compatible with evidence that cluster collaboration strengthens open-innovation practices and, through expanded knowledge flows, contributes to market/financial performance (Kim et al., 2022). Our multi-actor findings extend these results by linking cluster services to employability pathways, not only to firm-level innovation outcomes (Kim et al., 2022).

Two barrier dimensions recur in our sample – (i) visibility/coordination (unclear contact points, weak brokerage) and (ii) process frictions (bureaucracy, IP/NDAs). This mirror synthesis work categorises obstacles into triple-helix misalignments, relational capital deficits, and procedural hurdles; proposed mitigations (standard IP toolkits, named liaison roles) align directly with our governance suggestions (Johnston, 2022).

A notable divergence is the near-zero association between Academic initiatives and Practice ($r = -0.001$, Appendix, Table A1), whereas many WIL settings assume complementarities between curriculum-embedded activities and mentored placements. A plausible explanation is construct heterogeneity: in our context, "academic initiatives" appear not to be embedded WIL (e.g., scholarly events/coursework without workplace assessment), which weakens coupling. This suggests a design issue rather than a refutation of WIL benefits, and it recommends disaggregating initiative types (credit-bearing vs. co-curricular; duration/quality) and tracking mentorship intensity in future research (Johnston, 2022).

Related to the paper's contribution to the literature, the study integrates cluster governance into the employability narrative by demonstrating, with multi-stakeholder evidence, how cluster-enabled UBC mechanisms co-vary with early labour market outcomes – an angle underrepresented in work that typically focuses on firm-level innovation alone (Kim et al., 2022). Second, we validate compact latent constructs (UBC mechanisms; barriers) that are directly measurable and portable for policy evaluation in an emerging economy with moderate innovation (Marra et al., 2022). Third, by connecting proximities and interface quality to observed outcomes, we provide a micro-to-meso bridge that is consistent with proximity-based open-innovation theory (Johnston, 2022) and with recent patterns of openness profiles in U–I collaboration (Băban & Băban, 2025).

Where firms report active cluster collaboration, the literature documents gains in open-innovation breadth and business performance; our evidence complements this by adding employability-focused signals (Kim et al., 2022) and by situating mechanisms in a moderate-innovation region (Marra et al., 2022).

Two refinements follow from the contradictions above: (i) disaggregate "academic initiatives" into embedded WIL versus non-embedded activities and test interactions with liaison support; (ii) extend outcome tracking beyond self-reports to objective indicators (co-publications, co-patents, internship-to-job conversion), consistent with network/performance research in U–I collaboration (Mingli & Ping, 2014).

5. Conclusions

This research analysed the interdependence link between the USV and the business environment in the context of Helix and cluster partnerships, highlighting the impact of collaboration on graduates' employability, the factors that stimulate university partnerships, and the barriers that hinder their development. The results confirmed that practical experiences, such as internships and joint projects, positively affect labour market insertion. At the same time, differences in vision and excessive bureaucracy continue to be significant obstacles.

Regarding the specialised literature, the study validated the Triple Helix model, highlighting the crucial role of collaboration among universities, industry, and government. However, empirical data suggest that the application of this model is limited by the lack of adequate institutional mechanisms and insufficient participation of the private sector. Also, the Open Innovation hypothesis was partially supported, as only a few companies use universities as

strategic partners for innovation, citing difficulties related to funding, intellectual property protection and differences in research objectives.

Another essential aspect this research highlights is the role of economic clusters in facilitating collaboration between universities and the business environment. The results suggest that regions that benefit from cluster structures have a higher degree of integration of graduates into the local economic environment, due to already functional collaboration networks.

Improving UBC requires reducing bureaucracy, creating flexible administrative structures, aligning university curricula with labour market needs through practical integration, fostering economic clusters to enhance technology transfer, and developing government policies that support joint projects via dedicated research funding.

Beyond streamlining procedures and establishing liaison units already noted, we recommend five operational steps: (1) a cluster-run internship clearinghouse that coordinates calls, supervision standards and cohorts; (2) credit-bearing micro-credentials co-branded with cluster members in smart specialisation domains; (3) an annual UBC & Employability dashboard tracking internship-to-job conversion, 6-month employment rate and job-study match; (4) seed vouchers for student-firm co-creation projects with demo-day dissemination; and (5) formal boundary-spanner roles (time allocation and recognition) to preserve relational proximity beyond single projects. Each action is tied to measurable KPIs (e.g., placements per cohort, conversion rate, median time to hire), enabling iterative scaling after the first year.

Despite offering valuable insights, this study has limitations. First, its regional focus may restrict generalizability, as results reflect a specific set of universities and companies. Broader studies could yield more comprehensive findings. Second, reliance on questionnaires introduces subjectivity and social desirability bias; integrating objective data like employment rates or actual collaborations would enhance accuracy. Third, the analysis centres on university and business perspectives, omitting policy or governmental views. Lastly, focusing on specific economic sectors may limit applicability; future research should explore less developed or emerging industries for a fuller understanding.

Acknowledging these limitations offers a foundation for future research, including longitudinal studies on the long-term effects of collaboration on graduates' careers, international comparisons of partnership models to identify best practices for Romania, and analyses of psychological and cultural factors affecting companies' willingness to engage with universities.

In conclusion, this research confirmed that university-industry partnerships are essential in human capital formation and economic development, but their implementation requires more flexible policies.

Author contributions

The authors contributed to all stages of the research.

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APPENDIX

Table A1. The correlation matrix related to the university and the business sector collaborative relationship

Variables	Partner-ships	Practice	Round-tables	Career Develop-ment Assistance	Academic Initiatives	Work-shops	Dialogue with the Business Environ-ment	Job Fair
Partnerships	1	0.452	0.468	0.441	0.244	0.324	0.349	0.196
Practice	0.452	1	0.476	0.244	−0.001	0.306	0.325	0.198
Roundtables	0.468	0.476	1	0.342	0.26	0.445	0.396	0.229
Career Development Assistance	0.441	0.244	0.342	1	0.484	0.261	0.39	0.456
Academic Initiatives	0.244	−0.001	0.26	0.484	1	0.26	0.204	0.417
Workshops	0.324	0.306	0.445	0.261	0.26	1	0.651	0.351
Dialogue with the Business Environment	0.349	0.325	0.396	0.39	0.204	0.651	1	0.495
Job Fair	0.196	0.198	0.229	0.456	0.417	0.351	0.495	1

Table A2. Correlation matrix related to barriers in strengthening the university and the business sector relationship

Variables	Mist-rust	Different goals	Diffe-rent expec-tations	Different priorities	Organi–sational culture	Lack of re-sour-ces	Lack of commu-nication struc-tures	Lack of govern-ment support
Mistrust	1	0.476	0.32	0.082	−0.123	0.095	0.306	0.396
Different goals	0.476	1	0.622	0.211	0.184	0.144	0.38	0.402
Different expectations	0.32	0.622	1	0.358	0.187	0.232	0.332	0.297
Different priorities	0.082	0.211	0.358	1	0.249	0.208	0.183	0.126
Organisational culture	−0.123	0.184	0.187	0.249	1	0.362	0.197	0.063
Lack of resources	0.095	0.144	0.232	0.208	0.362	1	0.345	0.392
Lack of communication structures	0.306	0.38	0.332	0.183	0.197	0.345	1	0.474
Lack of government support	0.396	0.402	0.297	0.126	0.063	0.392	0.474	1

Table A3. The correlation matrix related to the university collaborative relationship from the business sector perspective

Variables	Commercial orientation	Public funds	Partner flexibility	Student engagement	Faculty engagement	Geographical distance	Mutual trust	Common goals	Previous relationships
Commercial orientation	1	0.462	0.465	0.262	0.363	0.331	0.388	0.348	0.135
Public funds	0.462	1	0.539	0.252	0.448	0.262	0.245	0.156	0.003
Partner flexibility	0.465	0.539	1	0.411	0.506	0.386	0.571	0.606	0.45
Student engagement	0.262	0.252	0.411	1	0.191	0.283	0.316	0.174	0.144
Faculty engagement	0.363	0.448	0.506	0.191	1	0.247	0.344	0.421	0.326
Geographical distance	0.331	0.262	0.386	0.283	0.247	1	0.432	0.395	0.363
Mutual trust	0.388	0.245	0.571	0.316	0.344	0.432	1	0.852	0.568
Common goals	0.348	0.156	0.606	0.174	0.421	0.395	0.852	1	0.711
Previous relationships	0.135	0.003	0.45	0.144	0.326	0.363	0.568	0.711	1

Table A4. The correlation matrix related to the university and the business sector relationship from the business sector perspective

Variables	Low visibility	Lack of information	Lack of funds	Lack of contact details	Company bureaucracy	University bureaucracy	Theoretical orientation	Need for confidentiality	Lack of responsible person	Different values	Differences in communication	Different time horizon	Limited student absorption capacity
Low visibility	1	0.498	0.121	0.185	0.318	0.335	0.245	0.363	0.182	0.301	0.35	0.204	0.18
Lack of information	0.498	1	0.64	0.32	0.264	0.247	0.44	0.18	0.262	0.439	0.355	0.387	0.236
Lack of funds	0.121	0.64	1	0.325	0.468	0.405	0.35	0.214	0.429	0.43	0.436	0.466	0.325
Lack of contact details	0.185	0.32	0.325	1	0.334	0.519	0.558	0.385	0.258	0.479	0.522	0.535	0.204
Company bureaucracy	0.318	0.264	0.468	0.334	1	0.574	0.364	0.397	0.544	0.408	0.471	0.393	0.478
University bureaucracy	0.335	0.247	0.405	0.519	0.574	1	0.429	0.559	0.34	0.403	0.538	0.512	0.331
Theoretical orientation	0.245	0.44	0.35	0.558	0.364	0.429	1	0.394	0.254	0.426	0.414	0.607	0.232
Need for confidentiality	0.363	0.18	0.214	0.385	0.397	0.559	0.394	1	0.316	0.448	0.521	0.41	0.397
Lack of responsible person	0.182	0.262	0.429	0.258	0.544	0.34	0.254	0.316	1	0.488	0.497	0.358	0.373
Different values	0.301	0.439	0.43	0.479	0.408	0.403	0.426	0.448	0.488	1	0.709	0.714	0.276
Differences in communication	0.35	0.355	0.436	0.522	0.471	0.538	0.414	0.521	0.497	0.709	1	0.66	0.442
Different time horizon	0.204	0.387	0.466	0.535	0.393	0.512	0.607	0.41	0.358	0.714	0.66	1	0.381
Limited student absorption capacity	0.18	0.236	0.325	0.204	0.478	0.331	0.232	0.397	0.373	0.276	0.442	0.381	1

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Table A5. The correlation matrix related to the importance of the cluster business and RDI sectors' partnerships

Component	Knowledge transfer	Technology transfer	Competi-tiveness	Product develop-ment	Access to re-search results	Development of innovative models	Qualified personnel
Knowledge transfer	1	0.752	0.604	0.597	0.641	0.568	0.639
Technology transfer	0.752	1	0.674	0.716	0.713	0.684	0.737
Competitiveness	0.604	0.674	1	0.673	0.691	0.658	0.632
Product development	0.597	0.716	0.673	1	0.752	0.64	0.707
Access to research results	0.641	0.713	0.691	0.752	1	0.684	0.704
Development of innovative models	0.568	0.684	0.658	0.64	0.684	1	0.678
Qualified personnel	0.639	0.737	0.632	0.707	0.704	0.678	1

Figure A1. Degree of correlation between variables and extracted components