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National Innovation System - proposal model for Algeria

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Abstract:

The aim of this paper is to appear the importance of the National Innovation System (NIS), and the possibility of building a national system for innovation in Algeria.

This article has been divided into three parts; The First part studies the concept of a (NIS). Then the second part analyzes the reality of innovation in Algeria, This analysis will allow the third part which is proposing a model of national innovation system specific to Algeria.

We use the descriptive and historical approach in the theoretical aspect and we use the analytical approach to the case of Algeria and in finally we propose a model for a (NIS) in Algeria.

The most important results that have been reached is that the level of innovation in Algeria is still far from the international level in both the input and output elements of innovation, and the efforts made to develop innovation have not yet been able to create an ecosystem that encourages innovation.

Therefore, it has become necessary to move towards building a national innovation system=

Keywords: *national, innovation, system, model, Algeria*

JEL Classification Codes *: O31, O32, O33, O34, O38*

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Introduction :

Innovation is defined as a pioneering activity, rooted primarily in a firm's internal competencies, to develop and introduce a new product to the market. Innovation is different from pure invention. Innovation involves the successful implementation of a new product, service, or process, which for most activities entails their commercial success. (Kim, 1997, p. 13) Generally Innovation, understood as the recombination of existing ideas or the generation of new ideas into new processes and products (McCann & Gordon, 2005, p. 523)For new entrepreneurs, a network of peers and mentors is of greater importance than product and finances. (Fabian, 2016), If I had to name the single characteristic shared by a ll the truly successful people I've met over a lifetime, I'd say it is the ability to create and nurture a network of contacts," wrote Harvey Mackay in "Dig Your Well Before You're Thirsty" (Harvey, 1997).

The National Innovation System (NIS) is a concept aimed at interpreting the phenomena of current growth. Largely analyzed in the literature of the 1990s, NISs have become indispensable, both in academic circles as well as in international institutions. Introduced explicitly by (FREEMAN, 1987) in a work identifying the reasons for the performance of the Japanese economy.

First applied in developed countries, NISs were more recently analyzed in developing countries (Kim, 1997; Hobday, 1995; Bell, 2007). Consequently, research on innovation systems has had to consider all the distinctive features specific to developing countries (Altenburg, 2009, p. 36)

Innovation systems in developing countries are different from those in mature OECD countries in a number of ways. They need to cater for different needs; they build on institutional frameworks that tend to be much less formalized, and rules that are less enforceable; and the key agents as well as the incentives that determine their behaviour tend to be very distinct (Altenburg, 2009)

Over recent years, the topic of innovation has received growing attention from Algerian government and she's trying to develop the innovation on both sides in input and output and seeks to develop the supporting institution like the incubators and universities.

But Algerian economic has still characterize by defective markets, informal practices; incipient financial institutions and regulation; inadequate and inefficient collective infrastructure; an economy subject to the vagaries of the international environment; fragility due to unpredictable capital movements.

Our idea is thus directed towards the lack of coherence of institutional actions which could be explained by the absence of a global national strategy for innovation.

the study problem **: what's the importance of national innovation system (NIS), and How can building it in Algeria?**

- the study hypotheses

1- Innovation policies in Algeria are still useless and ineffective.

2- If the national innovation system is implemented in Algeria, the innovation environment will improve.

- the study objectives

1- Understand the concept and importance of the national innovation system.

2- Viewing innovation policies in Algeria and their effectiveness.

3- Attempting to propose a model for a national innovation system for Algeria.

- the importance of the subject

The importance of this topic lies in the importance of innovation in itself as a drive of economic growth and economic development, and that the national innovation system allows for the establishment of a suitable environment for business.

However Algeria is seeking to move towards a knowledge economy and encourage startups and innovation, but the business and innovation environment is still under the required level, so it is necessary to move towards building a national innovation system.

- The methodology used in the study

In this article, we use the descriptive approach in the theoretical aspect of the study and the analytical approach in the applied aspect related to innovation in Algeria, in addition to trying to propose a model for a national innovation system specific to Algeria and evaluate it in a SOWT method.

- Previous studies

1- (Băzăvan, 2019), **Chinese government's shifting role in the national innovation system**, paper published in journal of Technological Forecasting & Social Change, this study finds that the principal model change is the fact that the state progressively aims to become a platform creator, facilitator for innovation. The government plays a assembly of roles that differ significantly through industries and levels of administration, in a way that could be best defined as structured uncertainty. While in some industries, the state follows the classical approach of central-led investments and heavy protectionism, in others, it acts more as a business-partner and multiplier for private investment. There are also those industries where the government stimulates emerging technology by completely refraining from any action or regulation.

2- (Casadella & Uzunidis, 2017), **national innovation systems of the south, innovation and economic development policies: a multidimensional approach**, paper published in journal of Innovation Economics & Management. this study finds that the general literature around NISs is very often focused on a connection between the territory examined and the recommendations around technology policies, and does not sufficiently re-examine the fundamental subjects on which NISs are based: innovation capacities, innovation policy and economic development. The aim of theoretical contribution of this article it will re-examine the NIS concept. Then it will analyse the acceptability of innovation policies, And finally, it will re-examine the conditions that structure the latter with regard to globalised growth, and economic development that is sometimes impeded.

3- (Kwon & Motohashi, 2016), **How institutional arrangements in the National Innovation System affect industrial competitiveness: A study of Japan and the U.S. with multiagent simulation**, this paper published in journal of Technological Forecasting & Social Change, this study finds that The institutionalized long-term business relationships among Japan's (JP's) innovating players have been indicated as a weakness of JP's National Innovation System (NIS) compared with that of the U.S. This study examines how this institutionalized business relationship practice determines the strengths and weaknesses of the U.S. and JP's NIS using agent-based modeling and simulation. this analysis reveals that the JP NIS is at an advantage in an industry where consumer demand changes rapidly and incremental innovation is crucial. In contrast, the U.S. NIS benefits an industry where frequent radical innovation is required. Furthermore, it show that heavy reliance on in-house R&D is advantageous over open-innovation practice in an industry where radical innovation is crucial when long-term business relationships are prominent. Based on the simulation results, the conclusion include strategic and policy implications for JP firms and policymakers, respectively.

4- (Lundvall & Lema, 2014), **Growth and structural change in Africa: development strategies for the learning economy African**, published in Journal of Science, Technology, Innovation and Development, This paper discusses opportunities and policy options for African

countries in search of innovation and learning based development strategies. What kind of policies and institutions are necessary in order to transform the current growth in rents from merchandises exports into industrial investment and upgrading of agriculture and agro-industrial development? This question is elevated in the context of competing theories about economic development. On the basis of empirical patterns and theoretical reflections and discuss policy options in relation to the African reality.

1. Concept of National Innovation System (NIS):

An innovation system is more than those elements directly related to the promotion of science and technology; it also includes all economic, political, and other social institutions affecting innovation. (ATKINSON, 2014)

The National Innovation System (also NIS, National System of Innovation) is the flow of technology and information among people, enterprises and institutions which is key to the innovative process on the national level. (OECD, 1997)

Christopher Freeman defined National Innovation System as "*a network of institutions in public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies*"

(Lundvall, 1992) distinguishes two different concepts of NIS:

- the narrow concept is limited to the fields of science, research, technology and, in some cases, education,
- the broad concept extends to all economic and institutional structures which affect the production system.

NISs are constructed in developing countries by building capacities of learning, which are structured more or less formally between actors and communities. Innovation only makes sense through the formalization of these national capacities, conveyers of new knowledge. If innovations systems act as milestones for establishing innovation policies, these only make sense through the view they provide on the nature of the links and interactions between institutions and organizations within society as a whole. In this sense, NISs respond to the new vision of innovation, reconsidering the role of the State by applying technology policies and, more indirectly, learning, social, experimentation policies, etc. Moreover, the NIS concept, initially structured around growth targets, has recently found coherence around the aims of economic development (Lundvall *et al*., 2009, Muchie *et al*., 2013). The idea is to use this concept to understand the processes of learning and innovation in developing economies. So the NIS would no longer only serve to compare national technology performances but as a tool to promote economic development. Enshrined in the current phenomenon of globalization, NISs should both respond to the globalization of economic activities, as well as construct inclusive orientations of growth and development.

The globalization of innovation, coupled with the imperatives of growth, do not prevent States from defining their innovation policy with a view to economic development. There is little evidence of the link between capacity and development in the literature. But innovation shapes economic development just as economic development influences innovation (Casadella et al., 2015). Indeed, the reduction in poverty and the improvement in income distribution remain linked to the capacity of poor countries to control the use, diffusion and creation of knowledge.

Economic development is understood through the accumulation and use of tangible and intangible resources. One talks about innovation and inclusive development to show how growth, but also social inclusion, are important in less advanced economies (Lundvall, Lema, 2014). Inclusion can be "passive" or "active", depending on the scope that individuals have for structural change that considers the ambitions of individuals. It redistributes revenue generated in formal and informal sectors, and allows them to shape future society in interaction with other groups. Development is no longer considered to be a linear phase, but through a set of structural and

historical elements taken in their global context. This view calls for the building of unique capacities for innovation, which consider the specific, social character, and the specific contexts of the economies in question.

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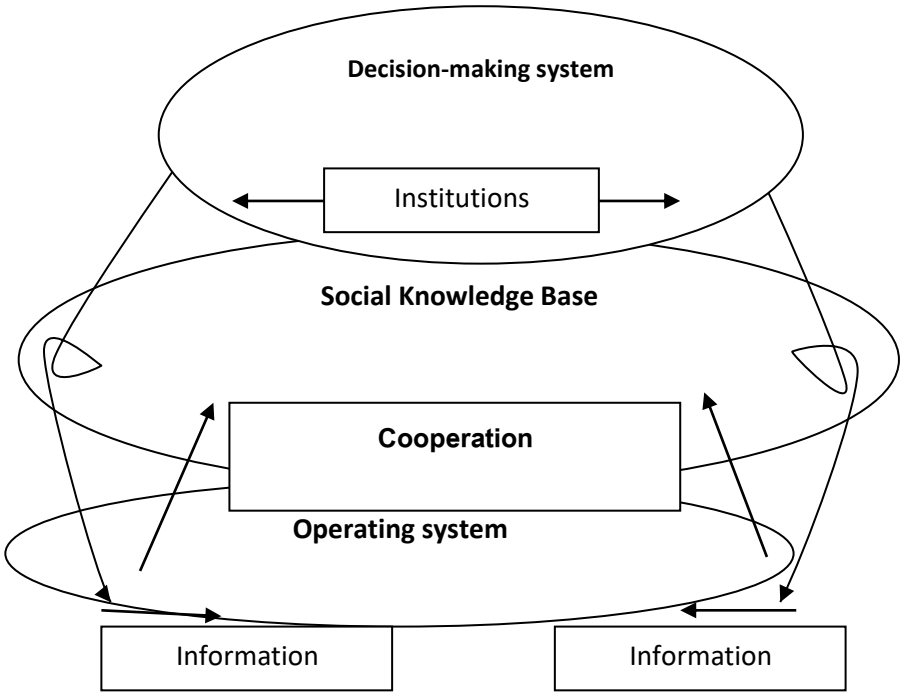
NISs are based: innovation capacities, innovation policy and economic development.

Figure (1): structure of the national innovation system



Source: Alejandro Nacelerio, la dimension systémique du système national d'innovation: une application au cas de l'Argentine, Thèse de doctorat, UFR de sciences économiques, université Paris13, 2004, P134.

According to K. Smith (2000), the approach in terms of NIS is based on three conceptual foundations:

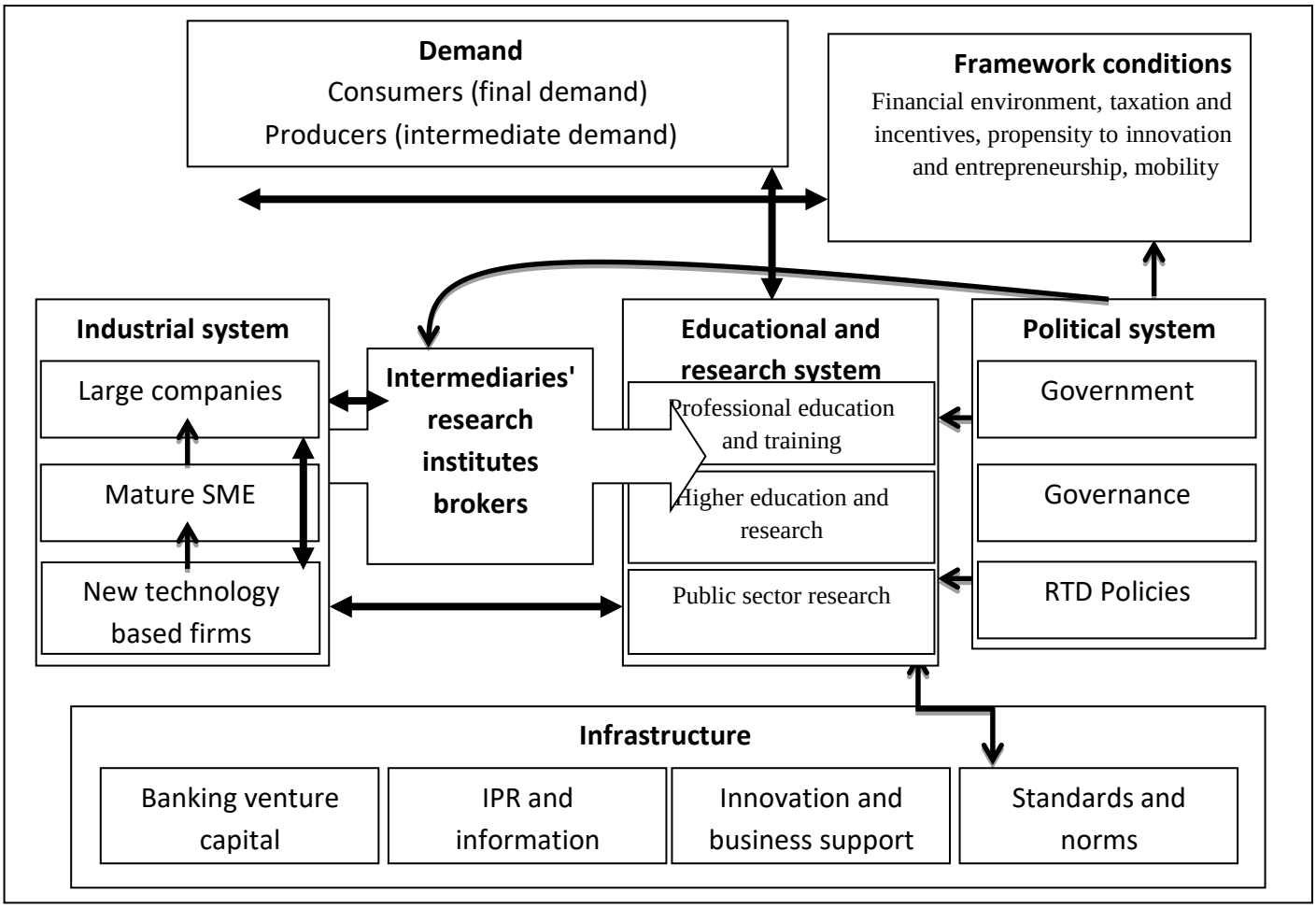
1- **decision-making system** is based on institutional foundations. Consequently, different institutional structures give growth to differences in economic behavior and the performances driven by these different behaviors.
2- **Social Knowledge Base** results from variety and specialization in terms of learning and innovation. This therefore has properties of accumulation and conduit dependence. Technological and industrial specializations lead to self-reinforcing phenomena which provide system effects. And Technological knowledge is produced by interactive learning, which gives rise to "knowledge bases" that differ, depending on the agents, and these bases determine the opportunities for innovation.

In this broad concept of NIS, innovation, as an ability to create new products and processes, and quality (remains less important than its capacity to use and adapt existing technologies to competitive levels of costs (Lall & Pietrobelli, 2005)

Therefore, the institutions that structure NIS are:

1- **Governments:** and related organizations that support innovation through regulation, norm-setting, public-private partnerships and funding for basic research
2- **Sectors and industries companies** that generate business innovations through experimentation, R & D, and product improvement
3- **universities** that conduct basic research and train a technical workforce (Patel, Pavitt, 1994; Lundvall, 2005
4- public and private organizations engaged in directed education activities.

Figure (02): National Innovation System model



Source: O' Doherty and Arnold (2003) cited by: Radmil Polenakovik and Ricardo Pinto, The National Innovation System and its relation to small enterprises: the case of the Republic of Macedonia, World Journal of Science, Technology and Sustainable Development, Vol. 7, N° 1, 2010, P122.

2. the reality of innovation in Algeria :

Indeed, Algeria still there no found the completely national innovation system, but there is found a several parts of it, such us the incubators and universities. And the recently created ministry of startup and knowledge economy, this ministry has established a fund to finance innovation and an platform to grant the label of innovative and startups, which will benefit from several financial, administrative, tax and many facilities. In many African countries the most fundamental barriers for development are socio-political rather than techno-economic. Here political transformations must go hand in hand with socioeconomic and technological transformations. (lundvall, lima, 2014)

Table (1) : Rankings of Algeria (2019–2021)

	GII	Innovation inputs	Innovation outputs
2021	120	109	128
2020	121	111	126
2019	113	100	118

Source: Rapport Global Innovation Index, Algeria, 2021

Algeria performs better in innovation inputs than innovation outputs in 2021.
• This year Algeria ranks 109th in innovation inputs, higher than last year but lower than 2019.
• As for innovation outputs, Algeria ranks 128th. This position is lower than both 2020 and 2019 (GII, 2021)
29th Algeria ranks 29th among the 34 lower middle-income group economies.
18th Algeria ranks 18th among the 19 economies in Northern Africa and Western Asia

Table (2): The seven GII pillar ranks for Algeria

Human capital and research	74
Infrastructure	96
Institutions	104
Creative outputs	118
Global Innovation Index 2021	120
Business sophistication	124
Knowledge and technology outputs	125
Market sophistication	132

Source: Rapport Global Innovation Index 2021

We observe through the above table the human capital and research has the best ranking (74), and followed by the infrastructure (96), however the market sophistication still the weakest link ranked last.

Table (3): State of development of the level of competitiveness by country

Stage1: Factor-driven	**Transition from stage1 to Stage2**	**Stage2: efficiency driven**	**Transition from stage2 to Stage3**	**Stage3: innovation-driven**
	Algeria			

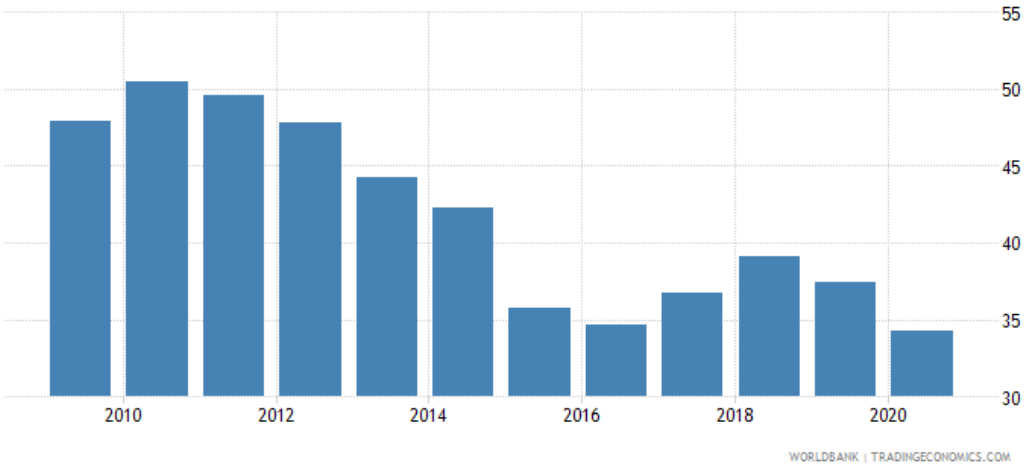
Source : The Global competitiveness Report (2016-2017)

Most problematic factors for doing business in Algeria is inefficient government bureaucracy, Access to financing, Corruption (The Global competitiveness Report (2016-2017))

Algeria is the 89 most competitive nation in the world out of 140 countries ranked in the 2019 edition of the Global Competitiveness Report published by the World Economic Forum

The 2018 edition of Global Competitiveness Report assesses 140 economies. In 2018, the World Economic Forum introduced a new methodology emphasizing the role of human capital, innovation, resilience and agility, as not only drivers but also defining features of economic success in the 4th Industrial Revolution. As a result, the GCI scale changed to 1 to 100 from 1 to 7, with higher average score meaning higher degree of competitiveness. The report is made up of 98 variables organized into twelve pillars with the most important including: institutions; infrastructure; ICT adoption; macroeconomic stability; health; skills; product market; labour market; financial system; market size; business dynamism; and innovation capability.

figure (3) – Industry / value added index in Algeria (% GDP)



Source : trading economics, (2010-2020)

Industry (including construction), value added (% of GDP) in Algeria was reported at 34.25 % in 2020

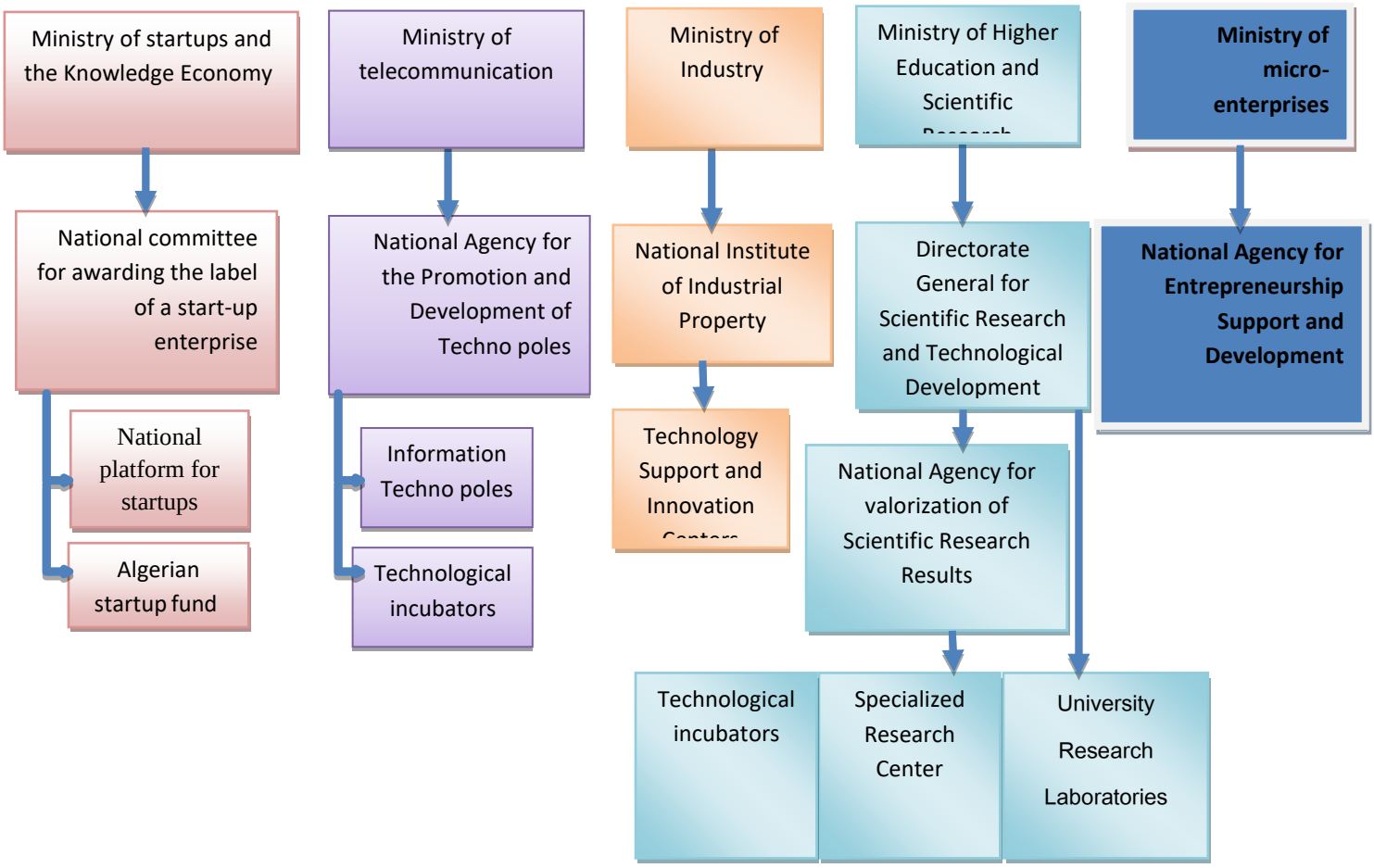
The table below gives an overview of the strengths and weaknesses of Algeria in the GII

Table (4): Strengths and weaknesses for Algeria 2021.

Strengths		Weaknesses	
Indicator name	**Rank**	**Indicator name**	**Rank**
Tertiary education	**1**	**Global corporate R&D investors, top 3, mn US$**	**1**
Tertiary enrolment, % gross	**9**	**QS university ranking, top 3**	**4**
Graduates in science and engineering, %	**8**	**E-participation**	**31**
Researchers, FTE/mn pop.	**4**	**Ease of getting credit**	**29**
Gross expenditure on R&D, % GDP	**2**	**Ease of protecting minority investors**	**30**
General infrastructure	**0**	**Market capitalization, % GDP**	**5**
General infrastructure	**0**	**GERD financed by abroad, % GDP**	**01**
GDP/unit of energy use	**4**	**Patent families/bn PPP$ GDP**	**00**
Domestic market scale, bn PPP$	**2**	**High-tech exports, % total trade**	**29**
State of cluster development and depth	**7**	**Global brand value, top 5,000, % GDP**	**0**
High-tech imports, % total trade	**9**		
Industrial designs by origin/bn PPP$ GDP	**0**		

Source: Rapport Global Innovation Index, Algeria, 2021

Figure (4): Public Institutions supporting innovation in Algeria



Source: Prepared by the researcher based on several sources

in an NIS, companies operate in an ecosystem. In this ecosystem coexist and interact proximity structures, resources and incentive mechanisms (Groenewegen, 2006), qualifying them to continue their activities and more indirectly diffusion innovation. These structures have an effect on the development and the fixing of the routines in the interactions between the actors of the NIS.

The role of public actions in supporting the creation, production and diffusion of innovation is very importance and permitting to the firms operating in a geographical area with advanced technological suppliers are better off than others in installing an innovation strategy. (Handfield R. B., 1999)

We find also the institutions that can support network activities, incubation startups. This refers to the role of innovation support institutions as well as the coordination of the actions of the actors of the NIS (Liu, 2001)

This refers to certainly; the public plays a key role in the construction and performance of an NIS, since an operative structural policy provides a comprehensive structure for building a knowledge-based economy that promotes innovation (Laperche, Uzunidis, 2007).

In this regard, it is noted that there are several forms joined with several ministries. However, there are no active links to work within a coherent and interconnected national system, and absence of support for some institutions and forms that are not well-implemented in supporting innovative activities. Following the enumeration of actors in the innovative process in Algeria, we will try to propose a model of the national system of innovation for Algeria that includes what exists on the ground, what can be added as a first step and then developed in other stages.

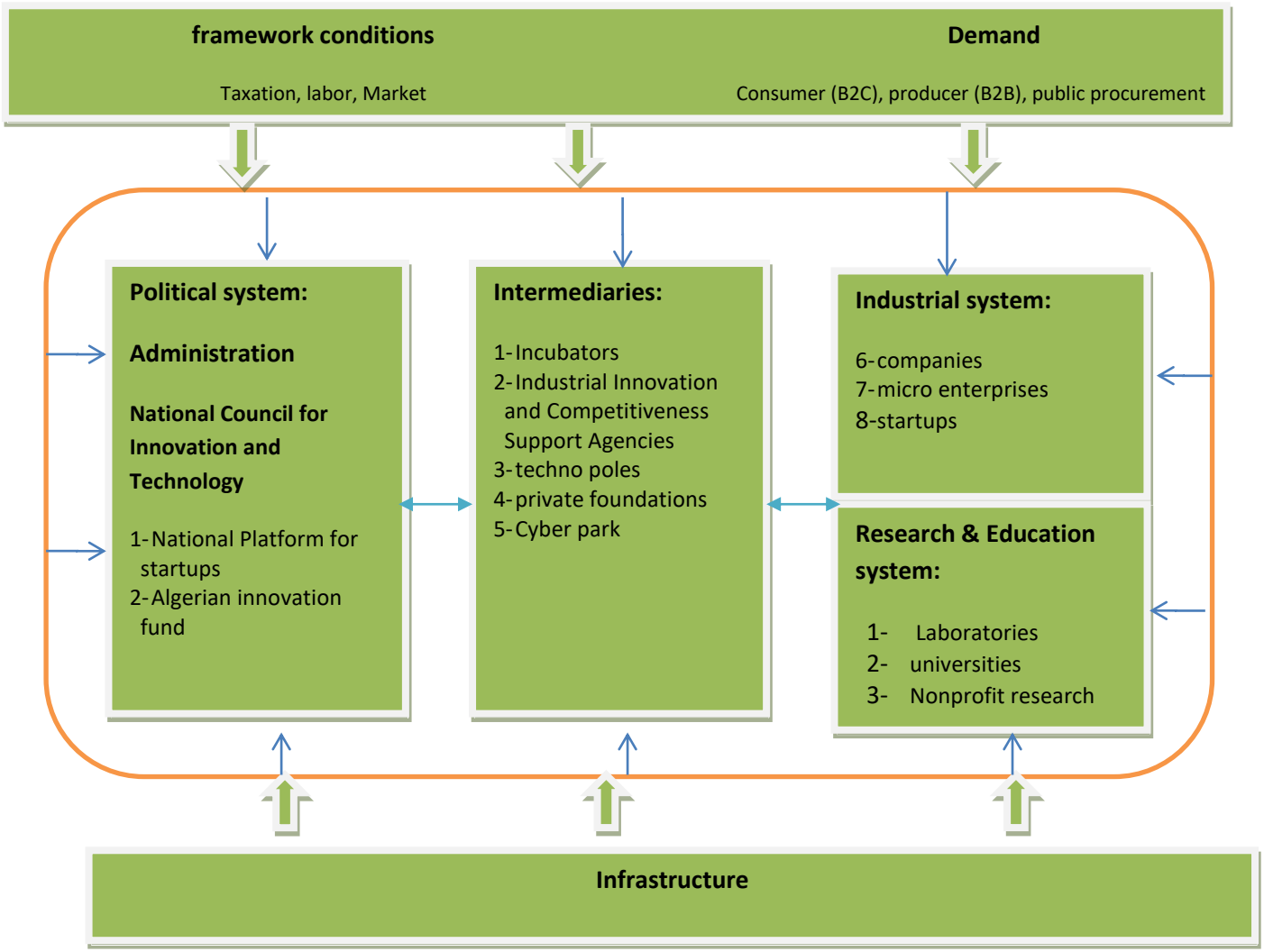
3. Proposal national innovation system model for Algeria

Algeria has been motivated in recent years to support innovation through the establishment of a ministry in charge of the knowledge economy and startups, and it's create of several frames and institutions to support innovation. However, all these efforts did not improve the level of innovation through international reports or through what is on the reality, due to several Reasons like the method of management, which depends on the bureaucratic model.

Indeed, innovation, in order to succeed must provide an environment of economic freedom and a package of administrative and financial facilities and protect innovators from stealing their innovations, here lies the basic role of the state, which is to regulate the market, enforce the law and provide the infrastructure, then permission the liberty to compete in the light of administrative, financial and legal facilities.

in light of the above comes our proposal, which is called national innovation system and this system includes under its space three main under systems, The first is the political system, includes the administration, which is the entirety of governmental structures that contribute to supporting innovation, and it must be under a head for formulating innovation and technology policies at the national level. Algeria has directed towards this trend and it named the National Council for Innovation and Technology. It includes experts from national competencies fro; inside and abroad who work in respected international institutions and are acquainted successful experiences. This council can draw the lines and axes on which the state will focus. To support it, such as renewable energies, industries with high added value, and even issues related to public health, education, etc., then come the intermediary structures and institutions that have the role of incubation and provide the appropriate environment for innovation such as centers of competitiveness poles, technology parks and other intermediaries distributed throughout the country, then the system of industrial sector, which includes all industrial institutions and companies and startups, small and medium enterprises, and big companies. In other part the education and research system, including all the kind of learning in the society like professional learning, and research in Universities, laboratories, training centers, research centers. and all of these under systems must interact with each other within one system, which is the national innovation system, and must benefit from a strong infrastructure that forms a solid base for it to launch and achieve the desired goals, and this system produces innovations Depending on demand, whether related to consumer demand or government demand, in accordance with the framework condition of market, labor and taxation, and all this perception can be summarized in the illustration below.

Figure (5): Proposal national innovation system model for Algeria



Source: Prepared by the researcher based on several sources

Algeria innovation policy must be influenced by the commercial innovation philosophy that is primarily the specialized of the private sector, supported by universities and government laboratories, not directed by the government itself. Under this perspective, the primary role of the government is to facilitate the interactions of these organizations.

While the governments must take a more explicit role in development of innovation policy, such as defense and security, foreign policy, budget deficits, taxing, healthcare, and social security.

The legal and governing framework of the Algeria must be inclining towards innovation, and encouraging innovators to take risk, and to include the flexibility to start, and succeed at startups. At the same time, the government's effort to improve the environment for innovation, such

as upgrading systems of professional training for manufacturing, intellectual property, tax policy, and procurement. (Philip Shapira, 2010)

4. Conclusion:

In this research paper, we tried to shed light on the concept of the national innovation system, which is still not widely known in developing countries, and which is of great importance to achieving economic growth because it will localize and spread technology and this factor is vital in light of the increasing competition between companies and countries. And countries those that have a good level of innovation are those that have production that achieves a high added value.

We have touched upon the reality of innovation in Algeria in the light of the international reports on innovation and competitiveness, which show that Algeria lags behind in positioning innovation, poor innovation inputs and outputs, due to feeble policies and the absence of a clear vision and plan.

However, all efforts made in Algeria remain useless until now. This is due to several factors, including what is related to public policies and the method of administration, including what is related to industry and the nature of the market, which depends profoundly on imports for most of the industry inputs without the existence of strategic contracts for technology transfer. There are other obstacles with regard to research, as research in Algeria is mostly in universities and remains in libraries, while the orientation is supposed to be towards research in factories and orientation to find solutions to national problems through research. All these problems and others affected innovation in Algeria.

So, Through this research paper, we tried to shed light on the national innovation system as a solution to this problem, and we proposed a model that could help as a start in developing a general perception, as this system includes other systems under it, namely the political system, the industrial system, the education and research system, the intermediaries like the incubators and other environments Technological and all these systems must interact with each other and have links between them and all work under one plan and goals.

Indeed, For this system to succeed, a supportive infrastructure must be available and on the it provides stable and clear laws for the market, labor, taxes and others, and this system works according to market requirements.

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