

## University-Industry Collaboration in the Innovation Process in Algeria: Reality and Actions for Improvement

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Reçu le : 03/03/2023

Accepté le : 08/05/2023

Publié le : 30/06/2023

### Abstract:

University-industry collaboration is one of the main sources of shared knowledge and technologies outside the industrial sector, particularly in the context of innovation. This paper aims to identify the most important potential factors that help companies and universities in Algeria use collaboration to innovate successfully. This research falls within the descriptive analytical studies. By conducting an analytical study on the Global Innovation Index for Algeria during the period 2019–2022, it was found that this indicator is weak compared to the global average and to economies in Northern Africa and Western Asia. It was also found that the contribution of university-industry collaboration to this indicator is not significant. Through these results, a set of measures was proposed, the most important of which is considering university-industry collaboration as a basic mission for universities and a necessity for industry, creating a climate of trust, and providing support from social partners.

**Keywords:** University-industry collaboration; University; Company; Research & development; Innovation; Algeria.

**Jel Classification Codes :** I23; L24; O32.

### ملخص:

يعد التعاون بين الجامعة والصناعة أحد المصادر الرئيسية للمعرفة والتقنيات المشتركة خارج القطاع الصناعي، لا سيما في سياق الابتكار. تهدف هذه الورقة إلى تحديد أهم العوامل المحتملة التي تساعد الشركات والجامعات في الجزائر على الاستخدام الناجح للتعاون من أجل الابتكار. يندرج هذا البحث ضمن الدراسات الوصفية التحليلية. تبين من خلال إجراء دراسة تحليلية على مؤشر الابتكار العالمي للجزائر خلال الفترة من 2019 إلى 2022 أن هذا المؤشر ضعيف مقارنة بالمتوسط العالمي ودول شمال إفريقيا وجنوب آسيا. كما وجد أن مساهمة التعاون بين الجامعة والصناعة في هذا المؤشر ليست كبيرة. ومن خلال هذه النتائج تم اقتراح مجموعة من الإجراءات أهمها اعتبار التعاون مهمة أساسية للجامعة وضرورة للصناعة وخلق مناخ من الثقة، إضافة إلى تقديم الدعم من الشركاء الاجتماعيين.

الكلمات المفتاح: التعاون بين الجامعة والصناعة؛ الجامعة؛ المؤسسة؛ البحث والتطوير؛ الابتكار؛ الجزائر.

تصنيف JEL: I23; L24; O32.

## I. Introduction:

There is no doubt that universities have an important role in the development of society through their contribution to the graduation of human cadres in all fields and with different specializations. In general, universities perform three main functions: education, scientific research, and service to the industrial sector. On the other hand, the volatile and highly competitive environment requires companies to innovate at a rapid pace to introduce new products and services in order to meet customer requirements and strive to achieve competitive advantage in the market, which is enhanced by new economies of scale. Moreover, the impact of the digital revolution on a personal and organizational level has changed the social and economic aspects of collaboration and interoperability between individuals and companies. Therefore, collaboration has become a popular topic as a necessary tool to overcome organizational challenges.

University-Industry Collaboration (UIC) continues to attract new participants and additional investments and has become a global center of excellence in R&D. In Algeria, UIC has been written in bold type in the missions of the university since at least the advent and implementation of the LMD (License-Master-Ph.D.). The collaboration in question is none other than the mechanisms that aim, in a logic of action, to strengthen the links between the university and the organization in order to carry out joint actions. This collaboration is of particular importance not only for the university because it allows it to be in interaction with its socio-economic environment, but also for the organization that wishes to benefit from the developments and technology transfer. However, it is still difficult for companies and universities to determine what best practices to follow in order to create and maintain successful collaborations. This has led to a growing need to establish certain practices and principles to guide the inception, implementation, and success of collaborations. Accordingly, the main research question will be as follows:

### **What are the most important factors that contribute to the success of University-Industry Collaboration in the innovation process in Algeria?**

In order to answer this question, three sub-questions have been formulated:

1. What are the nature and forms of collaborations between universities and industry?
2. What is the current reality of UIC and innovation in Algeria?
3. What are the possible solutions to activating the UIC in Algeria?

### **Importance of the study:**

The motivation behind this research is due to its treatment of the issue of UIC and innovation as an engine of economic growth and development. In this context, Algeria seeks to move towards a knowledge economy and encourage startups and innovation, but the business and innovation environment is still below the required level, so it is necessary to analyze the reality of the contribution of UIC to innovation in Algeria and make proposals in the form of concrete steps to be taken for effective collaboration between universities, industry, and the government.

### **Purpose of the study:**

In light of what was mentioned above, the objectives of this research can be as follows:

1. Understand the concept and forms of UIC;
2. Clarify the extent of UIC's contribution to innovation in Algeria;
3. Identify the most prominent challenges and obstacles that prevent the establishment of an effective UIC in Algeria;
4. Attempt to develop proposals and determine the appropriate mechanisms to ensure the activation of UIC in Algeria.

### **Design and methodology:**

The structure of this paper is as follows: The first section provides an overview of collaboration between university and industry as well as on innovation. The second section analyzes collaboration between university and industry and innovation in Algeria in numbers. The last section describes the main difficulties facing universities and industry on the one hand and, on the other hand, the measures that need to be adopted to improve collaboration.

This study belongs to the descriptive research, by defining the theoretical framework of the research and making use of the studies related to the field of research, as well as the analytical approach, by making analyzes about the UIC and innovation in Algeria and presenting a set of proposals to improve the effectiveness of this collaboration.

### **Review of Literature**

A review of available research on UIC and innovation was conducted. Searches for relevant papers, articles, proceedings, and reviews were performed using Google Scholar and other electronic journal websites, the most relevant of which are the following:

**Kleiner-Schaefer, T. and Schaefer, K. J. (2022)** tried to identify potential barriers within the firm as well as in the regional innovation system that might prevent firms from using UICs for innovation, in particular in an emerging market context. For that, they conducted a firm-level study of the R&D-related segment of the manufacturing industry in Istanbul using the logistic regression analysis to test the effect of potential barriers on using UICs for innovative activities. Their findings showed that a lack of information about UIC opportunities as well as a lack of financial support for UICs are the most relevant barriers that inhibit firms' usage of UICs for innovation. This firm-level evidence pointed out the importance of university technology transfer offices in regional innovation systems and for fruitful UICs. They further found that administrative barriers have no significant effect, while barriers related to trust and skill matching with scientific partners have the opposite effect of what they would have expected from the literature.

**O'Dwyer, M. et al. (2022)** explored the establishment of a successful UIC and considered a range of perceived barriers and enablers through four emergent evolutionary phases: embryonic, initiation, engagement, and established. The study adopted a qualitative research approach using a single-site case study, focusing on the pharmaceutical industry, with 10 multinational firms and 8 academic institutions involved in a pharmaceutical collaboration. The results demonstrated that specific UIC barriers and enablers emerge at different points in time; for example, a strong lack of trust, a strong fear of knowledge leakage, and a reluctance to share in the embryonic phase evolve to achieving integrity-based trust and an intellectual property agreement in the engagement phase. These barriers were overcome using a range of phase-appropriate mechanisms; for example, prior experience of the partners was critical in the embryonic phase, while cohesiveness and knowledge complementarity were vital in the engagement phase.

**Awasthy, R. et al. (2020)** attempted to propose a framework to improve the effectiveness of UIC. A workshop and focus group meetings of practitioners and academic researchers were designed and organized to explore the current state of university–industry engagement within the Australian Capital Territory (ACT) region and gather input regarding possible approaches to improving collaboration. The study discovered that various measures have been proposed in the form of best practices or models to improve the effectiveness of UIC. However, these measures often address a specific concern such as technology transfer, intellectual property (IP), etc. Finally, the study proposed a framework for improving the effectiveness of collaboration, considering a comprehensive list of factors operating in a broad context within the collaboration system.

**Jonbekova, D. et al. (2020)** examined University–Industry Partnerships (UIPs) in Kazakhstan. The study explored the kinds of collaborations with industry that universities have undertaken, their purposes and benefits, and the contextual barriers to such partnerships. Their findings revealed that UIPs in Kazakhstan remain weak and are largely limited to employers' involvement in teaching, the provision of internships for students, and technical consultancies. They argued that the goal of policymakers to develop robust research partnerships that contribute to innovation and economic growth is constrained by heavy faculty teaching loads, poor institutional support for research, constant reforms in the higher education system, and little consistency in the priorities of the fast-changing Ministers of Education.

### **Research Gap:**

From the analysis of previous studies on the subject of UIC, it was found that no study focused on the contribution of UIC to the innovation process in Algeria. Therefore, the current research aims to bridge the current gap by conducting a study on the reality and challenges of the UIC and the innovation process in Algeria and to reach results that help draw attention to the need to improve and upgrade this collaboration locally.

## **II. Fundamentals of University-Industry Collaboration and Innovation:**

Universities have traditionally been expected to teach and conduct research. However, as a result of the increasing economic competition in recent decades, many policymakers have worked to support more interaction between universities and organizations, and thus, it has become imperative for universities to make their research more relevant to the needs of industry. For their part, companies have historically organized R&D in-house, then turned towards more open innovation through collaboration between other organizations in general and universities in particular. The main elements that will be discussed in this part are the role, channels and policy instruments of the UIC, as well as the role of the UIC in the innovation process.

### **II.1 Role of University-Industry Collaboration:**

Most academic papers do not provide a definition of UIC, possibly due to the self-explanatory nature of the term. Furthermore, UIC is often considered a homogeneous activity, although there are different types of collaboration in practice, which makes it difficult to create a

definition that covers all types of UIC. UIC can be defined as “the interaction between any part of the higher education system and industry whose primary objective is to encourage knowledge and technology exchange”. (Kaloudis, et al., 2019)

Companies from a range of industrial sectors collaborate with universities in order to gain access to research and technology, as well as the resulting knowledge and analysis, in order to improve their competitive positioning. Such collaboration can be more common in so-called knowledge-intensive industries, such as the pharmaceutical, aerospace and defense, oil and gas, and telecommunications sectors. Companies in these sectors have a major focus on sustaining technical innovation, and working with universities provides an important channel to gain access to both creative thinking and knowledge that can ultimately be used to help companies develop and subsequently produce new or improved products or services. (Philbin, 2013) The role of UIC can be summarized in the following points: (Haidar, 2021)

- ✓ Closing the gap between industry and academia to accelerate the collaboration and innovation process, accumulate knowledge, and construct intellectual property rights.
- ✓ Reducing development risk, increasing the efficiency of knowledge sharing, gaining trust that leads to additional network linkages, and acknowledging the positive role of academia in R&D.
- ✓ Increasing bi-directional knowledge flow and learning gains. However, it is very difficult to maintain the collaboration mechanisms since companies will have to interact with multiple internal and external actors.
- ✓ Acquiring external resources such as new information, external knowledge, and the people who develop the technology.
- ✓ Funding programs with external resources always stimulate interaction between collaboration partners. The external resources of companies do not just maximize their power but also affect the behavior of the company in collaboration.

Collaboration between academics and industry plays an essential role in driving innovation. However, with innovation processes poorly managed between collaborating actors, these activities rarely translate into commercial success. Moreover, more efforts need to be made to overcome some hurdles, such as understanding the administrative complexity of the entire collaboration process. (Haidar, 2021)

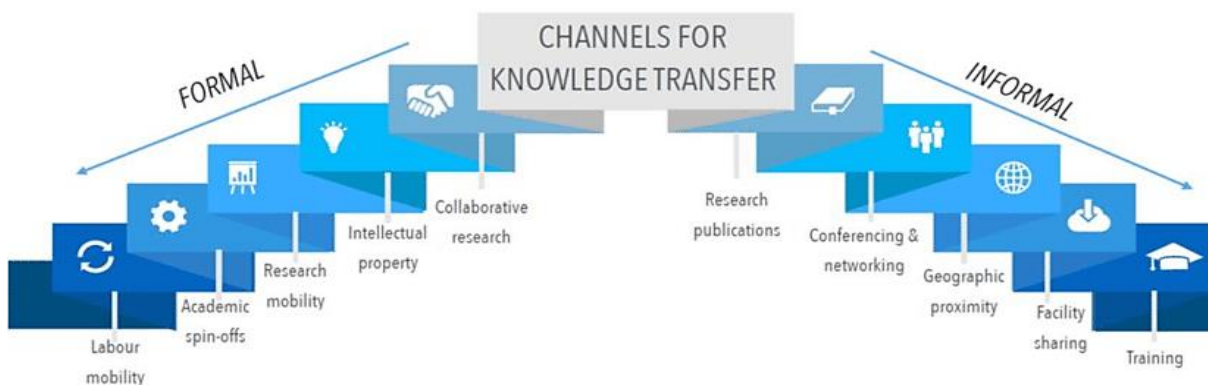
**II.2 Channels and policy instruments of University-Industry Collaboration:**

The importance of UIC and interactions for fostering innovations has led universities to rethink their purposes. Indeed, universities are increasingly participating in regional development through diverse initiatives such as technology transfer offices, licensing, intellectual property rights, consulting services, collaborative research, start-up incubators, spinoffs... Universities are not only responsible for developing human capital (Education – the first mission) and for producing new knowledge (Research – the second mission), but also must engage in regional development (Regional development – the third mission). This third mission for universities requires them to act more entrepreneurially, such as in creating spinoffs, promoting an entrepreneurial culture among students, and/or participating in the elaboration of smart specialization strategies. (Fonseca & Salomaa, 2019)

**II.2.1 Ten types of channels for University-Industry Collaboration:**

Interactions between universities and companies unfold through various formal and informal channels. The OECD (2019) distinguished 10 channels of knowledge transfer, which include a broad overview of the channels found to be important for university-industry interaction. The ten channels are divided into five formal channels and five informal channels, as shown in Figure 1:

**Figure (1): Channels for knowledge transfer**



Source : OECD, 2019, p. 31.

In the following, each channel is presented, starting with the five formal channels:

- ✓ **Collaborative research** refers to research projects carried out by university researchers. These projects can be partially or fully funded by industry and range from small to large-scale projects. Small-scale projects often happen through contract services and academic consultancy, in which firms commission universities to perform research, while long-term strategic partnerships often consist of multiple actors as stakeholder, such as in university-industry research centers.
- ✓ **Intellectual property (IP) transactions** refer to the licensing and selling of IP, such as patents and licenses generated by universities to the industry.
- ✓ **Research mobility** includes both permanent and temporary assignments of university researchers working in the industry and the converse. In general, research mobility is deemed important because these individuals will act as what is often termed "knowledge brokers" or "boundary spanners" between universities and industry actors, as they are knowledgeable about both the university and industry sectors. (Kaloudis, et al., 2019)
- ✓ **Spin-out/Spin-off** is a separate business that has split off from a larger company. Shareholders from the parent company retain equivalent shares in the spin-out. In university terms, the technology transfer office may choose to spin out a technology if it has the potential to generate multiple products for multiple sectors and may otherwise be unexploited. As the owner of the IP, the university receives equity in the spin-out business. (Bennett, 2022)
- ✓ **Labor mobility** refers to university graduates who join industry. This channel is often deemed to have one of the biggest impacts on the industry, particularly in some disciplines and industry sectors, based on the share of students who graduate every year.

Informal channels of university-industry interaction that diffuse knowledge from universities to industry, and conversely, include the following: (Kaloudis, et al., 2019)

- ✓ **Research publications** are academic writings presented in academic journals and other specialized media. Science-intensive sectors such as biotechnology and pharmaceuticals have strong complementarities with basic academic research, and their firms' R&D tends to be able to utilize research publications.
- ✓ **Conferencing and networking** concern the interaction between university researchers and industry representatives. These interactions can take place in formal conferences or dissemination events, but also in more informal settings such as meetings with and having contact with former classmates employed in universities and industry.
- ✓ **Geographic proximity** often facilitates networking and informal interactions between university and industry researchers. These informal encounters may be facilitated by locating science parks near university campuses, by firms' laboratories within university campuses, or by using the university facilities for a firm's research. Research shows that collaborative research is often conducted locally as well as in more peripheral regions, which implies the importance of having research institutions in close geographical proximity to industry.
- ✓ **Facility sharing** refers to university and industry partners who share infrastructure, such as laboratories and equipment. It is often expensive to build up a lab; thus, universities often have labs that could be used for both the training of students and doing research for industry.
- ✓ **Training** includes courses and continuing education provided by universities to firms but also lectures held by industry employees at the university. Training is also linked to labor mobility, and for companies, there are also possibilities to engage with students during their education.

These 10 channels for knowledge and innovation development between universities and companies are distinct, but still connected. Accordingly, scholars have emphasized that university-industry interaction takes place through a mix of formal and informal channels (Kaloudis, et al., 2019)

### **II.2.2 Policy instruments of University-Industry Collaboration:**

The OECD report on UIC offers a new taxonomy of 21 policy instruments to support UIC, which can be classified as financial, regulatory, or soft instruments, and characterized by their target, the channels they address, and their supply- or demand-side orientation. (OECD, 2019) The following figure shows these policy instruments developed by the OECD in 2019:

**Figure (2): Policy instrument for University–Industry Collaboration**

Financial Instruments	Regulatory Instruments	Soft Instruments
<ul style="list-style-type: none"> <li>• R&amp;D innovation subsidies/grants for industry-science research</li> <li>• Tax incentives for companies purchasing research from universities</li> <li>• Grants for IP applications from universities</li> <li>• Financial support to academic spin-offs</li> <li>• Financial support to firms to recruit PhDs &amp; post-docs</li> <li>• Financial support for universities to host industry researchers</li> <li>• Public procurement of university research</li> <li>• Innovation vouchers for R&amp;D services from universities</li> <li>• Performance-based funding systems for university linkages with industry</li> <li>• Public-private partnerships creating joint research laboratories</li> <li>• Funding of infrastructures &amp; intermediaries for collaboration</li> </ul>	<ul style="list-style-type: none"> <li>• IP regulations publicly-funded research</li> <li>• Regulation of spin-offs founded by researchers &amp; students</li> <li>• Sabbaticals &amp; mobility schemes for researchers to work in industry</li> <li>• Career rewards for researchers engaging in knowledge collaboration</li> <li>• Open access &amp; open data provisions for publicly-funded research</li> </ul>	<ul style="list-style-type: none"> <li>• Outreach activities to raise awareness of science-industry opportunities</li> <li>• Training programs on knowledge collaboration</li> <li>• Collective industry-science roadmapping &amp; foresight</li> <li>• Guidelines, standards, &amp; code of conduct for science-industry collaboration</li> <li>• Networking support to build science-industry linkages</li> </ul>

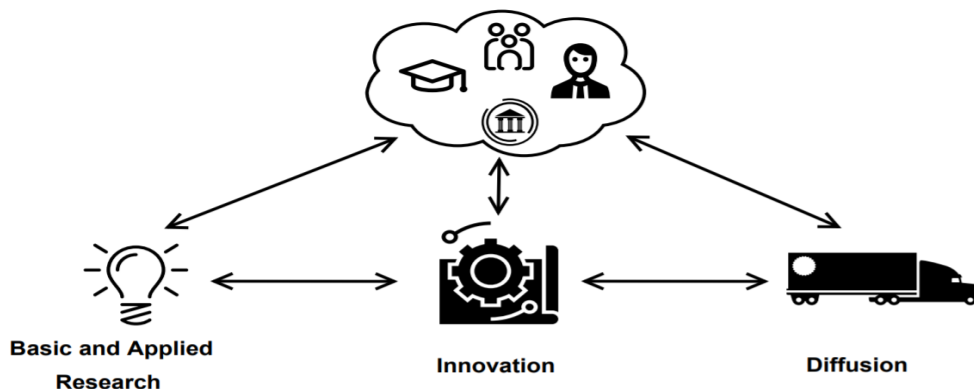
Source : OECD, 2019, p.79.

Regional policymakers must design place-based policies adapted to their regional institutional contexts. As a result, a regional diagnostic of the state of UIC must be undertaken to select the most effective policy mix. The term "policy mix" is used to refer to the policy instruments implemented to deliver public action in this specific policy domain and their interactions. (Morisson & Pattinson, 2020)

**II.3 University-Industry Collaboration in the Innovation Process:**

UIC is emerging as a critical component of the innovation process. Regional policymakers are thus devising policy instruments to promote knowledge transfer between science and industry to strengthen their regional innovation systems. The emergence of this policy trend comes from the wide acceptance in innovation studies of the non-linear model of innovation to explain the innovation process. In the 1980s, the non-linear models of innovation were the responses to the shortcomings and overly simplistic linear model of innovation. Indeed, the non-linear models of innovation point out the importance of feedback mechanisms among the different parts of the innovation process and flow paths of information and cooperation. In the non-linear models of innovation, it is recognized that science emerging in universities and technology emerging in industry are often separate entities. Indeed, there exist lags between science and technology that are more or less wide depending on the technologies. The objective of knowledge transfer is to optimize an innovation process that is systemic, non-linear, and involves diverse quadruple helix innovative actors, among them university-industry actors. (Morisson & Pattinson, 2020)

**Figure (3): The non-linear model of innovation**



Source : Morisson & Pattinson, 2020, p. 03.

As a result, new models of innovation have been introduced to stress the importance of interactions between science and industry to promote knowledge transfer. The concept of a "triple helix" model of innovation highlights the importance of interactions among universities, the private sector, and public institutions. The open innovation model stresses the importance of knowledge transfer to build internal capabilities for companies with high R&D needs. Moreover, literature on innovation systems argues that successful regional innovation systems are characterized by effective interactions among regional innovative actors. (Morisson & Pattinson, 2020)

**III. University-Industry Collaboration and Innovation Index of Algeria:**

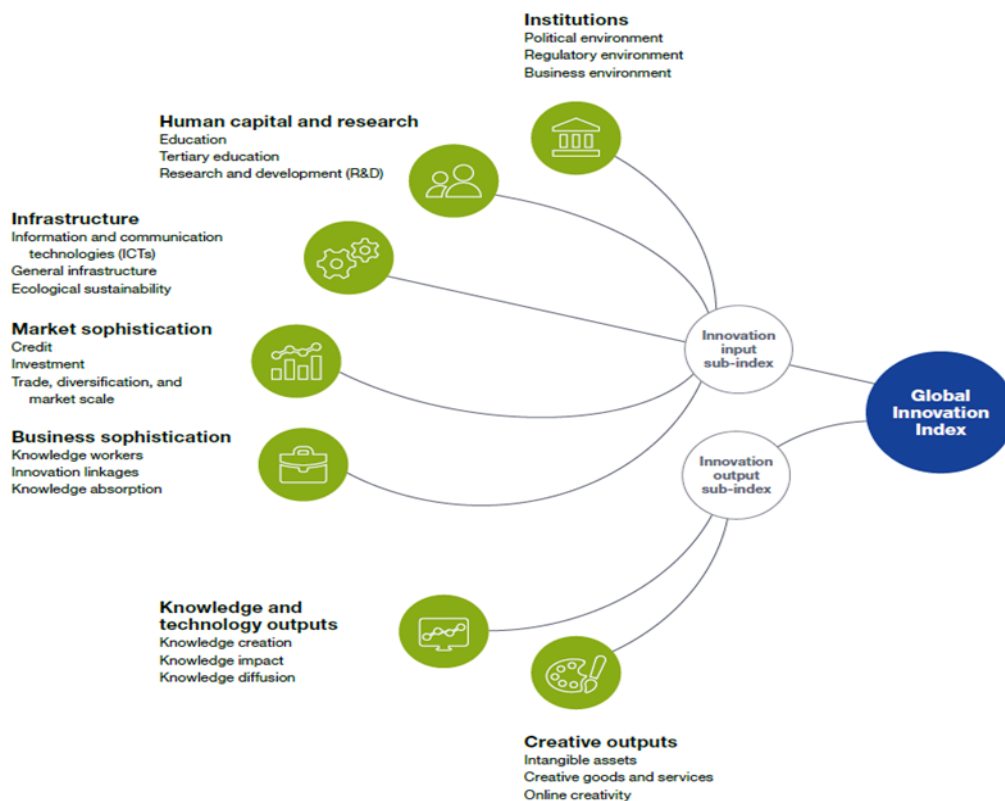
The increasing importance of knowledge-based capital, both for competitiveness and for meeting social and economic challenges, benefits those countries that have strong public research and the ability to effectively use research results to innovate. Theoretically, if a company chooses to collaborate with universities, it can gain diversified knowledge from high-quality research, which contributes to recombination and thus increases the potential for innovation. It is therefore more important than ever to understand how UIC can have the greatest impact on innovation. This part presents information about the Global Innovation Index (GII), analyzes the figures associated with the Global Innovation Index of Algeria, and finally explores the contribution of UIC in supporting the Global Innovation Index of Algeria.

**III. 1 About the Global Innovation Index:**

The Global Innovation Index (GII) is published by the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations. Recognizing that innovation is a key driver of economic development, the GII aims to provide an innovation ranking and rich analysis referencing around 130 economies. Over the last decade, the GII has established itself as both a leading reference on innovation and a "tool for action" for economies that incorporate the GII into their innovation agendas. (WIPO, 2022)

The GII includes two sub-indices: the Innovation Input Sub-Index and the Innovation Output Sub-Index. The Input Sub-Index captures elements of the national economy that enable innovative activities and is based on five pillars: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication. Two output sub-indices capture actual evidence of innovation outputs and are based on two pillars: (6) Knowledge and technology outputs, and (7) Creative outputs. Each pillar is divided into three sub-pillars, each consisting of individual indicators. (TheGlobalEconomy.com, 2022)

**Figure (4): Framework of the global innovation index**



Source : WIPO, 2021, p. 10

The GII ranks world economies according to their innovation capabilities. Consisting of roughly 80 individual indicators, grouped into innovation inputs and outputs, the GII aims to capture the multi-dimensional facets of innovation. (WIPO, 2022)

**III. 2 Analysis of Innovation Index of Algeria:**

In fact, Algeria has not yet found its entire national innovation system, but there are several parts of it, such as incubators and universities. And the recently established Ministry of Startups and Knowledge Economy has established a fund to finance innovation and a platform for granting the label of innovative startups, which will benefit from many financial, administrative, tax, and other facilities. (Redouane, 2022) To find out Algeria's position compared to the rest of the world in the field of innovation, the following table is showing the rankings of Algeria over the past six years, noting that data availability and changes to the GII model framework influence year-on-year comparisons of the GII rankings. The statistical confidence interval for the ranking of Algeria in the GII 2022 is between ranks 109 and 117. (WIPO, 2022)

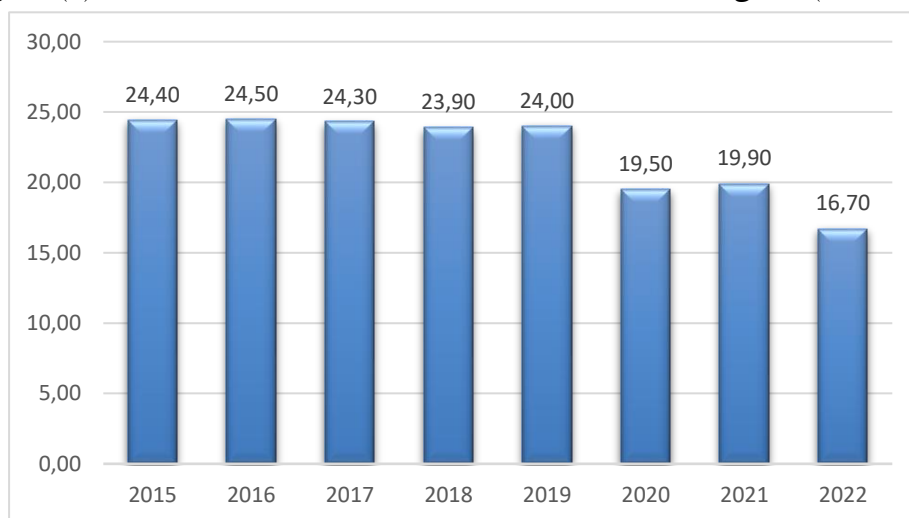
**Table (1): Rankings of Algeria in the GII (2017–2022)**

Year	GII	Innovation inputs	Innovation outputs
2017	108	105	117
2018	110	100	116
2019	113	100	118
2020	121	111	126
2021	120	109	128
2022	115	110	118

**Source:** Prepared by the researcher based on WIPO, 2019, p. 01 and WIPO, 2022, p. 01.

Algeria ranked 115<sup>th</sup> out of 132 economies in the GII 2022. In general, the development of this index fluctuated during the period 2017-2022. The best ranking was in 2017, and the worst ranking was in 2020, with an average of 114<sup>th</sup>. From the above table, it can be seen that Algeria's performance in innovation inputs has been better than innovation outputs during this period. Algeria ranks in innovation inputs from 105<sup>th</sup> to 111<sup>th</sup>, and the best ranking was in 2017, while the worst ranking was in 2020. As for outputs, its rank ranged from 116<sup>th</sup> to 128<sup>th</sup>. The best ranking was in 2018, while the worst was in 2021. It is also noted from the table that Algeria's performance in the first three years was better compared to its ranking in recent years. The following figure provides more details about the value of the innovation index for Algeria from 2015 to 2022.

**Figure (5): The evolution of the innovation index for Algeria (2015–2022)**

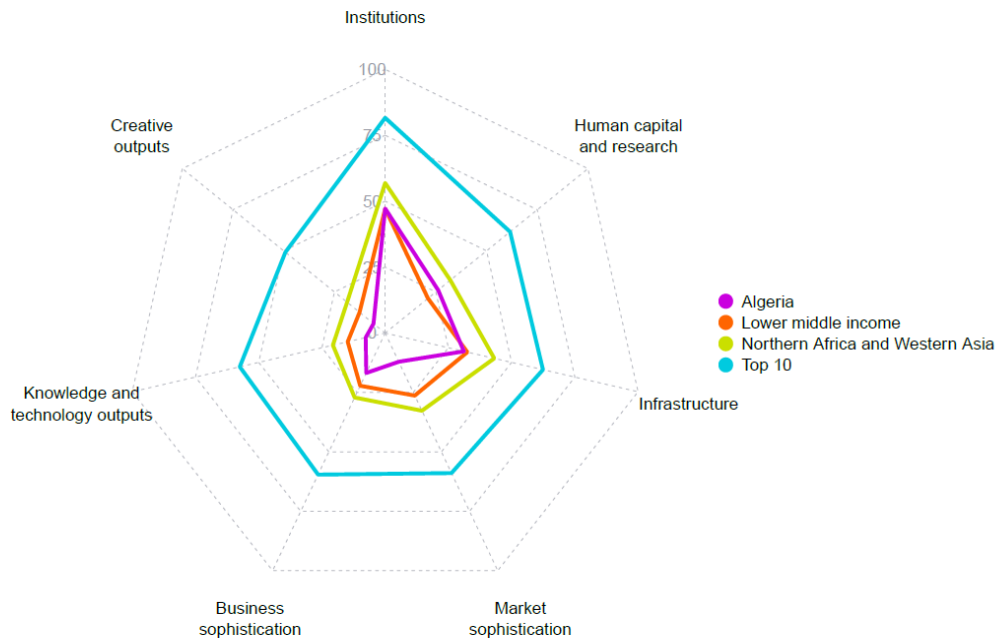


**Source:** TheGlobalEconomy.com, 2022

The last value of the innovation index for Algeria in 2022 was 16.7 points. For comparison, the global average in 2022 based on 128 countries is 32.09 points. (TheGlobalEconomy.com, 2022) With regard to the development of the innovation index, we note from the above table that provides data about Algeria's innovation value from 2015 to 2022 that the average value for Algeria during that period was 22.39 points, with a minimum of 16.7 points in 2022 and a maximum of 24.5 points in 2016. So, there has been a deterioration in this value for Algeria in this period. For further analysis, the following figure presents the location of the seven GII pillars of Algeria in comparison with Northern Africa and Western Asia, and the Top Ten.



Figure (6): The seven GII pillar scores for Algeria in 2022



Source: WIPO, 2022, p.04.

Algeria ranks 30<sup>th</sup> among the 36 lower-middle-income group economies. Algeria performs above the lower-middle-income group average in two pillars, namely: Institutions and Human capital and research. Algeria ranks 17<sup>th</sup> among the 19 economies in Northern Africa and Western Asia. (WIPO, 2022) Algeria performs below the regional average in all GII pillars. We observe from the above figure that Algeria performs best in Institutions and followed by Infrastructure then Human capital and research with its weakest performance in Creative outputs.

### III. 3 Contribution of University-Industry Collaboration in innovation index of Algeria

In the innovation input sub-index, there is the pillar of business sophistication, which is based on three main sub-pillars, including innovation linkages. The latter contains several individual indicators, the first of which is the University-industry R&D collaboration. In a context where the development of innovation processes requires close interactions between universities and industry, the situation here is different, as illustrated in the table below:

Table (2): Business sophistication indicators of Algeria (2019–2022)

Code	Indicator label	2019		2020		2021		2022	
		Value	Rank	Value	Rank	Value	Rank	Value	Rank
<b>5</b>	<b>Business sophistication</b>	<b>18.1</b>	<b>126</b>	<b>15.6</b>	<b>126</b>	<b>14.7</b>	<b>124</b>	<b>16.8</b>	<b>120</b>
<b>5.1</b>	<b>Knowledge workers</b>	<b>19.0</b>	<b>110</b>	<b>13.5</b>	<b>115</b>	<b>13.3</b>	<b>116</b>	<b>15.2</b>	<b>111</b>
5.1.1	Knowledge-intensive employment, %	17.9	81	17.9	86	17.9	88	17.9	85
5.1.2	Firms offering formal training, %	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5.1.3	GERD performed by business, % GDP	0.0	75	0.0	77	0.0	78	0.0	76
5.1.4	GERD financed by business, %	6.7	77	6.7	82	6.7	82	6.7	81
5.1.5	Females employed w/advanced degrees, %	8.1	79	8.1	79	8.1	78	8.1	81

<b>5.2</b>	<b>Innovation linkages</b>	<b>13.8</b>	<b>122</b>	<b>15.1</b>	<b>111</b>	<b>15.2</b>	<b>107</b>	<b>17.4</b>	<b>111</b>
5.2.1	University-industry R&D collaboration	26.9	117	37.1	88	37.1	93	37.1	96
5.2.2	State of cluster development and depth	40.6	91	48.3	58	48.3	57	48.3	66
5.2.3	GERD financed by abroad, % GDP	0.0	102	0.0	98	0.0	101	0.0	95
5.2.4	Joint venture/strategic alliance deals/bn PPP\$ GDP	0.0	94	0.0	118	0.0	119	0.0	124
5.2.5	Patent families/bn PPP\$ GDP	0.0	89	0.0	99	0.0	100	0.0	97
<b>5.3</b>	<b>Knowledge absorption</b>	<b>21.4</b>	<b>117</b>	<b>18.3</b>	<b>113</b>	<b>15.6</b>	<b>115</b>	<b>17.8</b>	<b>125</b>
5.3.1	Intellectual property payments, % total trade	0.4	73	0.4	75	0.3	85	0.4	77
5.3.2	High-tech imports, % total trade	8.3	53	8.9	49	8.9	49	8.9	55
5.3.3	ICT services imports, % total trade	0.7	91	0.7	94	0.6	97	0.5	112
5.3.4	FDI net inflows, % GDP	0.5	120	0.9	116	0.8	112	0.8	107
5.3.5	Research talent, % in businesses	0.5	82	0.5	82	0.5	82	0.5	81

**Source:** Prepared by the researcher based on WIPO, 2019 - 2022

Despite the rather encouraging indicators of Institutions, Infrastructure and Human capital and research activities within the academic sphere in Algeria, collaboration between universities and industry remains weak. Indeed, the global ranking of the GII from 2019 to 2022 highlights the weakness of Innovation linkages in Algeria since it is positioned for these indicators at the bottom of the ranking (at the 122<sup>nd</sup>, 111<sup>th</sup>, 107<sup>th</sup> and 111<sup>th</sup> respectively). Furthermore, it is not surprising to note that Algeria is ranked 117<sup>th</sup>, 88<sup>th</sup>, 93<sup>rd</sup>, and 96<sup>th</sup> in University-industry R&D collaboration according to the GII of 2019, 2020, 2021, and 2022, respectively.

The low involvement of local firms in R&D activities penalizes innovation performance. From an empirical point of view, a research survey has found that in Algeria, the innovation of companies operating in an emerging market is influenced mainly by external factors (strong growth in demand, low competitive intensity, strong bargaining power of companies, and low barriers to entry) and tangible resources. Moreover, it should be noted that other studies on innovation have also pointed out that the culture of innovation gets quite little response in Algerian companies. Indeed, innovation is considered by some Algerian managers as a luxury that will become relevant only at a later stage in the company's development. Business leaders neglect the fact that economic development requires lifelong learning and progressive innovation. (Bouacida, 2019)

#### **IV. Exploring Challenges and Supporting Factors for University-Industry Collaboration:**

Conducting research that leads to innovations is somewhat challenging for both the university and the industry, as they often have conflicting R&D requirements. Companies generally desire more applied research, while universities generally pursue basic research. Despite the existence of these large-scale collaborative challenges, the results of good UIC are well known,

such as innovations, patents, licenses, products, and academic publications. While the critical success factors of how these results were developed are less explored due to a lack of studies about this issue. In this last part, the difficulties encountered by UIC in Algeria will be presented, then a set of actions will be proposed to activate and promote UIC in Algeria, and finally the role to be played by the social partners will be discussed.

### **III.1 Barriers and challenges of university–industry collaboration in Algeria**

In Algeria, innovation from higher scientific and technical institutions and feedback on learning processes are limited. Both the university and the company share, as far as they are concerned, the responsibility for the existence of difficulties and obstacles to the innovation process. In short, the lack of integration between the world of research and the industrial sector can be explained by several factors in the following table:

**Table (3): The main difficulties facing the UIC in Algeria**

<b>Main categories</b>	<b>Factors</b>
<b>The university side</b>	<ul style="list-style-type: none"> <li>✓ Failure to complete academic research directives is due to the framework of scientific and technological policy that is generally not commensurate with the requirements of the industrial sector.</li> <li>✓ The low level of researchers in the scientific and technological fields is due to their poor academic university training.</li> <li>✓ Lack of incentives for academic research and innovative projects discourages learning processes within formal institutions.</li> <li>✓ The Algerian University is overwhelmed by the massification of a workforce to which it has devoted all its time, plus academics are generally hostile to the business community.</li> <li>✓ The profile of certain university courses is currently unsuited to the innovation process. For example, education in the humanities and social sciences attracts about 60% of students at the expense of technological disciplines that are more likely to support the innovation process.</li> </ul>
<b>The industry side</b>	<ul style="list-style-type: none"> <li>✓ The low diversification of the industrial fabric is not favorable to the development of a science/industry interface.</li> <li>✓ Knowledge-transfer opportunities produced by universities and research institutions within companies are limited.</li> <li>✓ The company cultivates anti-academic attitudes and considers academic studies to be too theoretical.</li> <li>✓ The company is absorbed in the management of its affairs, market surveillance, etc.</li> <li>✓ The composition of SMEs consists of 97% of very small enterprises with fewer than 10 employees and 3% of small and medium-sized enterprises with 10 to 249 employees. Thus, there is a dominance of very small enterprises, which are generally family businesses or small tradesmen and artisans and have little or no influence on the innovation process.</li> <li>✓ The company views research and development as an extra cost without interest and is looking elsewhere for solutions to its problems rather than going to university.</li> <li>✓ Some companies find it difficult to structure and express their needs clearly.</li> </ul>
<b>University and industry jointly</b>	<ul style="list-style-type: none"> <li>✓ The phenomenon of brain drain and Algeria's inability to preserve its brains, which is a great loss for the country in terms of experienced skills.</li> <li>✓ The lack of mechanisms to encourage the movement of researchers between the worlds of research and industry prevents progress in research and development.</li> <li>✓ Weakness in taking on interns (the internships are usually done on the basis of personal knowledge) due to the absence within the university of a university-business liaison office.</li> <li>✓ Many agreements are signed but not followed through, which distorts the relationship between the university and the company, discourages employees on both sides, and slows down the establishment of partnership mechanisms (incubators, nurseries, and technology parks).</li> </ul>

**Source:** Prepared by the researcher based on: Baddari, 2022; Bouacida, 2019

These difficulties, added to the lack of academic and professional culture, tend to be reinforced if the university and the company continue to take divergent paths. They are the source of many problems facing governments, such as youth unemployment and the low return on investment in training and research. These results contrast with the policy and resources allocated by the government to the development of small and medium-sized enterprises. In the recent period, these difficulties have been aggravated by the epidemiological situation due to the Corona virus, which has led to a significant slowdown in activities. (Baddari, 2022) In this context, there are ongoing challenges associated with this form of collaboration in Algeria, which can be mentioned as follows:

- ✓ Companies are under increasing financial pressure to maintain their competitive edge alongside other competitors, so their focus is primarily on the industrial benefits of research and its alignment with the company's goals and value from research is needed in the short term.
- ✓ There can be challenges associated with commercial arrangements that UIC, particularly how intellectual property (IP) is allocated and then managed. In some cases, this challenge can lead to unsecured cooperative agreements and the failure of collaboration even before it begins.
- ✓ There can be challenges associated with coordinating academic output so that it remains focused on industrial requirements, which can result from a misalignment of objectives from the outset of the interaction.
- ✓ The stagnation of applied texts on this issue will delay any attempt to rectify the situation.
- ✓ Socio-political challenges rather than economic-technical challenges can be considered among the basic challenges of UIC.

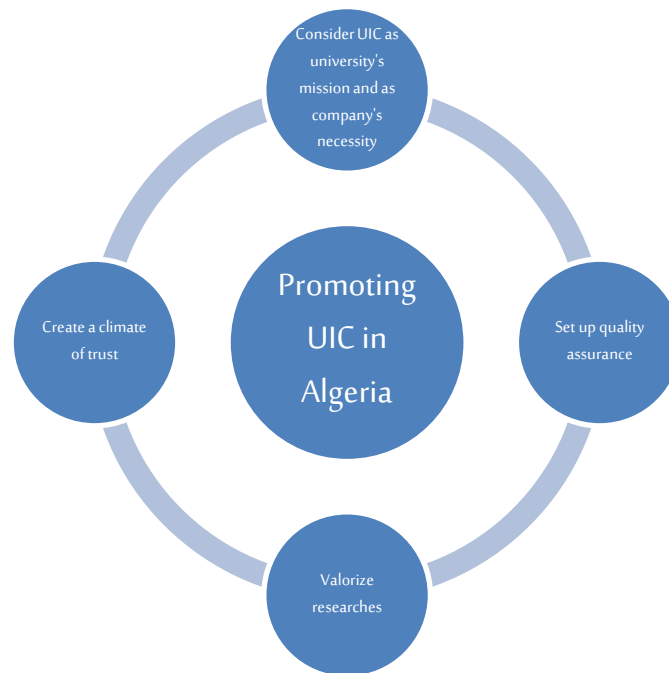
Ultimately, the UIC is hampered by the obstacles of its actors in interconnecting and promoting the flow of scientific and technological knowledge. For a country like Algeria that is lagging behind in scientific and technological development, there are many actions that must be taken in order to activate UIC and advance the innovation process.

### **III.2 Actions to improve university–industry collaboration in Algeria:**

With the identification of the difficulties, a series of necessary recommendations can be made to build a UIC most beneficial to the process of innovation and the upgrading of the Algerian economy. First of all, the partnership must be considered part of the university's mission and the company's necessity, so that there is greater support from the partners to develop training and make it more professional, conduct staff adequacy studies to master the company's needs, and propose program improvements based on these results. It is also necessary to create a climate of trust conducive to fruitful dialogue and communication, to make companies appreciate the advantages of collaboration and work to activate it and provide the conditions for its success, and to establish and train managers of collaboration projects (incubators, technology parks, and nurseries).

Another equally important plan for achieving UIC is the valorization of research (making the results of research conducted by the university, by companies, or jointly usable and marketable). Thus, if development is a new mission for the university, the main issue that will arise is how the latter can adapt to its traditional tasks of education and research without losing sight of its role as a strategic partner and accelerator of innovation. In this context, a set of discrete factors can be recommended, including continuing education, applied research contracts, improving the business climate conducive to initiatives and action, and monitoring and surveying employability and graduate satisfaction. Finally, it is necessary to insist on the need to establish quality assurance, which is an absolutely necessary field for the university and the company. It allows for adequacy, improvement, follow-up, and respect for procedures.

Figure (7): The main actions to improve the UIC in Algeria



Source: Prepared by the researcher

The translation of these measures into reality requires, first of all, the cleaning and preparation of the environment in which these two partners operate and the provision of all the necessary capabilities to start and continue the collaboration; then spaces must be created in which projects can be prepared from start to finish smoothly and under the joint auspices of the university and the company. This also requires the creation of spaces for support and advice services for entrepreneurs and joint ventures that bring together companies, universities, and research centers.

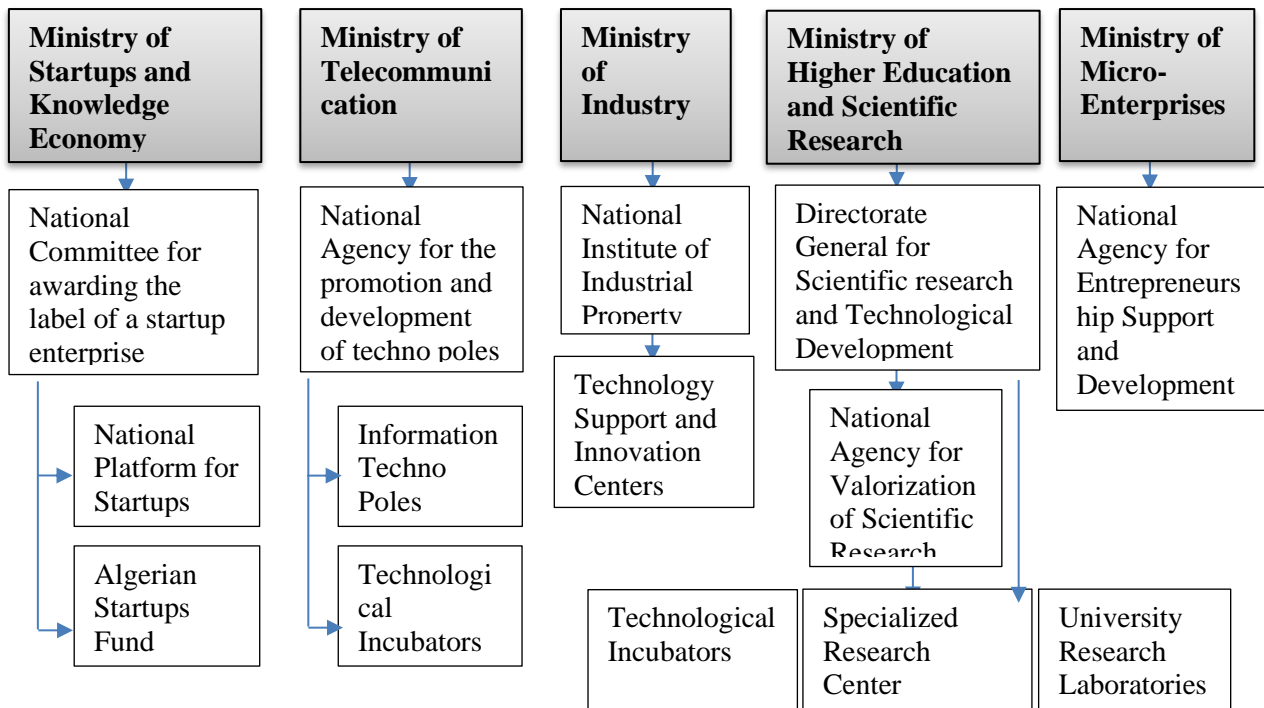
It is of great importance that the basic principles that govern this collaboration are defined: the principle of autonomy, which ensures that the partners remain free in their actions; the principle of equality, which states that the relationship between the partners should not be hierarchical but should be equal; also the principle of common interests, which is based on the fact that each side finds its own advantages; And finally, the principle of cooperation, which requires a significant exchange of information, data, experience, and mutual assistance from partners (including social partners).

### III.3 The role of social partners

The social partner represented by the relevant ministries must attach the utmost importance to the development of the innovation process. To this end, it can play a major role in building the UIC project by encouraging companies to learn more about the research being carried out in universities, encouraging the work of units responsible for communications with the university, and promoting meetings and round tables that bring professionals and academics together for collaboration projects. The social partner must also take on the tasks of persuading companies to become more aware of innovation, welcoming and supervising trainees in order to get to know their future employees better, and investing time, money, and effort in the UIC.

The relevant ministries should play a dominant role in strengthening the UIC, in particular by adapting texts to encourage the various partners to cooperate better. These provisions must allow the actual partner to benefit from incentive measures (such as tax relief). It should also allow the university to take into account in the development of the professional life the results obtained by the researcher affiliated with a real partnership project, to benefit from it according to a fair measure, and so on. It is also necessary to emphasize the role that the five main ministries of Algeria and their agencies must play in efforts to reduce difficulties and support the innovation process.

**Figure (8): Public institution supporting innovation in Algeria**



Source: Redouane, 2022, p. 645

Through the above figure, it is noted that there are several ministries linked to the innovation process in Algeria, the most important of which are the Ministry of Higher Education and Scientific Research and the Ministry of Industry, who have to support the UIC. However, there are no active links to work within a coherent and interdependent national framework. There is a lack of institutional support in terms of well-implemented research and innovative activities.

The UIC entails many collective interests that must be translated into action so that this collaboration has a lasting and viable meaning. It will allow the university to open up to its environment and ensure the placement of its students for professional integration and follow-up, the development of training programs that meet the needs of the company, the development of research promotion, and the sponsorship of scientific events (seminars, conferences, etc.). For the company, this allows it to know the latest research results and integrate new technologies through the movement of ideas, improving its brand image, providing continuous training for its employees, etc.

**VI. Conclusion:**

In this paper, the issue of UIC and its relation to the innovation process has been addressed. Although UIC has been around for a long time, the rapid increase in knowledge and technologies has increased the demand for strategic partnerships that go beyond traditional funding for research projects. In fact, Algeria still suffers from a lag in several areas, the most important of which are the technological and scientific fields, and it was found through the analysis of the GII that Algeria has a low index and that the contribution of the UIC to this indicator is weak due to several difficulties and challenges. Therefore, these difficulties and challenges were analyzed in order to explore the best actions to improve collaboration between the two entities.

It is well known that innovation does not happen in a vacuum: the context - economics, society and politics - determines how easy or difficult it is to innovate. The success and sustainability of collaboration is based on the understanding of all parties, the clarity of the objectives set, and the form of partnership that best matches the capabilities and expectations of the partners. University research should also be developed in the future to play an important role in industry and thus economic growth, in addition political transformations must go hand in hand with social, economic, and technological transformations. In this context, the role of the government is very important through the development of legislation that makes the relationship between the university and industry fruitful and effective, as well as supporting the implementation of research and innovative activities. In addition, the government will have to initiate structural reforms in research, education, and training and strengthen them with far-sighted goals and well-considered strategies in all respects.

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