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Adapted model for developing cooperation between the university and industry sector in Algeria

نموذج مكيف لتطوير التعاون بين الجامعة وقطاع الصناعة في الجزائر

Adimi Dallel [1] Zoubeir AYACHE[2]*

[1] Abbas Leghrour University- Khenchela adimi.dallel@univ-khenchela.dz

[2] COFIFAS Laboratory, Oum El BouaghiUniversity

zoubeirayache@yahoo.fr /zoubeir.ayache@univ-oeb.dz

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Abstract

This study aims to analyze the topic of cooperation between the University and industry as the most important components of national innovation systems to build a strong economy through an approach adapted to the cultural and economic privacy of Algeria, where the government can guide the experiences and models of developed countries in this field to understand the types of cooperation, its incentives and obstacles, and the role of government policies to develop this cooperation.

The study finally proposed a distinct model of cooperation based on criteria and factors of success, as well as concrete outcomes and obstacles, aimed at identifying appropriate policies and mechanisms to promote industrial university cooperation.

Keywords: Cooperation, University, Industry sector, Adapted Model.
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ملخص

تهدف هذه الدراسة إلى تحليل موضوع التعاون بين الجامعة والصناعة كأهم مكونات أنظمة الابتكار الوطنية لبناء اقتصاد قوي وذلك من خلال مقاربة مكيفة مع الخصوصية الحضارية والاقتصادية للجزائر، حيث يمكن للحكومة الاسترشاد بتجارب ونماذج الدول المتقدمة في هذا المجال لفهم أنواع التعاون، محفزاته وعوائقه، ودور السياسات الحكومية لتطوير هذا التعاون.

توصلت الدراسة في الأخير إلى اقتراح نموذج متميز للتعاون يرتكز على معايير وعوامل النجاح، إضافة إلى المخرجات الملموسة والعوائق، ويهدف إلى تحديد السياسات والآليات الملائمة لترقية التعاون الجامعي الصناعي.

الكلمات المفتاحية: التعاون، الجامعة، قطاع الصناعة، نموذج مكيف.

* Corresponding Author

1. INTRODUCTION

The knowledge economy is one of the most important variables that has strengthened the university's new role in developing industry and contributing to economic development, which has made the urgent need to develop strategic relationships between the university and industry that go beyond the limits of traditional funding for research projects.

What can be seen is that developed countries have been able to understand the new and critical role played by the University and higher education in achieving industrial competitiveness, where they have developed deep and long-term cooperative and partnership between the university and industry for decades, while developing countries, including Algeria, and because of the cultural backwardness they are experiencing face many obstacles and multi-levels to build such relations. Recognizing the importance of industrial university cooperation as a tool to promote institutional performance and achieve competitive ranks in the global economy, many of these countries have moved towards adopting policies to promote scientific research and higher education and to link it to close and continuous relations with industry.

2. The problem of the study:

In light of the cultural and economic delays that Algeria is experiencing, between the incentives and obstacles of industrial university cooperation, given the economic and cultural challenges facing Algeria with limited budgets and multiple competitive priorities, the government needs to focus efforts on effective tools and policies to stimulate cooperation between economic institutions and universities. So we ask the following question:

What is the most appropriate model that can contribute to building strategic cooperation between the University and industry in Algeria?

The strategy of this study is to present the various literature on the University and its policies of cooperation with the industrial sector in developing countries in general and in Algeria in particular, in light of which we present a proposed model of mechanisms for developing strategic cooperation between Algerian universities and the industrial sector.

3. Background on the university:

University and knowledge, including technology, are two sides of the same coin, the primary source of knowledge in societies and the main product of technology needed by the global industry is the university.

3.1. The concept of the university and its functions:

The origin of the word university belongs to the Latin word universitas, which means all and all, which means that the role of the university is to know everything in all fields (Anderson, 2015, p. 01). After the expansion of natural and technological knowledge in the nineteenth century, social and economic development has become one of the most important additional modern roles of universities. Because knowledge and the search for the truth of things and phenomena are characteristics of man, the early beginnings of the establishment of universities date back to ancient civilizations, i.e. prehistoric, as Islamic civilization had its additions (Andalusian University of Cordoba in 1795, Moroccan University of Villagers 1859, Egyptian Al-Azhar University, 1970), The first university in the modern sense was the Italian University of Pologne in 1088, followed by the University of Paris in 1130, and oxford University of Britain in 1180, one of the oldest and best universities today (Wikipedia, 2019).

If we want to introduce the university to the modern concept, the following definition will do:

"The University is an independent scientific institution with a specific organizational structure and academic systems, customs and traditions whose main function is teaching, scientific research and community service, consisting of a group of colleges, institutes and departments of a specialized scientific nature, and offering various study programs in different disciplines whereby degrees and certificates are awarded to students" (Athanian, 1429 Hijri).

As for the objectives of the university, it can be summarized in the following points (University and its relationship with society, 2018):

-Developing specialized human competencies capable of assuming the responsibilities of scientific and practical life, and providing society with a highly qualified workforce;

-Scientific research and the development of knowledge of all kinds and fields to serve society;

-Protecting human heritage and preserving the cumulative output of human thought;
-Transfer of knowledge to generations through education and society through dissemination;
-Economic development is the new role of universities in developed countries.

The basic functions of the university can be categorized into three (L'institution universitaire: son rôle dans la société, sa mission et ses mécanismes de regulation, 2019) (J.Duderstadt, 2018):

A. **Education**: The basic function exercised by universities in their early beginnings, whether in ancient civilizations, in Islamic civilization or in Europe and America, is the function of education, not scientific research. Until now, universities were a place of teaching knowledge to individuals, so the university was described at the beginning of its inception as ***the teacher university***.
B. **Scientific research:** Scientific research has become a key factor in the process of professional growth and career advancement of university professors in all higher education systems. The reputation and places of universities within local and international academia have been associated with research activity in the fields of knowledge, so the university has known since the industrial revolution as ***the researcher university***.
C. **Community Service:** Since the university is the link between the outcomes of higher education (competencies, skills and technology) and the requirements of society for growth and development by supporting all sectors, especially industry, the university is now known as ***the entrepreneurial University***.

3.2. The role of University:

3.2.1. The university's role in the developed world:

Universities in the developed world have always achieved most of the goals and strategies drawn up, because the countries of the developed world have been witnessing security and civil stability and cultural and economic development for two centuries, so these countries have not long integrated their development policies into their educational programs, because both

education and scientific research support the economy through a set of factors (Porter, 2007, pp. 43-44) (lonescu & Alexandru loan, 2012, pp. 130-138):

A- Employment: According to recent studies, universities and education centres hold 1/3 positions and 2/3 of the remaining positions for administrative and productive work, so the university can train and employ job seekers simultaneously, expanding the labour market with its positions.

B- Consumption: Universities have purchasing power, about 50% of their budgets are directed at the acquisition of goods and services, this purchasing power can be used to stimulate development, local trade and industry.

C- Local development: Universities also contribute to the revival and reconstruction of areas and provinces that are difficult to penetrate and rebuild by the private sector, so governments usually develop expansionary development plans for the regions based on benefiting the local population before localizing the work that will come at a later stage.

D- Workforce Promotion: The University intervenes directly and importantly in the labour market through employment, training, it teaches and forms the workforce that will hold positions in the private sector, the public sector and civil life. In Europe, for example, the European Commission for Programme Development presented a new agenda in 2016 to support education and training skills allocated 15 billion Euros for the period 2014-2020, and the agenda focused on three main themes (2016, pp. 2-3):

- Developing the quality of training at the skills level.
- Make skills more comparable.
- Developing information to increase the chances of choosing a profession.

E- Consulting and establishing business networks: Universities also contribute to the development of business and industry by the consulting services they provide through their colleges and institutes and through the participation of students and teams, such as these

services: council services, institution management, research leadership, provision of specialized studies, facilitation and activation of networks for business organizations and institutions through the organization of clubs and spaces to meet and exchange experiences and benefits.

F- **Embrace and transfer technology**: Rapid technological development and marketing are the basis of modern economic development and competitiveness, universities undoubtedly play the greatest role in technology development and marketing, and can play the role of incubators that support technology startups.

Universities in the developed world are actively contributing to economic development through the above-mentioned factors, which are all in two main roles: the development of technology and industry on the one hand and the stimulation of consumption on the other, the most important catalysts for economic development, which has led developed countries to pay great attention to these educational research institutions, for example, U.S.A has an arsenal of universities of approximately 5300 universities (2021), including 600 universities recognized by the State, including 137 leading universities compete with universities around the world and always occupy the top positions in most disciplines, with registering 4,000 researchers per million people, while other developed countries register an average of 3,598 researchers per million people. U.S.A spends 2.5%-3% of GDP on scientific research, contributing 30% of global research and development spending (Academic ranking of world universities , 2021).

3.2.2. The university's role in the developing world:

Universities play a key role in connecting development requirements with knowledge, as research strongly reflects the participation rate of higher education in the level of development (particularly in the design and production of new technology), this ratio exceeds 50% in developed countries and does not exceed 05% in the best countries of the developing world (Cloete & Bailey, 2011, pp. 3-4).

The history of the developing world, particularly African countries, during the past century has not played a leading role for universities that were suffering from underdevelopment and unclear objectives and roles in

economic and civil life because of colonialism and the effects of second world war, since not all developing countries had appropriate models of development.

After the Second World War and after the liberation movements of the 1960s, some countries engaged in internal civil wars, others in foreign policies and the repercussions of the Cold War, while others were not spared the interference of the developed world in its internal affairs to exploit its wealth and use it as spheres of influence, which hindered and frustrated many governments, stakeholders and academics. The proportion of government spending on education in African countries, for example, decreased by 82% between 1980-2002, and began to rise after 2010 (Cloete & Bailey, 2011, p. 5), but it remains unstable because the economic development of these countries is linked to fluctuating political and security factors and the West's interference in their internal affairs. As the developing world is a victim of economic development policies in the developed world that have adversely affected education, research and the development of sensitive sectors.

4. Cooperation between the University and industry in developing countries

Cooperation between the University and industry is essential for the development of skills (education and training) on the one hand, and the acquisition and application of knowledge on the other one (innovation and technology transfer), so all countries (developed/developing) are concerned with the development of their innovative systems and research policies in accordance with their development programs. This is what developed countries are constantly and diligently doing, as successful cooperation achieves many gains and benefits, the most important of which are (Slusarek, Blazej, & Mendec, 2010, pp. 1-2):

-Helping to coordinate research and development programmes between industry and the university, and avoiding repetition;

-Exploiting the synergy and integration of scientific and technological capabilities;

-Expanding private sector support for research and development, thereby increasing cooperation between the public and the private sector;

-Increasing the readiness of industrial enterprises to produce new products and invention (as in Chile and Colombia).

4.1. Knowledge and technology Transfer:

In 1995, nonaka and takeuchi presented an important and distinct study on the classification of knowledge, in which the researchers classified knowledge into two basic types (Siege, 2003, p. 3) (Malhotra, 2002):

- **Explicit knowledge:** Knowledge that can be fully transmitted between people and through generations by encrypting it (letters, numbers, symbols, drawings and charts....).
- **Tacit knowledge:** The knowledge inherent in the minds of individuals reflected in their performance and experience, but difficult and sometimes impossible to move on because it cannot be encrypted.

The researchers added that the process of transferring knowledge needs to be converted first, and this is done in four patterns (Siege, 2003, p. 3) (Malhotra, 2002):

A- **Socialization:** The process of sharing implicit knowledge such as skills and technology, and the key to obtaining implicit knowledge is experience and direct friction.

B- **Externalization:** The process of converting implicit knowledge into explicit knowledge, the key of which is a metaphor-based encryption process, metaphor and visualization.

C- **Combination:** The process of arranging and organizing existing explicit knowledge, the key to that is summary, expansion or classification.

D- **Internalization:** The process of converting explicit knowledge into implicit knowledge that combines and interacts with people's skills and experiences in certain tasks, the key to that is oral presentation.

4.2. Transfer of technology from university to industry:

Technology is scientific and applied knowledge, so it is the important part of the process of transferring knowledge from its sources of production (universities and research centers) to its uses in industry, in this critical process intervens a group of stakeholders who move by different incentives to achieve their goals, as the following table explains:

Table 1. Stakeholders in technology transfer from university to industry

Stakeholders	Operatin	The first incentive	The second incentive
University (researchers)	discover new knowledge	appreciation of the scientific milieu (publishing, grants...)	financial profit and securing additional scientific projects (funding laboratories and students)
Technology Transfer Offices (TTO)	coordination between university members and industrial institutions	protecting and marketing the university's intellectual property rights	to facilitate the dissemination of technology and secure funding for other research
Industrial enterprises	market products with new technology	Profit	to maintain private technology
Government	financial funding scientific research projects	upgrade scientific research and higher education sector/ industry promotion	economic and social development

Source: (Siege, 2003, p. 4)

4.3. The relationship University / Industry:

The degree of association between the university and industry varies from country to country and from stage to stage, the priorities and policies of countries vary depending on the stage of economic development they are going through.

A- **Degree of association between university and industry:** The

association between the university and industry has many objectives, purposes, areas and institutional arrangements, the degree of this correlation varies between strong and weak, may be based on training or research activities, and may be formal or informal, the cooperative relationship can be at short-term (related to solving demand problems with predetermined results) through research contracts, consultations, licenses, or long-term related projects such as private public partnerships (research agreements and private funding of universities), this type of cooperation is strategically providing floors for organizations to develop strong innovation capabilities (Guimon, 2013, p. 3).

B- **Priorities of the university/industry relationship in developing countries:** The priorities and areas of cooperation between the University and industry vary differently between developed and developing countries that have many difficulties in developing areas of cooperation, the most important of which are:

-Lack of quality in the education system (inputs, processes, outputs);
-Lack of funding for universities.

The following table outlines the priorities of the university/industry relationship for developed and developing countries according to university roles (Guimon, 2013, p. 3):

Table 2. Priorities of the university/industry relationship in developed/developing countries

	developed countries	**developing countries**
University Teacher	-Private sector participation in teaching programmes	-Development of graduation and post-graduate studies curricula

	-Continuous supervision of students and phD students	-Training students
University Reseacher	-Long-term research agreements and partnerships	-Building capacity to adopt and deploy existing technology -Focus on technology appropriate to the needs of the local market
university Entrepreneurial	- Spin off and invention licenses - Entrepreneurial education	- Business incubation services - Entrepreneurial education

Source: (Guimon, 2013, p. 3)

Through the previous table, it is clear that developing countries are unable to link industry to joint innovation and research projects with universities, so building relations between the university and industry in these countries requires time and continuous efforts due to the limited experience of universities in the field of industrial cooperation, in addition to their limited research capabilities, as the only cooperation that exists is informal cooperation consisting of the recruitment of graduate students in industrial institutions, and some consultations.

4.5. Barriers to university/industry cooperation:

As mentioned earlier, cooperation between the University and industry brings many gains to both parties, but it is not easy to achieve, as this process also encounters many obstacles, especially in developing countries:

A- University/Industry cooperation incentives: The most important of these incentives are (Guimon, 2013, p. 4):

- **For the University:** improving education, access to funding, access to the industry database, improving the university's image and reputation.

- **For industry:** access to complementary technological knowledge (patents and implicit knowledge), overcoming the bet of qualified workers, providing training to current and future workers, access to university structures and facilities, access to government funding and incentives, reducing risk by sharing research and development costs with the university, influencing research and education programmes at universities.

B- Obstacles to cooperation university/industry :

The most important obstacles to such cooperation are (1426 Hijri, pp. 21-23):

- Industrial research trends are incompatible with academic research, for a number of reasons including the orientation of universities for basic research, the orientation of institutions for applied research and development and their desire for rapid marketing of products.

-The cost of cooperation and, in return, its returns are realized in the medium and long term.

-At the output level, institutions are interested in rapidly obtaining the new invention or product with a desire to keep quiet and monopolize information (research and results process) and to obtain intellectual property rights (licenses) for commercial exploitation, while the University and its researchers are interested in publishing researches as soon as possible (the message of spreading science and knowledge).

-The difficulties of negotiating cooperation on: information, costs, confidentiality, individual communication, transformation costs to find another partner more mutually friendly, intellectual property rights and commercial exploitation of innovations.

4.6. Models of successful collaboration university/industry in the developed world:

Some of these successful experiments are classified by the basic purposes of cooperation as follows (Edmondson, 2012, pp. 6-12, 48-50):

A- **Teaching and learning-based cooperation:** The main focus of cooperation between the university and industry can be the development of teaching and learning programmes such as: Melbourne University experience with Microsoft-Cisco-Intel.

B- **Cooperation based on the development of new flows of funds**: sometimes the University seeks to provide new flows of funds through collaboration with industry, as has imperial innovation group -a technology transfer office (TTO)- which has developed a technology agreement in the name of imperial college London, investing in spin out institutions in health, energy, engineering and the environment.

C- **Cooperation based on the role reformulation of scientific research:** example of this type of cooperation include: Karolinska I, known for pioneering Europe since 1990 -has won many Nobel Prizes in Medicine and many famous inventions- and is constantly producing spin out and contracting graduates.

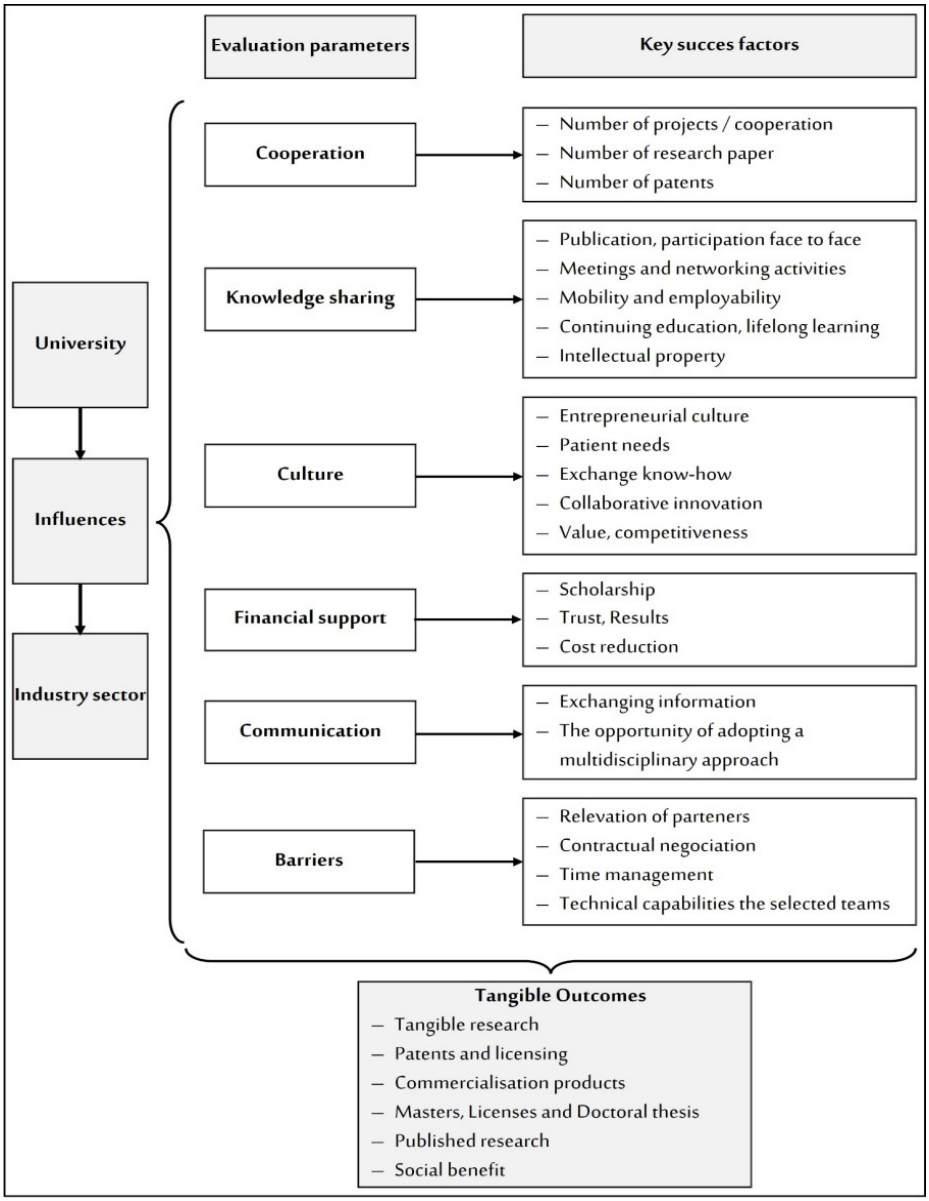
D- **Strategic cooperation:** One of the most successful global models in long-term cooperation: IBM is collaborating with imperial college London through a strategic relationship of more than 25 years.

5. Policies to promote university/industry cooperation in Algeria based on an adapted model:

5.1. Adapted model:

Below, we propose a revised model explaining the conditions, mechanisms, obstacles and outcomes of cooperation between the university and the industry sector in Algeria, taking into account its cultural and economic specificity:

Fig.1. Adapted Model to promote university/industry cooperation in Algeria



Source: Based on: (Ivascu, Cirjaliu, & Draghici, 2015)

In order to obtain benefits and tangible outputs, The adapted model we propose for the cooperation university – industry sector in Algeria is based

on the data analysis of four key elements (Ivascu, Cirjaliu, & Draghici, 2015):

A- **Evaluation of parameters:** collaboration, knowledge sharing, culture, financial support, communication, and barriers. Each parameter includes one important concept to be assessed in order to obtain benefits and tangible outputs after operation between industry and universities.

B- **Success factors:** are associated to each category of parameters, thereby suggestive for each category. These factors contribute to the development of a relationship based on open working win to win, so that results are maximized.

C- **Tangible outcomes:** results obtained from collaboration between universities and industrial sector. Tangible outputs are the main pillar of the industrial environment, while for universities is the reputation and image created.

D- **Barriers:** in cooperation between industry and university there are some barriers that are hindering the collaboration between the two parties.

5.2. Practical policies of cooperation:

By linking these challenges with limited budgets and multiple competitive priorities, Algeria must focus efforts on the most appropriate tools and policies, the most important of which are (Guimon, 2013, pp. 6-8):

A- **Incentives and grants for research and development**: In this context, Algeria must design grant systems and incentives for research and development. Innovation bonds can be an effective tool, which is a small government-provided loan to SMEs to purchase services from universities and research centers for innovation within these institutions. This tool has succeeded in many countries such as the Netherlands, Ireland and Britain, and is easy to adopt in developing countries because the main problem of their institutions is the lack of incentives and funding.

B- **University-based funding:** The Government can stimulate cooperation between the university and industry through its role in funding public universities so that the amount of funding granted to

universities is determined by their performance and expressed by a range of traditional criteria such as: number of students, number of doctoral students, scientific publication, patents, and non-traditional standards such as: number of research and development contracts with industry, income from invention licenses, number of startups and institutions emerging from university colleges (spin off).

C- **Creating intellectual property rights systems and technology transfer offices:** U.S.A was the first to legislate a legal system to stimulate and protect university invention activities in 1980 and market research products, followed by many developing countries with similar laws since 2000, but intellectual property reforms cannot bear fruit for countries with weak national innovation systems, as is the case for Algeria, where research and development results are unstable and unexpected due to the low technological capacity of Algerian universities at the level of intellectual capital, and at the level of structures and facilities.

D- **Scientific gardens, business incubators and spin off institutions:** Scientific parks are expected to develop university/industry cooperation through business incubators to support spin off and startup institutions. The number of scientific parks in both developed and developing countries has doubled, but many have failed to achieve their goals such as the Chinese experiment, which failed due to a lack of realistic estimates.

E- Education and training: For economic institutions, the most important relationship with the university lies in employing the outputs of the latter, which considers education and training one of its most important roles, especially in developing countries that lack qualified and highly skilled labor. Thus Algeria must first look to improve the quality of university output by strongly linking the university to industry, and the first practical step is to establish an advisory system in which there is a clear role for businessmen and institutional managers, which enables the Algerian University to respond better for the needs of the industry.

6. RESULTS AND DISCUSSION

Algerian government policies can strongly influence the willingness of economic institutions to cooperate with universities and vice versa, by (Guimon, 2013, p. 5):

-The direct role of providing funding for universities and research projects;

-The modified role of influencing the rules of university bodies that constitute an intellectual property rights system;

-Providing the necessary structures and facilities and intermediary organizations such as technology transfer offices, scientific parks and business incubators;

-Stimulating cooperation through flexible standards such as providing special services to support university institutions in the search for partners and leading activities to upgrade business networks.

Cooperation between the University and industry is a complex process in developing countries including Algeria, where the efforts of many parties need to meet at several levels, the most important of which are: the university, economic institutions and the government, and these efforts can be classified for each party as recommendations:

• For the government:

-Working to build a national innovation system (bodies supporting scientific research at the university and supporting research and development in economic institutions);

-Financially and academically stimulating universities (grants, funding, prizes...) and stimulating industry (grants, funding, tax incentives...) to cooperate.

• For the university:

-The need to respect the wishes and areas of researchers for cooperation;

-Helping teachers to find economic partners and to cooperate with;

-Cooperation should include strengths and excellence at the university and research opportunities in the industry sector;

-The need to integrate the standard of cooperation into the careers of research professors (recruitment, installation, promotion);

-Establishing supporting scientific research bodies such as technology transfer offices that handle partnership negotiations and protect intellectual

property rights for university research.

- **For industrial organizations:**

-Assessing external research and the ability to integrate its results into innovative products;

-The flexibility of management to negotiate, so that it can adopt many partnerships;

-Encouraging workers and employees to participate in research and adopting this as a criterion in the process of assessing their performance;

-Facilitate the contact of university researchers with the foundation to accelerate cooperation;

-Adopt and adhere to a long-term cooperation strategy.

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