University–Industry Partnership: Literature Review of the Collaboration Channels and Motivations. The Case Study of Yerevan State University[1]

Karlen Khachatryan[1,*], Anna Hakobjanyan[2] and Kristine Nikoghosyan[3]

[1]*Associate Professor at the Department of the Management and Business, Yerevan State University, Armenia, Yerevan.*

[2]*Associate Professor at the Department of the Management and Business, Yerevan State University, Armenia, Yerevan*

[3]*MA degree student at Department of Economics, Ca' Foscari University of Venice, Italy.*

Abstract: This study investigates the motivations and channels utilized by universities in establishing university-industry partnerships. The research focuses on a case study conducted at the largest higher education institution in Armenia. A comprehensive literature review was initially conducted to gain a deep understanding of the motivations and channels within the framework of university-industry partnerships. Data for this study was collected through online questionnaires administered to the YSU Faculty Administrative Staff, including deans and chairs. Additionally, a documentary analysis was employed as a supplementary data collection method. The analysis of the literature resulted in the development of a hierarchical classification with group/subgroup divisions for the collaboration channels, which distinguishes itself from other variations by encompassing all possible channels. Furthermore, a set of criteria was developed to assess the impact, practical applicability, and feasibility of each collaboration channel. Based on the survey results, these criteria were used to characterize each collaboration channel. The study also examined the primary constraints and difficulties associated with university-industry partnerships. The findings of the study offer several suggestions and implications for policy development.

Keywords: Academic Entrepreneurship; Innovative Capacity; Innovative education; Research and Development; Knowledge and Technology Accumulation.

1. INTRODUCTION

The partnership between education and industry is considered one of the main factors in developing human resources. Each of the parties has its expectations from this cooperation. The university is interested in cooperating with businesses to produce more competitive graduates and meet the labor market requirements. On the other hand, the business expects to receive personnel with the most knowledgeable and necessary skills, whose training will be the least expensive. This is perhaps the most traditional mechanism of university-industry cooperation.

In contrast to traditional perceptions, contemporary universities have evolved beyond their traditional roles of imparting specialized training and engaging in academic research. They now embrace a broader objective of fostering "entrepreneurial education" (Remeikiene et al., 2013; Welsh et al., 2016; Li and Wu, 2019; Bauman and Lucy, 2021) by cultivating a culture of innovation and business ideation among their student and faculty members. Presently, the role of

universities extends beyond the mere provision of qualified specialists and conducting scholarly investigations; rather, academic research institutions should actively strive to implement the concept of the "entrepreneurial university" (Bathelt et al., 2017) through the practical development of academic innovation and business ideas. As a result, universities encompass three primary functions: teaching, research, and entrepreneurial endeavors (Gulbrandsen & Solesvik, 2015). Consequently, over the past decade, universities have transitioned from predominantly fulfilling teaching obligations to assuming a more research-oriented focus, thereby serving as catalysts for the promotion and support of startups and spin-offs.

University-industry cooperation has emerged as a vital source of innovative solutions, driving technological advancements within organizations while promoting heightened productivity and economic growth (Chedid and Teixeira, 2019). This collaborative endeavor fosters the generation of new knowledge, facilitates meaningful interactions, and engenders long-term benefits (Van Rijn et al., 2018). Furthermore, it serves as a catalyst for the dissemination of scientific technology (Rahm et al., 2000). Consequently, the primary objectives of university-industry cooperation revolve around enhancing the modernity of the education sector, improving graduate employability, and ensuring the effi-

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*Address correspondence to this author at the Associate Professor at the Department of the Management and Business, Yerevan State University, Armenia, Yerevan; Tel: +374 99 992123; Email: karlen.khachatryan@ysu.am

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cient utilization of knowledge. Within the framework of this cooperation, the effective and sustained collaboration between universities and industries assumes a foundational role in the development of the educational and research domains (Albuquerque et al., 2015), as well as in expanding the economic and innovative capacities of organizations. Moreover, it serves as a prerequisite for fostering labor mobility between the public and private sectors (Larsen et al., 2016).

Considering the exploratory nature and purpose of this study, have been adapted a case study approach. The sources of empirical evidence used in this exploratory case study was the online survey tool (primary sources) as well as documents and materials (secondary sources).This study has analyzed the case of Yerevan State University, which is perhaps the most appropriate for studying university-industry partnership and is considered the largest university in the Republic of Armenia with the widest scientific orientations (humanities, social studies, exact and natural sciences).

To promote knowledge and technology transfer between the academic and business worlds, it is essential to have a deeper understanding of academics' motivations, underline the role of organizational and institutional structures, introduce the channels. The research also complements previous research giving some policy development implications and measures to foster University-Industry Collaboration in Armenia.

This paper is structured as follows. The next section presents the literature review of the university industry in terms of motivations and interaction channels and institutional structures. The Section "Materials and Methods" describes the research methods and shows the main information about Yerevan State University. In the "Results and Discussion" section, we present and discuss all the results of the online survey. Finally, the last section presents conclusions, implications, limitations, and proposals for further study.

2. LITERATURE REVIEW

Collaboration Channels

The literature on university-industry cooperation extensively covers various aspects of interaction, including drivers, channels of interaction, perceived benefits, and other pertinent factors. In this section, we present a comprehensive review of the dimensions pertaining to the channels of university-industry cooperation. To ensure clarity and precision, we adopt a hierarchical approach in categorizing the interaction channels, drawing upon an established framework of theoretical and scientific classifications of structures and mechanisms.

To begin, it is important to establish a comprehensive understanding of the concept of cooperation channels. In the scientific literature, different terms such as channels, mechanisms, forms, and links are employed to describe the relationships between partnering entities. Notably, Perkmann and Walsh (2007) point out that the terms "channel" and "mechanism" may lack sociological precision. To avoid conceptual ambiguity, it is crucial to provide the following clarification. Building upon the classification proposed by Fuentes and Dutrénit (2012), we recognize the existence of various channels for establishing connections between university and

industry. These channels are typically operationalized through specific cooperation forms or mechanisms. In this study, we adopt the term "channel" to encompass its comprehensive nature and to align with the aforementioned classification.

Within academic literature, various categorizations have been proposed to outline the main channels of university-industry cooperation. We will present a selection of these categorizations, including broad-distinct categorizations, grouped categorizations, and criteria-specified categorizations, for a comprehensive overview.

One notable categorization was introduced by Bekkers and Freitas (2008), who identified 23 broad-distinct categories of channels. Their focus was to assess the relative importance of these channels for both universities and industrial performers. It is worth noting that these channels primarily revolve around the transfer of knowledge from universities to industry, and the authors did not group them explicitly.

Moving on to criteria-specified categorizations, we highlight several classifications utilized in literature. For the criteria-specified categorizations, we would like to mention the classification of formal/ informal channels (OECD, 2019), market-based and non-market-based channels (Wang et al., 2012), Short-long term, Institutional-Personal, Low-High Intensity channels (Chedid and Teixeira, 2019), channels based on low, relational and intermediate involvement of partners (Perkmann and Walsh, 2007).

These categorizations provide valuable insights into the diverse nature of university-industry cooperation channels, allowing for a fundamental understanding of the various dimensions and characteristics that shape these interactions.

In terms of grouped categorization, the study by Fuentes and Dutrénit (2012) is noteworthy. They distinguish four channels that describe the links between parties, with each cooperation channel encompassing specific interaction forms or mechanisms: the Info channel (including publications, conferences, informal information, and training), the Project channel (involving contract R&D, joint R&D, and consultancy), the IPR channel (encompassing technology licenses and patents), and the HR channel (involving the hiring of recent graduates). Bonaccorsi and Piccaluga (1994) identified six organizational forms of interaction: personal informal relationships, personal relationships, third-party intermediaries, formal targeted agreements, formal non-targeted agreements, and the creation of focused structures. Building upon this classification, Ankrah and AL Tabba (2015) expanded on the subcategories identified in their review. However, it should be noted that this approach may not be universally applicable to all universities, particularly in developing countries where traditional collaborations may exclude many knowledge and technology transfer channels.

D'Este and Patel (2007) surveyed respondents to ascertain the frequency and importance of different channels, which they categorized into five groups: meetings and conferences, consultancy and contract research, creation of physical facilities, training, and joint research. Subsequently, Muscio and Pozzali (2012) identified 12 types of collaboration, grouping them into the aforementioned five macro-areas following D'Este and Patel's approach. Parkman and Walsh (2007) in-

Fig. (1). U-I collaboration channels in Hierarchic approach.

troduced seven groups, referred to as links, including research partnerships, research services, academic entrepreneurship, human resource transfer, informal interactions, commercialization of property rights, and scientific publications. Schartinger et al. (2002) utilized three main categorizations of interactions—informal personal relationships, formal personal relationships, and formal targeted agreements—to identify nine types of interactions based on three dimensions: formalization of interaction, transfer of tacit knowledge, and personal (face-to-face) contacts.

Additional classifications mentioned in the works of Brennenraedts et al. (2006), Cohen et al. (2002), and Bruneel et al. (2010) align closely with the aforementioned channels outlined above.

The literature reveals a diverse array of classifications for university-industry cooperation channels. Taking into account the various approaches adopted in these classifications and the specificities of cooperation within the Armenian context, this scientific article presents a distinct categorization of channels (see Fig. **1**). A hierarchical approach was employed to provide insights into the initiation and progression of collaborations, highlighting the different levels of collaboration. Each channel is further subdivided, enabling further examination and analysis.

In the academic literature, several implications and classifications have been proposed to describe and categorize university-industry cooperation channels based on different criteria. Drawing from the insights provided by previous research, this study integrates and eliminates recurrent criteria to form a comprehensive categorization. The following criteria have been identified based on the literature review: degree of formalization, degree of interaction, potential of obtaining an applied result, direction of knowledge and technology flows, intensity of knowledge and technology flows, length of agreements, resource deployment, extensity of tacit knowledge transfer, personal interaction, and sequence of interaction (Franco & Haase,

2015; Fuentes De & Dutrénit, 2012; Schartinger et al., 2002; Polt et al., 2001; Ankrah & Omar AL-Tabbaa, 2015).

By incorporating the aforementioned criteria, the categorization formulated in this study serves as a comprehensive framework for comprehending and analyzing the various university-industry cooperation channels. The integration of multiple criteria allows for a more comprehensive understanding of the diverse dimensions and characteristics associated with these channels. In line with this categorization, each channel is described using a theoretical approach, supplemented by data collected through the survey conducted. Table **1** presents a summary of these findings.

This table provides a comprehensive overview of each cooperation channel, elucidating its theoretical underpinnings and supporting empirical evidence obtained from the survey. The categorization and associated descriptions contribute to a deeper understanding of the dynamics and mechanisms underlying university-industry cooperation.

Conducting an instrumental analysis of each collaboration channel offers a valuable opportunity to comprehensively evaluate their impact, practical applicability, and suitability within the context of university-industry cooperation. It is important to acknowledge that the effectiveness and relevance of these channels may vary depending on the country's background and specific circumstances. Therefore, the table presented in this study has primarily been developed with a focus on the case of Yerevan State University and the broader characteristics of the country. By considering the unique contextual factors, the table provides insights into the applicability and potential outcomes of each collaboration channel within the specific setting under investigation.

Collaboration Motivations

This section presents a comprehensive literature review on the motivations behind university-industry cooperation. Un-

Table 1. Criteria Based Analysis of Collaboration Channels.

Criteria's	Channels				
	Networking and communication	**Learning and Continuing education**	**Personal training and employment**	**Research and Science development**	**Business and Intellectual property rights**
Degree of formalization	low	low	Intermediate	Upper-intermediate	Higher
Degree of interaction	Low	low	Intermediate	Upper-intermediate	Higher
Potential of obtaining applied result	Low	Low	intermediate	Upper intermediate	Higher
Direction of knowledge and technology flows	U-I	U-I	U-I I-U	U-I I-U	I-U
Intensity of knowledge and technology flows	Low	Median	Intermediate	Upper intermediate	Higher
Length of agreements	one-time	3-6 months	6 months and more	1 year and more	Long-run
Resource deployment	No resources	No recources	Non-defined	Bilateral	Bilateral
Extensity of tacit knowledge transfer	Higher	Higher	low	Higher	Lower
Personal/institutional Interaction takes place.	Personal	Personal	Personal	Institutional	Institutional
Sequence of interaction	U▶I	U▶I	U▶I	U◀I, I▶U	U▶I I▶U

derstanding the main drivers for collaboration and identifying the potential benefits and challenges among partners is crucial for overcoming obstacles that may arise during the cooperation process. One significant challenge in this context is the divergence in communication and language between the scientific and industrial realms. Universities increasingly emphasize standardized knowledge transfer methods, while industries prioritize economic profitability and efficiency mechanisms.

According to Chedid and Teixeira (2019), one of the primary barriers to university-industry partnerships is the divergence in expectations, actions, and vision among the collaborating parties. Sanders (2017) also highlights the cultural differences between these two distinct worlds as a hindrance to effective cooperation. To address these challenges, it is crucial to explore the range of motivations, benefits, and opportunities associated with university-industry collaboration. By adopting such a research approach, potential challenges and limitations among partners can be identified and mitigated (Wallin & Isaksson, 2014).

In the scientific literature, several classifications have been proposed to categorize the motives among university-industry partners. Barnes et al. (2002), Ankrah and AL-Tabbaa (2015), and Perkmann (2013) primarily focus on the financial benefits of partnerships for universities, highlighting the potential for additional funding and income through licensing and patenting. Wallin and Isaksson (2014) suggest that collaboration provides students with easier access to the labor market, facilitates curriculum review, and enables updates.

Arza (2010) presents two forms of university motivation: intellectual, which relates to information exchange, new research ideas, new publications, and increased academic efficiency, and economic, which involves securing funds for new research. We find Arza's approach to be applicable and adoptable. Additionally, considering the broader academic literature and different perspectives on collaboration, we introduce two additional dimensions: institutional benefits and social benefits for both partners. The inclusion of the social aspect is inspired by the concept of the Quintuple Helix, where the university, industry, and government are integrated with social interactions and environmental aspects of collaboration (Carayannis et al., 2012).

Arza (2010) and D'Este and Perkmann (2011) highlight the direct relationship between the choice of cooperation channels and the combination of motivations and benefits. This relationship is illustrated in the corresponding diagram (see Fig. **2**). Arza (2010) proposes a grouped categorization of channels: service, traditional, bi-directional, and commercial. Furthermore, Arza (2010) distinguishes motivations for universities, including intellectual and economic benefits, and motivations for industries, encompassing passive short-term production benefits and active long-term innovation motivations.

Based on the established categorization of channels and motivations, there exists a direct correlation between the two. Fig. (**2**) illustrates this connection, where Quadrant 1 represents the combination of University Economic motivations and organizations' passive short-term benefits. In this case, the collaboration channel falls under the service category, with knowledge flowing from universities to the organiza-
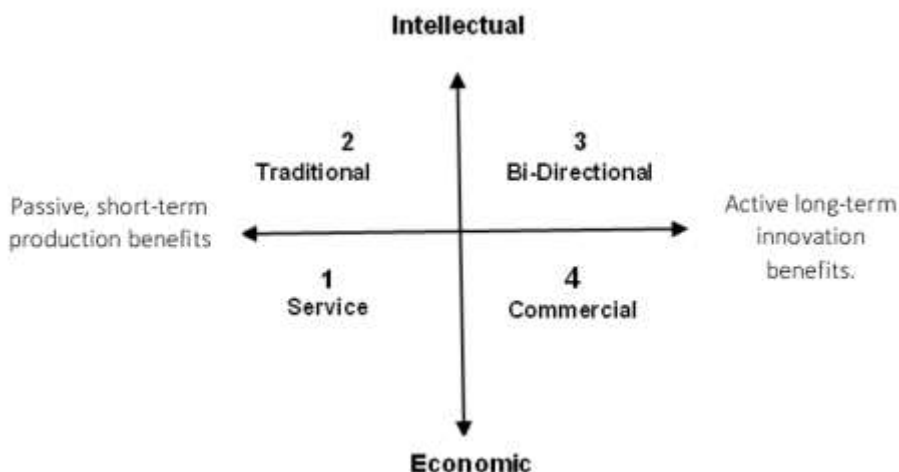
Fig. (2). Relationship of collaboration channels and motivations.

tion through activities such as consulting, equipment utilization, quality control, testing, and monitoring. These interactions primarily focus on short-term objectives. The other quadrants follow a similar approach and analysis.

To comprehensively evaluate the benefits and losses among partners, we consider Arza's classification of motivations (Economic, Intellectual) along with two additional motivations proposed by our research team: Social and Institutional. Based on these dimensions, the survey results are used to examine and present the benefits and losses in Table **2**.

Table 2. Benefits and Losses for University and Industry.

	University		Industry	
	Benefits	**Losses**	**Benefits**	**Losses**
Intellectual	Knowledge and information accumulation, Well-trained students, Improvement of the quality of teaching	Outflow of trained specialized academic staff from University to business, IPR conflicts between the two sides	Access to a well-qualified labor Strengthen research, innovation, technology development Joint publications	IPR conflicts between the two sides caused by the structural difference in interest.
Economic	Additional sources of funding, Employment opportunities	Financial dependence of the university on company funds The increase in resources from the private sector could lead that the government will reduce funding for universities	Boost company's sales Higher productivity Saving money invested in R&D Reduction of expenses on employee trainings Access to "cheaper" labor	Loss of financial resources spent on students trainings Inefficient cooperation/failures and unreliable partners (product development order by the organization haven't been efficiently implemented)
Social	Improvement of the university image	Failures in Collaboration will lead to the disappointment of interest parties	Strengthening their status and image by connecting with major universities	Failures in collaboration will impact on Corporate Image of the Organization
Institutional	Establishment of specialized structures, centers, techno parks Improvement of technological equipment in universities Improvement of the university image	Overload the university and bureaucratic system Conflict of interest and difficulties to choose strategic orientation	Use of University research infrastructure Improve technological performance	Substantial differences in the way of working between the parties (Long-term, short-term results)

In summarizing the benefits and losses outlined in Table **2**, it becomes evident that the involved parties stand to gain a wide array of benefits from university-industry cooperation. However, it is crucial to acknowledge that there are also po-

tential losses or risks that can arise in the absence of necessary institutional structures, infrastructures, and flexible management. Bureaucracy, a commonly known challenge within higher education institutions, can impede effective collaboration. Therefore, the establishment and implementation of appropriate structures, coupled with efficient management practices, are imperative to mitigate potential obstacles.

Another issue that may arise is the failure to meet expectations. Collaboration between universities and industries aims to yield specific outcomes. However, in some cases, while results may be achieved, they may lack practical applicability. For instance, a graduate trained at a university may possess theoretical knowledge but lacks practical skills, rendering their involvement in research programs less effective. To address this challenge, it becomes essential to involve representatives from organizations in the revision and transformation of educational programs. This collaborative effort ensures that the curriculum aligns with industry requirements, producing graduates equipped with the practical skills necessary for effective collaboration. Thus, the development and adaptation of unified strategic and action plans should consider the long and short-term expectations, interests, and needs of both parties involved.

Institutional structures

Career centers or units have been established as the initial structural units for facilitating university-industry collaboration. While similar structures were created in the 1940s, their prominence grew during the 1970s and 1980s when global graduate unemployment rates were high (Terzaroli, 2019). Since the late 1980s, the number of such associations or structures has significantly increased to foster institutional interactions between universities and businesses (Freitas et al., 2013). Career centers have emerged as a link between graduates and employers (McGrath, 2002), playing a crucial role in student career development and the dissemination of scientific findings (Chin Yuk et al., 2018). They also serve as a vital bridge between teaching, research, and entrepreneurship (Terzaroli & Oyekunle, 2019).

During the 1990s and 2000s, career centers transformed into dynamic network centers, driven by the growth of the IT industry and the Technological Revolution (Dey & Cruzvergara, 2014). This evolution aimed to ensure that personnel training aligns with current labor market requirements, student employment needs, and technological advancements (Hayden & Ledwith, 2014). The services provided by these centers have expanded beyond job placements to encompass a comprehensive range of career planning services, including work experience opportunities, entrepreneurial education, and the development of a "Portfolio of Achievements" (Curaj et al., 2020).

The nature of university-industry cooperation has changed due to the need for effective knowledge and technology transfer between academic institutions and the business world (Muscio & Vallanti, 2014). Consequently, there is a growing trend of establishing innovation and entrepreneurship development centers that support students or academics in commercializing inventions and creating

social enterprises or businesses (Wilczynski & McLaughlin, 2017).

Another crucial infrastructure explored in this research is the Research and Development (R&D) centers, which primarily aim to enhance the education system and promote student achievement through research, development, evaluation, and national leadership (Wilkinson, 2014). In developed countries, university-industry collaboration encompasses various aspects such as employment, education, training, research, and innovation (Martin, 2000). The ultimate goal of such partnerships is to realize the concept of the entrepreneurial university (Etzkowitz, 1983) and facilitate the practical implementation of academic entrepreneurship (Klofstena et al., 2019) through educational programs that foster mutual learning, information exchange, and innovation (Nakagawa et al., 2017).

In conclusion, career centers and units have emerged as important structural units for facilitating university-industry collaboration. They have evolved over time to become dynamic network centers, serving as bridges between graduates and employers, and promoting student career development and scientific dissemination. Furthermore, the establishment of innovation and entrepreneurship development centers has become a growing trend to support the commercialization of inventions and the creation of social enterprises or businesses.

Overall, university-industry collaboration, facilitated by career centers, innovation and entrepreneurship centers, and R&D centers, plays a critical role in promoting economic growth, knowledge transfer, and the practical application of academic research, ultimately benefiting both academia and industry.

3. MATERIALS AND METHODS

This research is based on the online questionnaire survey (https://questionpro.com/t/AScsPZs6ks) and has been sent to the YSU faculty administrative staff (primary sources). Moreover, this paper will be based on documentary analysis such as reports, regulations, and strategy plans (secondary sources).

In addition to the demographic information about the respondents, they were asked questions about the channels of cooperation, motives, obstacles, and the activities of institutional structures, legal framework, and measures contributing to the partnership.

The respondents are the university's faculty administrative staff (dean, vice-dean, head of the department), but they also have an academic/teaching workload. In order to ensure broad coverage of the survey, the survey was sent to the staff via the Mulberry administrative document circulation system.

The following documents and materials were used for secondary data analysis: YSU Charter, 2016-2021/2011-2015, the strategic plan, 2019-2020, the report on the implementation of the strategic plan, as well as the information published on the YSU website.

DESCRIPTION OF YEREVAN STATE UNIVERSITY

Yerevan State University (YSU), established in 1919, is the largest university in Armenia and a prominent public institution of higher education. Over the years, YSU has witnessed the graduation of approximately 100,000 students, and it currently enrolls around 20,000 students across its 19 faculties. The educational process at YSU is facilitated by a diverse faculty of over 1,600 highly qualified specialists and experts, comprising 207 professors, 581 associate professors, 375 assistants, and 453 lecturers. These faculty members contribute to the university's educational and research activities, which are organized in more than 100 chairs equipped with modern techniques and equipment.

The YSU Strategic Development Program for the period 2021-2026 outlines the university's plans to conduct innovative research in various disciplines, including social sciences, socioeconomics, humanities, natural sciences, and mathematics. However, it is worth noting that the strategic plan does not explicitly address the development of innovation and entrepreneurship within the university. The plan lacks specific indicators related to the necessary institutional, structural, and procedural frameworks required to foster innovation and entrepreneurship.

Upon analyzing YSU's strategic development plan and annual activity reports, it becomes evident that the university recognizes the importance of fostering research collaboration among research institutes, universities, and enterprises. However, it is noteworthy that the strategic planning and implementation processes at YSU have not resulted in significant changes regarding the university's activities in the field of career and entrepreneurship. This observation may indicate that the existing structures at YSU are primarily focused on ensuring stability and continuity, without actively pursuing changes in these areas over time.

4. RESULTS AND DISCUSSION

The objective of the survey was to investigate the primary collaboration channels employed in university-industry cooperation and the departments responsible for facilitating such cooperation at Yerevan State University. Additionally, a factor analysis was conducted to identify the factors that contribute to the development of university-industry collaboration, as well as to identify the barriers hindering its progress. This approach aimed to uncover the expectations among the partners involved in such collaborations.

The survey was distributed to the key administrative personnel of 19 faculties, one institution, and three scientific centers. In total, 51 respondents completed the survey, comprising 28 individuals from the fields of exact and natural sciences (55%) and 23 respondents from social and humanitarian sciences (45%). The survey primarily targeted deans, vice-deans, and chairs of the faculties.

In terms of whether the respective faculty or unit engages in collaboration with private or public organizations, 90.2% (51 respondents) answered affirmatively. The breakdown of responses based on the specialization of faculties indicates that all respondents from humanitarian-oriented faculties responded positively. Among the 28 respondents from facul-

ties specializing in natural and exact sciences, 17.9% answered negatively, while 82.1% responded positively.

Regarding the assessment of cooperation frequency by the respondents, 93% indicated that the collaboration was continuous, close, and periodic. This positive response suggests that the cooperation primarily entails long-term and close relationships. Furthermore, it indicates that parties involved in the collaboration tend to sustain their engagement even after initial experiences, thus fostering ongoing partnerships. (see Graph 1).
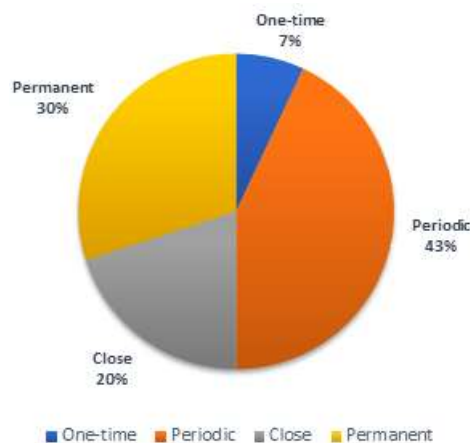

Graph 1: The Frequency of Calloboration at YSU Faculties

Within the context of university-industry partnerships, the exploration of collaboration channels and mechanisms holds significant importance. While the survey findings indicate that the frequency of collaboration tends to be constant, close, and permanent, it is crucial to examine the specific channels and mechanisms employed in these partnerships. Such an analysis will provide insights into the level of development of university-industry cooperation at Yerevan State University (YSU) with public and private organizations. Moreover, it will shed light on whether the collaboration primarily relies on traditional mechanisms and structures or if there is a inclination towards modern collaborative approaches.

To achieve this, the survey participants were presented with an open-ended list of channels, taking into account the hierarchical classification established by the research team (see Fig. **1**). By examining the responses provided by the survey respondents, valuable insights can be gained regarding the prevalent channels and mechanisms utilized at Yerevan State University (YSU). This analysis enables a deeper understanding of the nature and extent of the university's collaborative engagements with external organizations.

The channels presented to the respondents were accompanied by their respective sub-components, which allowed for a more detailed exploration of the specific channels utilized within each faculty. Respondents were given the freedom to select the channels that were most frequently employed in their respective faculties without any restrictions or limitations. Consequently, the survey aimed to capture the preferences and choices of the respondents regarding the utilization of various collaboration channels.
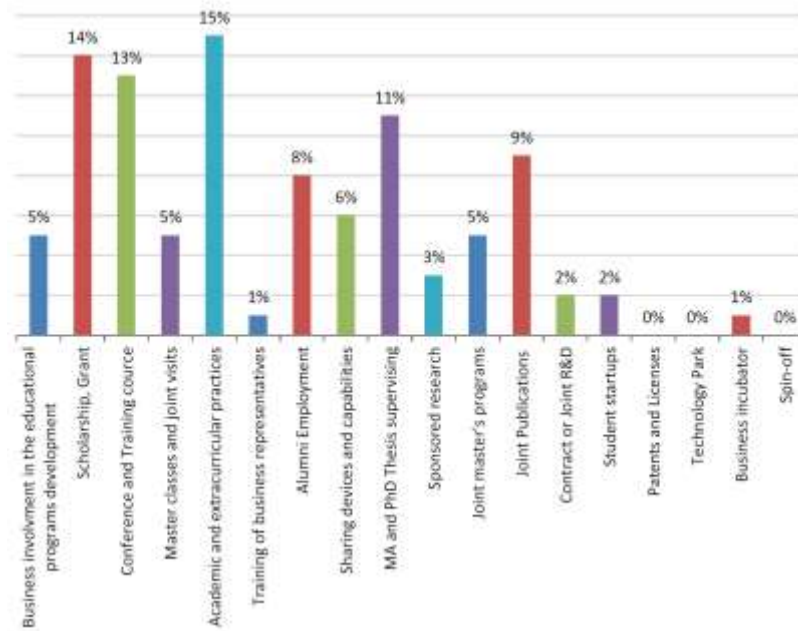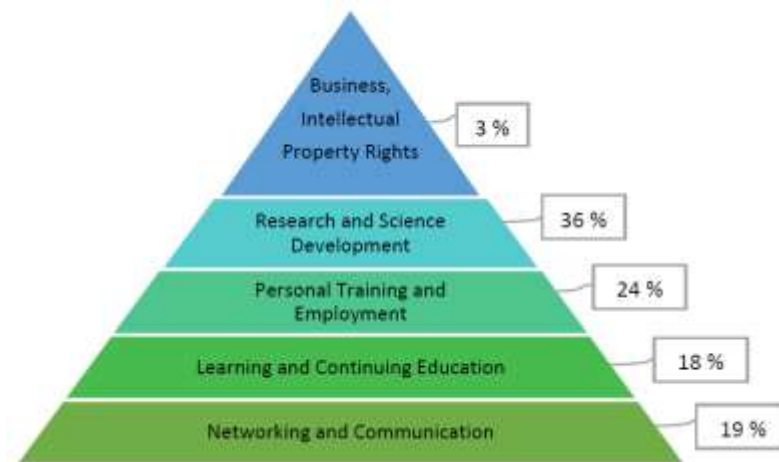
Graph 2. Channels used by Faculties.

Fig. (3). Proportion of usage of channels at YSU.

Interestingly, the results revealed that educational and extra-curricular practices were perceived as the most suitable channels for both faculties oriented towards science and humanities, with a frequency of 15%. Following closely behind were conferences/training with a frequency of 13.8%, and scholarships/grants with a frequency of 13.5% (refer to Graph 2). These findings shed light on the preferred channels for university-industry collaboration within YSU and provide valuable insights into the specific mechanisms that are commonly utilized in fostering partnerships with external organizations.

The survey results indicate that the first, second, third, and fourth sub-components of the hierarchical approach, namely Networking and Communication, Learning and Continuing education, Personal Training and Employment, and Research and Science Development, were the most frequently mentioned channels for university-industry cooperation at Yerevan State University (YSU). These channels gained notable percentages, as depicted in Fig. (**3**).

It is worth noting that the choice of channels for both humanities and natural sciences respondents exhibited a remarkable similarity. This convergence implies a homogeneous development trend within the university concerning university-industry cooperation. While this can be seen as a positive aspect, it is important to acknowledge the relatively limited applicability of channels such as Business and Intellectual Property Rights, which scored below average. Thus, it becomes evident that the university's collaboration with public and private organizations primarily relies on traditional mechanisms.

Within the Research and Science Development category, two subcategories were commonly mentioned. These include MA and Ph.D. thesis supervising, accounting for 10.55% of the responses, and Joint publications, which garnered 8.86% of the responses. These findings indicate that YSU places importance on research collaborations, thesis supervision, and the dissemination of research outcomes as integral components of its university-industry cooperation efforts.
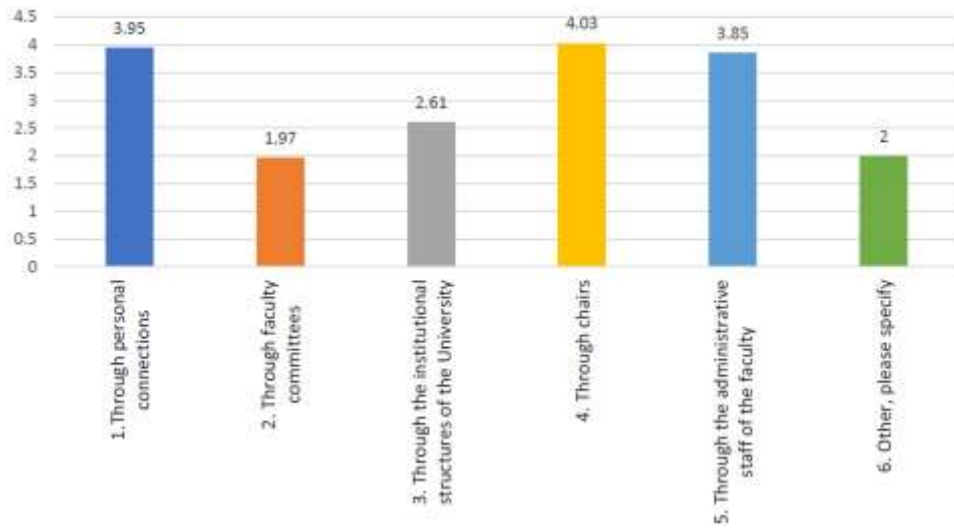
Graph 3. Calloboration Formats and Initatives with Public-private organizations.
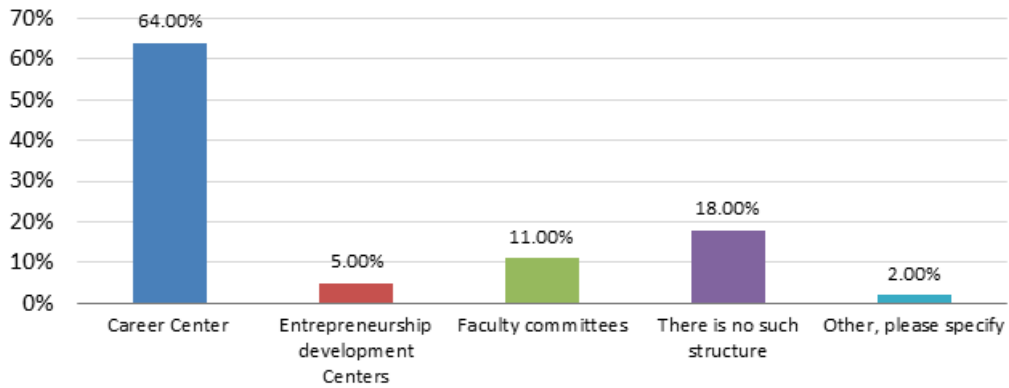
Graph 4. Institutional structures in the framework of UIC at YSU.

Within the Business and Intellectual Property Rights category, only selected subchannels were emphasized. For instance, the Faculty of Chemistry, Mathematics, and Mechanics highlighted the utilization of business incubators and student startups as channels. Additionally, the Faculty of Chemistry and Biology emphasized Contractual or Joint R&D as a means of collaboration. Notably, the IT Educational and Research Center stood out as the only entity mentioning the use of Patents and Licenses as a channel for university-industry cooperation.

Overall, the findings suggest that while there is a convergence in the choice of channels across different disciplines, the utilization of certain channels, particularly those related to business and intellectual property rights, is relatively limited. This indicates a predominant reliance on conventional approaches to collaboration with external organizations. These insights shed light on the specific channels that are more prominently employed within the university-industry cooperation framework at Yerevan State University, highlighting areas for potential growth and diversification in the future.

In the humanitarian block, we have the following picture: there are no used mechanisms and structures that would favor entrepreneurship, innovation, and deeper cooperation with private organizations. The higher-level channels used

by the humanitarian block are joint publications, MA and Ph.D. thesis supervising, and Sponsored Research.

In conclusion, based on the survey results, at YSU, the 4th level channels have partial applicability. While 5th-level channels are not yet applicable soon, it is necessary to implement operational and structural changes in this direction.

One of the essential characteristics of studying university-industry cooperation is the existence of infrastructures or specialized structures that contribute to the partnership in the university system. For that reason, the respondents were asked to indicate the format by which the cooperation with private-public organizations at the faculties is organized and what institutional structures exist in the framework of this collaboration. First, based on a 1-5 scale, the respondents were asked to evaluate by frequency indicator which formats are mainly used to initiate the partnership with the public-private organization.

As presented in graph 3, the respondents mostly noted that the application of various channels was initiated through personal connections, faculty chairs, or faculty administrative staff.

As for the existence of institutional structures, the respondents were additionally asked to answer what kind of institutional structure/structures operate in the university which
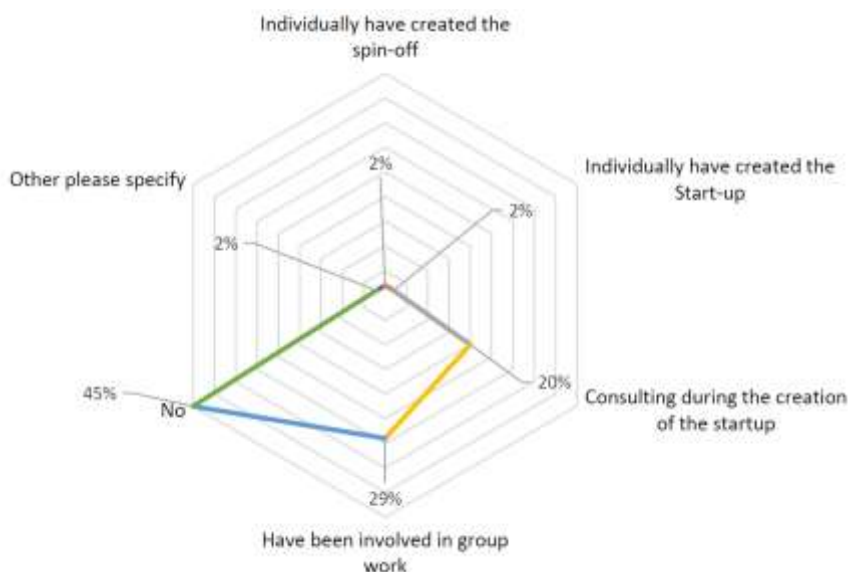
Graph 5. The involvement in the creation of spin-offs and start-ups

contribute to the development of university-industry cooperation.

As presented in graph 4, 63.64% of the respondents agreed that the Career Center is critical in this regard. What is important here is to note that there is an obvious contrast with the previous question. In particular, to the question of which formats the cooperation is implemented, most respondents denied the existence of institutional structures. However, in the next question, 63.64% of respondents stated that the Career Center has an important role, and only 18.18% believe such a structure does not work at YSU.

Such results allow us to make two conclusions. First, the faculty representatives did not want to admit that the university has existing structures. However, in the next question, whether there is any institutional structure, most respondents preferred the career center. On the one hand, this may be why the Career Center does not function effectively, or there is no cooperation between the center and the faculties.

Contract and joint research and development (R&D) projects, along with consulting programs, play a vital role in facilitating university-industry cooperation. To gauge the prevalence of such projects, respondents were asked whether their respective faculties had engaged in joint R&D and consulting initiatives with private or public organizations over the past five years. The results revealed that 70.21% of respondents answered affirmatively, indicating a significant level of involvement in these collaborative endeavors.

To further explore the nature of these R&D projects, respondents were prompted to provide specific details about the programs they had participated in. Remarkably, only 24.24% of respondents provided information regarding specific programs. Among the programs identified, only three were classified as R&D initiatives. Notably, one of the program is the establishment of a "Scientific and Educational Center for the Control and Monitoring of the Quality of Medicinal Preparations." Additionally, the Faculty of Radiophysics undertook the development of a novel microwave heater, which included the creation of an experimental proto-

type, conducting experimental research, and preparing a patent application in collaboration with an external organization. Another noteworthy example involved the engagement of students in research projects aimed at addressing industrial challenges and the pursuit of joint research endeavors with other research groups from different institutes.

These examples underscore the limited number of explicitly identified R&D programs within the surveyed faculties. However, they also highlight the notable instances where substantial efforts were made to engage in impactful R&D collaborations with external organizations.

From the Business and Intellectual Property Rights channels, the academic spin-offs and student start-ups are the important ones. To the question of whether the faculty academic employees participated in the creation/promotion of an academic business (spin-off) or start-ups during the last five years, 45% of the respondents answered no, and 29% answered that they were involved in a group works and 20% that have provided counseling services. However, at the individual level, the number of academic employees who created a start-up or spin-off is only 4% (See graph 5). The results allow us to conclude that at the individual level, there are no entrepreneurial and innovative activities among YSU academic staff.

We note that academic employees do not always connect business and innovative activities with academic work. The abovementioned results could be explained by the fact that the faculty administrative staff is unaware of that activity. Because the academic employees did not participate in the survey, the results of this study are somewhat limited in this regard. So, the research team planned to broaden the research framework and gave some new insides about the last question in future academic works.

Collaborating with private/public organizations with universities also implies financial inflows and the implementation of jointly financed projects.

To the question, if the faculty received financial resources from private/state organizations in the last five years, at least
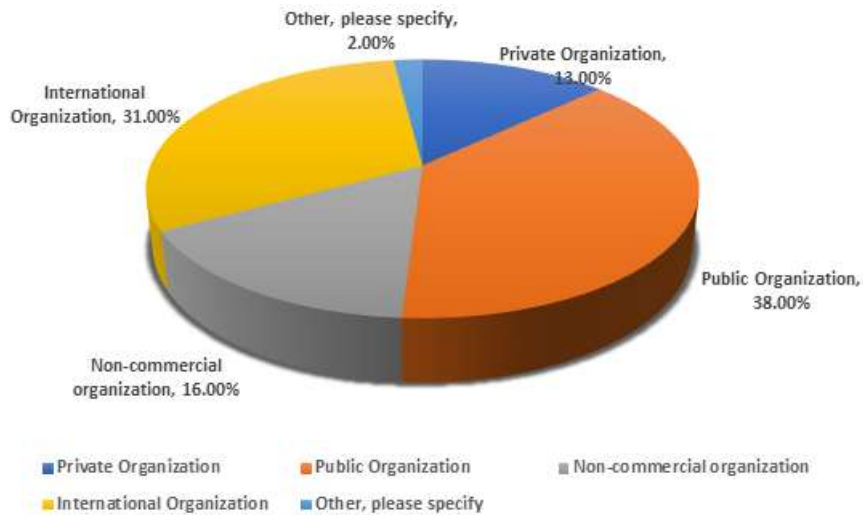
Graph 6. Financial flows to University based on the type of the organization.
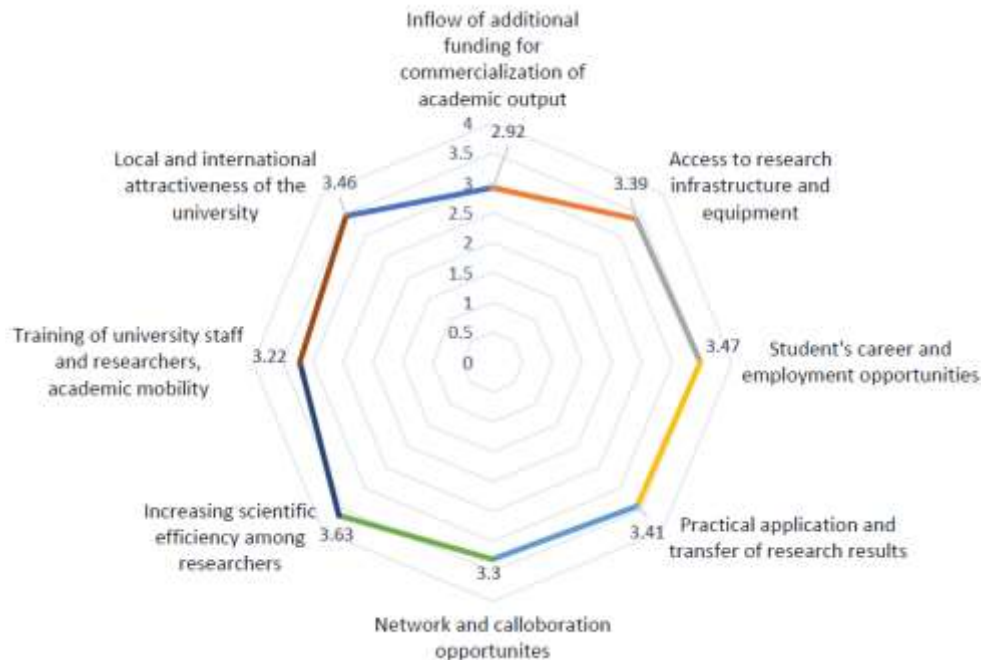
Graph 7. Benefits of University-Industry Partnership.

65.91% of respondents answered yes. Regarding the question from which organizations the funding came, graph 6 allows us to conclude that the primary funding sources came from the government (38%) and international organizations (31%), while funding from private organizations was only 13%. This perhaps represents that the cooperation with private organizations has gaps in financing, and there are no mechanisms to foster the implementation of joint projects.

Moreover, the respondents were given a series of factors. Based on the 1-5 scale, they were proposed to assess how many specific factors contribute to the development of the university-industry partnership. Graph 7 shows the average assessment of each factor.

This assessment allows us to conclude that almost all factors are essential, and university-industry cooperation will contribute to implementing the mentioned factors.

Thus, the respondents believe that university-industry cooperation will lead to scientific efficiency. Relatively few respondents believe that collaboration will lead to the inflow of additional funding and commercialization of academic output. This proves that the collaboration is not directed to the commercialization of the academic results, and there are no steps taken in patenting and licensing.

During the survey, respondents were presented with a range of problems to evaluate the extent to which these obstacles hindered the development of university-industry cooperation. The problems included time constraints of professors, insufficient financial resources of the university, and a lack of knowledge regarding how to engage in such programs and projects. Each respondent was asked to rate these problems on a scale of 1 to 5, with higher scores indicating greater hindrance to collaboration.
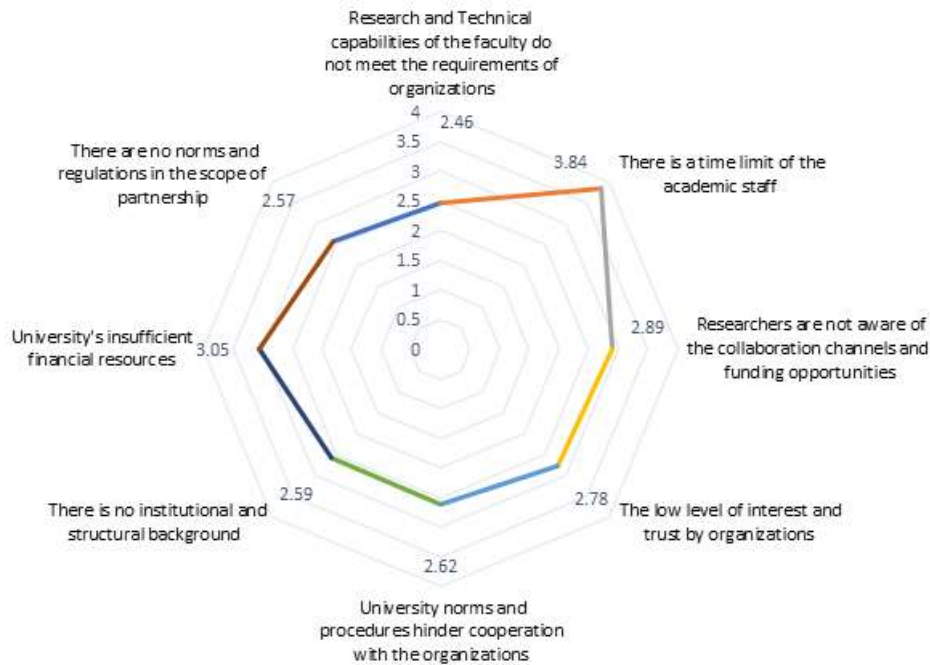
Graph 8. University-Industry Calloboration Limits at YSU.

Based on the responses obtained (as depicted in Graph 8), it is evident that the time constraints faced by professors emerged as a significant obstacle to closer cooperation between universities and organizations. This suggests that the demanding nature of academic responsibilities and commitments may limit the availability of professors to participate in various collaboration channels. The constraint of time can impede the initiation, planning, and execution of joint projects, hindering the overall progress of university-industry cooperation.

Another prominent obstacle identified by the respondents is the insufficient financial resources of the university. This constraint can pose challenges in allocating adequate funding to support collaborative initiatives and facilitate the necessary infrastructure for successful university-industry partnerships. Insufficient financial resources may impede the implementation of joint research and development projects, hinder the provision of necessary resources, and limit the overall effectiveness of cooperation.

Furthermore, respondents expressed a lack of knowledge on how to become involved in programs and projects related to university-industry cooperation. This indicates that there may be a need for greater awareness, guidance, and support systems to facilitate the participation of faculty members and researchers in collaborative activities. The lack of knowledge regarding available channels and mechanisms for engagement can act as a barrier to initiating and sustaining meaningful partnerships between universities and organizations.

5. CONCLUSIONS

In conclusion, the analysis of survey data has revealed several problems and obstacles within the context of the University-Industry Partnership at Yerevan State University. Addi-

tionally, this study provides policy development implications and suggestions for addressing these issues.

Structural Issues One major concern pertains to the structural aspects of the University-Industry Partnership at Yerevan State University (YSU). For instance, the Entrepreneurship Development Center, which was previously operational, is no longer functioning. Furthermore, although a Business Incubator was established nearly a year ago, it has yet to reach full functionality. Another structural limitation is observed in the Career Center, which primarily focuses on post-graduation employment support, lacking appropriate communication channels with students during their academic studies. Consequently, there is a gap of structural framework that fosters academic and student entrepreneurship and innovation. Since 2013, Yerevan State University has taken specific measures to plan and regulate cooperation with enterprises, predominantly at the faculty level. However, despite holding several meetings, no practical steps have been taken in this direction due to the lack of interest from employers, faculty representatives, and administrative staff of the university. These structural issues undermine the effectiveness of the University-Industry Partnership at YSU.

Operational issues - There is no proper mechanism for ensuring communication among universities and organizations, and there are no appropriate regulatory mechanisms in this regard. From a functional point of view, the strategic and tactical approaches and targets are almost not clearly defined. The directions of the career center are not updated and adapted to the recent changes.

Systematic Issues- university-industry cooperation at YSU is still based on implementing traditional channels. The channels like Technoparks and spin-offs are not developed at YSU. From the systematic point of view, the Government and responsible ministry are not giving such importance to

this collaboration. Specifically, have not developed any governmental approach and project to foster collaboration. The legal framework also has not implemented any activities and regulations. Likewise, the same situation is described at the University level. In the strategy planning of the University, no given importance to possible channel usage.

Learning/Educational Issues- There is no module or course to foster innovation among students and academics. It is essential to emphasize that the development of innovation capacities should be demonstrated in natural sciences and humanities, and social sciences.

In order to solve the presented problems, the following policy implications and suggestions are recommended:

Structural – Take some practical measures to start the activities of the Business Incubator, which will help develop innovative business ideas among the academics and students. As well as suggested transforming and reviewing the practices of the YSU career center. An alternative decision can be the creation of new departments promoting university-enterprise cooperation and the inclusion of career centers in those frameworks. The weakest direction of university-enterprise cooperation in RA is technological cooperation and joint research. The creation of technology parks should be another institutional solution. It can become a good pattern in university systems and contribute to RA's economic and technological development. Universities' financial and organizational potential cannot be sufficient to carry out works in this direction, so it is necessary to involve donor structures (European Union, World Bank, etc.) at the state policy level, involving various consulting and other supporting structures.

Systematic- it is proposed to create legislative regulations aimed at developing university-industry cooperation and encouraging the development of similar cooperation for universities by increasing state financial support and for the organizations to make some tax favors.

Operational - create a proper structure for communication, ensure constant communication and implement targeted programs based on assessing all partner needs. Eventually, launching the appropriate graduate-employer interaction platform is essential based on the lessons learned from failed programs (HEN-GEAR).

Learning/Educational - it is proposed to introduce an educational module at YSU for both humanities and science-oriented faculties. As a result, keeping a follow-up on each developed idea during the module and giving technical and financial support, as well as the involvement of employers in the educational process, remains an important step. The involvement of employers in the process of curriculum development, the organization of mutual visits, meetings, and the everyday use of devices and opportunities can become the beginning of a new culture in the framework of University-Industry Collaboration.

Therefore, the development of university-industry cooperation can become the basis and precondition for the country's scientific/technical and social-economic development.

In this context, the development of new collaboration channels and mechanisms that will take into account the interests and needs of all interested parties (state, business, society, social groups, university, students, graduates) will lead to increased labor productivity and quality and the country's competitiveness, as well as promoting and developing the innovative national potential.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

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