

***The role of technological poles in knowledge production:
Sidi Abdellah technological pole as a model in Algeria***

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Abstract: *This research paper aims to shed light on the role of technological poles in knowledge production, by studying the Sidi Abdellah technological pole and its role in knowledge production in Algeria. The components of technological poles and their importance in supporting scientific research and innovation were reviewed. We also focused on the role of educational and research institutions associated with this pole, in addition to local and international partnerships that contribute to enhancing knowledge production.*

We used the descriptive analytical approach to collect and analyze data from previous literature and relevant reports, with the aim of providing a clear picture of the extent of the contribution of the Sidi Abdellah technological pole to knowledge production. It was concluded that knowledge production in this pole depends mainly on higher schools that play a pivotal role in generating knowledge in addition to partnerships and research cooperation.

Keywords: *technological poles; knowledge production; Sidi Abdellah technological pole in Algeria*

Jel Classification Codes : *M13; O32*

1. Introduction:

In the era of digital technology and rapid developments, technology poles have become essential engines for driving sustainable development. They are incubators for creativity and innovation, contributing to knowledge production and driving technological development. In Algeria, the Sidi Abdellah technology pole stands out as a promising model in Algeria, as it seeks to build a diversified knowledge economy capable of competing regionally and internationally.

Knowledge production in technology poles represents a strategic investment for the future, as these poles constitute an incubator environment for creativity and innovation, leading to the development of new technologies and innovative solutions to the complex problems facing countries. It is an investment in human and knowledge capital, which in turn drives economic growth and enhances the global competitiveness of countries.

Research Problem:

Based on the above, the problem of this research paper appears:

How much does the Sidi Abdellah technology pole contribute to knowledge production in Algeria?

The following questions fall under this problem:

- What is meant by knowledge production? What are its stages?
- What is meant by technological poles and what are their components and importance?
- What are the educational and research institutions associated with the Sidi Abdellah Technology pole, and how do they contribute to knowledge production?
- What international and local partnerships and collaborations does the Sidi Abdellah Technology pole rely on to produce knowledge?
- What are the future opportunities facing the Sidi Abdellah technology pole in knowledge production?

Research Hypotheses:

- The Sidi Abdellah Technology Pole contributes to enhancing knowledge production in Algeria by providing an advanced infrastructure that supports scientific research and technological development...
- The educational and research institutions associated with the Sidi Abdellah Technology Pole play a pivotal role in developing scientific and technical knowledge through academic programmes and research projects.
- The local and international partnerships of the Sidi Abdellah Technology Pole enhance its ability to produce knowledge, through the exchange of expertise and cooperation in joint research projects.
- The Sidi Abdellah Technology Pole offers great future opportunities for knowledge production in Algeria, by hosting start-ups and providing support for innovative projects.
- The knowledge production process in the Sidi Abdellah technology Pole faces challenges related to funding scientific research and infrastructure, but supportive government policies may help overcome these challenges.

Research objectives:

- Study the concept of knowledge production, explaining what is meant by knowledge production, its various stages, and its role in the development of scientific societies.
- Determining the importance of technological poles: studying the concept of technological poles, their components, and their importance in supporting scientific research. And innovation in modern societies.
- Studying the role of the Sidi Abdellah Technology Pole in producing knowledge through the institutions associated with it, and the partnerships it relies on to promote scientific research and innovation.
- . Anticipating future opportunities: Analysis of future opportunities and challenges that may face the Sidi Abdellah Technology Pole in enhancing its role as a source of knowledge production in Algeria.

Research methodology:

The aim of answering the main question and research hypotheses was to rely on the descriptive analytical approach, where data will be collected and analyzed by studying previous literature, government reports, and scientific articles related to the Sidi Abdellah Technology pole and knowledge production in Algeria. The focus will be on analyzing the role of the technology pole in supporting scientific research and innovation by reviewing its components, partnerships, and most important achievements. The descriptive approach will also be used to provide a comprehensive picture of the current status of the technology pole, while evaluating the opportunities and challenges it faces in the future.

2 . Knowledge production:

Knowledge production is an ongoing process that aims to develop new ideas and concepts and enhance our understanding of the world around us. Knowledge is one of the most important drivers of progress in various fields, whether scientific, technological, social, or economic. It enables individuals and societies to

Solving complex problems, making the right decisions, and fostering innovation, the importance of knowledge production is evident in its ability to improve the quality of life, develop economies, and enhance human capabilities. However, the challenges are becoming more focused on how knowledge is produced rather than simply applied.

Knowledge production is not just an accumulation of information, but a dynamic process that requires creative thinking, experimentation, collective participation and investment in scientific research through cooperation between academic, research, industrial and technological institutions. Through this integration of research and innovation, a knowledge-based economy is created that enhances competitiveness at the global level.

Knowledge production goes through three main stages knowledge generation: through the creation of new knowledge or the improvement of existing knowledge; which enhances intellectual capital knowledge sharing: which encourages knowledge exchange and contributes to the valuation of intellectual capital and knowledge application: which aims to transform acquired knowledge into practical solutions that lead to improved performance and innovation through practical application in the work environment (عیشوش، 2018، الصفحات 46-58)

2.1 Knowledge generation process:

This term refers to several other names, including: acquisition, discovery, innovation, and most of them refer in their content to the acquisition of knowledge in a different way. Innovation refers to the production of new knowledge that has not been discovered before, while discovery is the identification of the good competencies that the organization needs and the knowledge that benefits it in its management, especially the implicit knowledge latent in the human competencies working in the organization" (نجاه و قوادرية ، 2024 ، صفحة 653)

"Nonaka (1994) considers two dimensions for knowledge creation: epistemological dimension and ontological dimension. The first dimension is related to the conversion of knowledge from tacit level to explicit level, and from explicit level to the tacit level. The second dimension is related to the conversion of knowledge from individuals to groups and further to organization. Combining these two motions Nonaka gets a spiral model for knowledge creation and processing " (Bratianu, 2010, p. 194)

So Nonaka provides a profound insight into how knowledge evolves within organizations (the cognitive dimension, which refers to the transformation of knowledge between explicit knowledge that can be easily documented and transmitted and tacit knowledge that is rooted in personal experiences), showing the importance of moving intangible knowledge into usable forms, and vice versa. This transformation is essential in organizations that seek continuous innovation.

The existential dimension, which deals with the transfer of knowledge from individuals to groups, and then to the institutional level, reflects the social process that depends on the interaction between individuals and groups. This transition shows the importance of human interaction in enhancing knowledge, as individuals collaborate and share their experiences, which enhances the institution's ability to create and disseminate knowledge more widely.

Nonaka's spiral model shows that the process of knowledge production is not linear, but rather dynamic and repetitive, as knowledge goes through successive stages of transformation and interaction between individuals and groups, which contributes to improving the continuity of innovation and the comprehensive development of the organization.

2.2 Knowledge sharing process:

" Knowledge sharing is the process through which knowledge held by an individual is converted into a form that can be absorbed, understood and utilized by other individuals through networks and channels between knowledge seekers and providers .Since tacit knowledge is theory based, it is more difficult to share as compared to explicit knowledge. Notably, explicit knowledge can be transmitted in ordinary, formal, systematic language and is theory-based. Consequently, the main objective of tacit knowledge sharing is to create new knowledge. The organised and systematic process of acquiring, sustaining and renewing employees' tacit knowledge has guaranteed survival of organizations in robust economic environments. Studies suggest that effort should be directed at converting tacit knowledge into explicit knowledge through externalization to make it shareable (Oranga, 2023, p. 737)".

One of the major challenges facing knowledge sharing in organizations is the willingness of individuals to share the knowledge they have acquired or created with others. Knowledge remains undisclosed and unrecognizable to others unless the knowledge owner decides to make it available. In practice, knowledge sharing cannot be forced on individuals, but it can be encouraged and facilitated. Therefore, changing the behavior of individuals is the biggest challenge facing organizations seeking to foster a culture of knowledge sharing among their members.

“According to a survey by McKinsey, 75% of executives believe that ineffective knowledge sharing negatively impacts their organizations' productivity and innovation capabilities. This statistic underscores the critical need to investigate the specific organizational factors that facilitate or hinder knowledge sharing practices within MNCs” (Maina, 2024, p. 18)

2.3 Knowledge application process:

The concept of knowledge application process refers to transforming acquired knowledge into practical practices that contribute to improving performance and decision-making within the organization. After generating and sharing knowledge, comes the application stage where this knowledge is used to solve problems, innovate new products or services, and achieve the strategic goals of the organization.

Knowledge application requires the ability of individuals or teams to leverage available knowledge and adapt it to different contexts within the organization. This involves integrating explicit (codified) knowledge with tacit knowledge (acquired from personal experience), and transforming theoretical ideas into practical actions whose impact on performance can be measured.

One of the most significant challenges in the knowledge application process is ensuring that individuals are able to understand and use knowledge effectively, as well as having an organizational environment that encourages continuous learning and application of new ideas.

3 Knowledge production: the pillar of research and innovation

Knowledge production is a dynamic process in which research and innovation interact in an integrated manner. Research provides a knowledge base that can be applied in innovation to develop new and effective solutions. This connection can be explained through several points:

- **Research as a source of knowledge production:** Scientific research is the fundamental process through which new concepts and ideas are explored and developed. Through research, scientists and thinkers collect information, analyze data, and test hypotheses to expand the knowledge base in various fields such as natural sciences, engineering, medicine, and social sciences. This knowledge production resulting from research represents the foundation upon which innovation is built.
- **Innovation as an application of knowledge production:** Innovation relies on knowledge produced from research to transform theoretical ideas into practical applications. By using research results and acquired knowledge, new products, technologies, and services are developed that improve people's lives and drive economic development. Without knowledge production through research, innovation becomes limited in its ability to provide effective solutions to current challenges.

- **Integration between research and innovation:** The process of knowledge production is not limited to the academic field only, but also includes industrial and commercial environments that benefit from the results of research to develop innovative ideas. This integration between research and innovation enhances the process of knowledge production and contributes to achieving sustainable progress.

4 Theoretical framework of technological poles:

Previous literature has proposed different names for technological poles such as clusters and industrial groups, science parks, technical poles, research parks, technical or scientific parks, technical city, scientific city, and competitive poles.... The similarity between these terms is very great, especially in terms of tasks and functions, but the difference is in the specialization of each in a specific and different field. In this article, we will rely on the term technological poles to refer to these names.

4.1 Definition of technological poles:

In his book "The Competitive Advantage of Nations" (1990), Michael Porter talked about the concept of industrial clusters, which refers to the gathering of companies and institutions in a specific industrial sector in a specific geographical area. Porter considered that the existence of these clusters gives the companies and institutions participating in them a distinct competitive advantage, due to many accumulated factors such as the availability of special skills, appropriate infrastructure, interaction and cooperation between companies, and the presence of a local value chain.

Porter also pointed out that industrial clusters contribute to enhancing innovation and technological development, as knowledge and expertise are exchanged between companies located in these clusters, which enhances their ability to adapt to changes in the market and improve their products and operations.

"The International Association of Science Parks (IASP) defines technology parks (PTs) as organizations that include companies, universities and research centers (staffed by experts who carry out key tasks including (1) facilitating the creation and growth of companies (2) promoting a culture of innovation and knowledge-based competitiveness (3) stimulating and managing the transfer of knowledge and technology between stakeholders, and finally (4) providing high-quality services, spaces and equipment, in addition to business incubators" (CHEBIL, Boualem , & Karim, 2018, p. 278)

Through the above, it is possible to crystallize an operational definition of technology poles as "a concept that refers to a specialized technology city or region that brings together companies, technology and research institutions, universities, and technology centers in one place that aims to encourage modern technology and innovation and provide a suitable environment for companies to develop research and development, exchange knowledge, and cooperate between different industrial sectors.

4.2 Objectives of establishing technology poles:

Technology poles are a growing phenomenon in many countries and play an important role in developing the technology sector and attracting foreign direct investment. The goals and stakes associated with these poles are:

- Developing highly qualified human resources necessary for technological innovation by developing skills and raising the efficiency of the workforce, students and graduates in the fields of technology.
- . Enhancing economic competitiveness Achieving improved economic competitiveness by providing an environment conducive to innovation and enterprise development.
- Attracting foreign direct investment: The poles work to attract foreign companies by providing advanced infrastructure and tax incentives, which may contribute to providing new job opportunities in related sectors such as technology and research and development.
- Developing the technology sector: The poles seek to develop the technology sector by providing advanced technological facilities and encouraging research and innovation.
- Improving infrastructure and services Providing more structures, such as incubators, accelerators, scientific clubs and cultural structures, in addition to improving internet networks.
- . Enhancing Public-Private Cooperation Poles are a meeting point between government agencies and private companies to enhance cooperation and develop innovation.
- Attracting economic institutions: whose activities depend on research, development, technological innovation, and establishing innovative institutions by valuing research results.
- Shifting to a knowledge economy strategy: Establishing technology poles is an essential part of the shift strategies towards
- Knowledge economy, which works to enhance the role of innovation and technology as a major driver of economic and social development.
- . Promoting education and scientific research: Technology poles provide an advanced educational infrastructure equipped with information and communication technology, which makes it easier for students to follow courses remotely and participate in educational activities thanks to the use of modern technologies and the keenness to value research results and harness them to serve economic development.
- Providing an environment for creativity and innovation that encourages creativity and innovation by providing a modern environment equipped with the latest technologies, which contributes to the development of the technology sector to provide new solutions to various challenges.

4.3 Components of technological poles:

Technology poles are a vital model in the global innovation landscape, bringing together human and technical resources to drive countries' technological development. Understanding the success and sustainability of these poles requires studying their key components that contribute to achieving their strategic goals. "There are three main components that characterize technology poles:

- **Structured**, by hosting companies in high quality spaces and facilities.
- **Productivity**, by facilitating the growth of innovative companies through incubators.
- **Scientific**, by stimulating the transfer of knowledge between universities, research institutions and companies.

In addition to the mix of these actors, several factors inherent in the creation of a technology pole are highlighted, such as tax or financial incentives, the availability of land, the presence of a good telecommunications and communication network, and a local labor market characterized by a high mobility of qualified workers. However, given the primary mission of a technology pole to

facilitate the production of new knowledge and support innovation within the hosted companies“ (Berthinier-Poncet, 2014, pp. 95-96).

These characteristics do not necessarily constitute key success factors. through this combination of the pole, you conclude that a technology pole that does not provide innovation and technology support services is not considered a real technology pole, but rather a commercial or service complex only, and from this the components of the technology pole can be limited to two elements essentials:

- **A high-quality activity park;** that aims to accommodate universities, R&D laboratories, start-ups as well as business incubators and service companies.
- **Support services for technological research, development and innovation:** These services include providing technical and advisory support to institutions located within the technology poles. A specialized team manages and activates operations within the pole, acting as an intermediary between institutions and service providers such as universities, research centers and laboratories. This team aims to enhance cooperation and build strategic partnerships that contribute to innovation and achieving common goals (IDATE, Technopolis, & OTranche, 2013, pp. 7-8).

With these components and services, the technology pole becomes an integrated environment that supports innovation and contributes to technological development.

4.4 Interaction within the technology pole:

The interaction within the technology pole is a complex and multifaceted phenomenon, which includes interactions between the various actors within this field, as follows:

- **Startups and Innovators:** They play a major role in the tech pole, producing and developing new technology. These companies interact with each other through cooperation and competition, and aim to achieve excellence in their field.
- **Educational and research institutions:** Universities and research centers play a pivotal role in producing the knowledge and skills needed for innovation.
- **Investors:** Investors provide the capital needed by technology companies to finance their projects and activities. Investors interact with technology companies to evaluate investment opportunities, and determine the expected risks and returns.

The forms of interaction within the technology pole vary, and include:

- **Research Collaboration:** Educational institutions collaborate with companies to conduct research, develop new technology and transfer their research results to companies for application.
- **Competition:** Companies compete to attract users and investors by offering the best products and services.
- **Training and Education:** Educational institutions provide training programs that meet companies' needs for technological skills.
- **Innovation:** The interaction between the various actors within the technology pole encourages innovation, as ideas are exchanged and new solutions to problems are developed.

4.5 The economic importance of technological poles:

As one of the most important economic drivers in the modern era, playing a vital role in promoting economic growth and innovation, we will explain the economic importance of technology poles from an economic perspective:

- Enhancing innovation and productivity: It provides an integrated environment that combines scientific research and industry, which contributes to accelerating the pace of innovation, which enhances productivity by adopting new technologies and improving industrial processes.
- Developing human capital: Attracting highly qualified individuals, which contributes to building a strong knowledge base through continuous training and knowledge exchange between universities, research institutions and companies.
- Facilitating technology transfer: They act as technology transfer centers, where scientific research is transformed into industrial and commercial products. This contributes to reducing the gap between scientific innovation and practical application, which has a positive impact on the economy.
- Stimulating investment: Thanks to advanced infrastructure and government support, technology poles attract local and foreign investment. This creates new jobs and boosts local economic growth.
- Sustainable Development: Focuses on innovations that promote environmental and social sustainability. This includes developing renewable energy technologies and environmental solutions that contribute to the conservation of natural resources.
- Supporting startups and small projects: Providing a supportive environment for startups and small projects through business incubators and accelerators. This enhances the growth of these companies and helps them overcome financial and technical challenges.
- Enhancing competitiveness: It contributes to raising the level of competitiveness of the economy by developing innovative products and services. This enhances the competitiveness of local companies at the international level.

Through these factors, it becomes clear that technology poles are not just industrial clusters, but rather comprehensive economic engines that promote innovation, create jobs, and support sustainable growth.

5 The relationship between knowledge and innovation through the technology poles strategy:

Technology poles transform theoretical knowledge into innovative practical applications. They bring together universities, research centers, companies and innovators in a unified environment, which contributes to accelerating the production of knowledge and its transfer to industrial and commercial innovation. This strategy is based on integrating academic knowledge with practical experiences to develop new technologies and solutions that enhance the competitiveness of institutions.

5.1 The role of knowledge:

Knowledge is the central element of this strategy, as it is the main driver of the innovation process. Knowledge is produced within technology poles through academic research, applied studies, and collaborative projects between different actors. This knowledge is divided into two main types: **tacit knowledge**, which is embodied in the personal experiences and skills stored in the minds of individuals, and **explicit knowledge**, which can be easily documented and transferred. After transforming knowledge from tacit to explicit form, and vice versa, it is a key factor in driving the wheel of innovation within technology poles.

5.2 The role of innovation:

Innovation is a direct result of the application of acquired knowledge, where theoretical ideas are transformed into new products and services through research and development. Technology poles provide the ideal environment for applying knowledge and generating innovation by providing resources, laboratories and networks that support collaboration.

5.3 The role of the environment within the pole in strengthening the relationship between knowledge and innovation:

The environment plays a crucial role in the success of the technology poles strategy, as it provides the appropriate climate for the exchange of knowledge and innovation. The environment in the technology poles is characterized by the following:

- **Effective collaboration:** The environment enables interaction between different actors, which enhances the exchange of ideas and experiences and stimulates the production of innovation.
- **Geographic proximity:** Firms choose their locations to best take advantage of technological externalities that stimulate knowledge-producing functions through multiple interactions and information exchange.
- **Infrastructure** Poles provide research and development facilities, such as laboratories and innovation centres, that help apply theoretical ideas and turn them into practical solutions.
- **Cognitive diversity:** The presence of a diverse group of actors from multiple fields enriches the environment and enhances opportunities for creativity and innovation.

Technology poles thus form a link between knowledge and innovation, providing an environment conducive to knowledge exchange and application in order to achieve innovation. The collaborative and supportive environment in technology poles contributes significantly to accelerating the transformation of knowledge into innovative solutions, which positively impacts competitiveness and the local economy.

6 Technology Poles Strategy in Algeria: Towards Promoting Innovation and Technological Progress

Technology poles are considered as driving factors for economic growth and innovation in many countries. By establishing these poles, Algeria seeks to strengthen its position in the digital economy and encourage entrepreneurship and innovation. This research aims to analyze the legal and institutional framework governing technology poles in Algeria, identify strengths and weaknesses, and propose the necessary amendments to enhance the performance of these poles.

6.1 Legal framework:

According to Article 06 of Algerian Law No. 15-21 issued on December 30, 2015, which includes the guiding law for scientific research and technological development, the technological pole is defined as the site that includes innovative institutions and education and research structures in various technological fields.

This text is one of the few texts that dealt with the legal and regulatory framework for technology poles, highlighting the urgent need to develop an integrated legal arsenal that regulates these poles and defines the tasks and powers of the bodies concerned with them. This definition clarifies the importance of having an integrated infrastructure that combines education, scientific

research, and the industrial sector in specific locations that contribute to stimulating economic development and improving technological competitiveness.

To achieve the objectives of technological poles, the Algerian legislator must establish a comprehensive legal framework covering the various aspects of the work of these poles, including the following:

- **Institutional organization:** The roles and powers of the bodies supervising the poles, whether governmental or private, must be defined. This includes establishing laws that regulate cooperation between universities, research centers, and technology companies.
- **Conditions for establishment and operation:** Clear criteria should be established for establishing and managing technology poles, in line with national objectives in the field of research and innovation.
- **Encouragement and motivation:** Legislation should include tax incentives and exemptions for start-ups and companies based in these poles, to enhance their attractiveness to local and foreign investment.
- **Quality and innovation guarantees:** Establishing monitoring and evaluation mechanisms to ensure that institutions adhere to the innovation and quality standards required in their products and her research.

6.2 Institutional framework of technology poles:

The institutional framework is an essential part of the success of technological poles in Algeria, as it includes a group of bodies and agencies that support the creation and development of these poles and contribute to strengthening the technological environment and innovation. At the forefront of these bodies is the National Agency for the Promotion and Development of Technological Parks (ANPT), which is a public institution of an industrial and commercial nature, created in 2004 under the supervision of the Ministry of Post and Information and Communication Technologies. Its headquarters are located in the new city of Sidi Abdellah. The agency works to create a national ecosystem that enables the development and growth of economic activity in the ICT sector, with the aim of ensuring effective participation in the national economy.

The Agency plays a role in promoting the further penetration of technology into Algerian society. Its mission is to validate, apply and disseminate the tools, mechanisms and skills necessary to develop a national ecosystem suitable for the expansion of the ICT industry and digitization to serve the various economic sectors in Algeria. Its main mission is to develop and design elements of a national strategy related to the promotion and development of technological poles, in addition to designing and implementing them to enhance national capacities in the field of ICT.

One of the strategic objectives of the agency is for the technological poles to eventually form "the nerve centers" of a national network of scientific and technological research capable of meeting the requirements of upgrading and excellence of the industrial fabric, as well as meeting the needs of developing high value-added services for the intangible economy, a major challenge of the twenty-first century. The National Agency for the Promotion and Development of Technological Poles seeks to be a leader in the field of information and communication technology, contributing to supporting start-ups and providing an environment conducive to the growth of companies and cooperation between the various actors in the sector. The table below shows comprehensive information on the technological poles in Algeria, the number of start-ups and tenant companies, in addition to the events organized to support the innovation environment. It is worth noting that the Sidi Abdellah technological pole is considered the most effective pole and has proven its success in

stimulating technological activity and its strong start in this field (L'Agence Nationale de Promotion et de Développement des Parcs Technologiques)

Table (1) : Technological poles in Algeria

Events	Rented companies	Projects/start-ups	Technology Poles / Incubators
200+	45+	800+	7

The source :(Pôle Technologique Algérien)

Data shows that Algeria is one of the countries seeking to adopt the technology poles strategy, as it has established 7 poles and incubators for more than 800 start-up projects and 45 tenant companies, with the organization of 200 events, noting that the Sidi Abdellah technology pole is considered the most prominent among them, as it has proven its success and effectiveness in stimulating technological activity and supporting entrepreneurship. We can point out the most important poles that Algeria seeks to activate and enhance their role:

– **Technology pole of Oran:**

In the municipality of Bir El Djir, 10 km from the headquarters of the Wilaya of Oran and 24 km from the industrial zone, and 13 km from the airport of Es Senia. The pole is characterized by strong commercial and service relations, developed thanks to the road axes National Road No. 11 and the Wilaya Road CW75, which facilitate access to the industrial zone of Arzew. The area allocated for the creation of the technology park is 32 hectares and includes an incubator created in collaboration with the National Institute of Posts and Information and Communication Technologies of Oran, following the agreement signed on April 14, 2016 at the Sidi Abdellah pole: it has been operating since 2018 and currently hosts 25 entrepreneurs.

– **.Technological pole of Ouargla:**

Spread over an area of 10 hectares, it will play a crucial role due to its location in the southern region of the country creating a favorable climate for investment at both the national and international levels. The project architecture has been adapted to the harsh climate of the region.

– **Technological Pole of Annaba:**

Located in the city of Sidi Amar, 11 km from the capital of Annaba, 2.5 km from the municipality of El Hadjar and 8 km from Annaba airport to the west, its area is 16 hectares.

– **.Technological pole of Bordj Bou Arreridj:**

Located in the industrial area of Bordj Bou Arreridj with a balanced economic fabric and strong growth in the industrial and digital sectors, it contains training rooms, meeting rooms, exhibition spaces, a reception hall, converted offices dedicated to hosting start-ups, industrial companies or players in the national economy.

These are considered the most important poles that Algeria seeks to push and work on upgrading. In the following, we will try to focus on the Sidi Abdellah technological pole under study, which is considered one of the main technological poles in Algeria, and which is distinguished by being in a phase of effective activity and exploitation, compared to the rest of the technological poles in the country.

7 Knowledge production in the technological pole of Sidi Abdellah, Algeria:

Technology poles in Algeria constitute one of the challenges of the country's economic development, which is still in the process of establishment and maturity. Their goal is to enhance research, development and innovation in various technical fields, by creating integrated environments that bring together universities, research centers and specialized companies. Algeria seeks to work to achieve a qualitative leap in its competitive capabilities on the global stage, and to direct its economy towards more diversity and sustainability.

7.1 Introduction to the Sidi Abdellah Technological Pole

The feasibility study for the Sidi Abdellah Technological Pole project was conducted in 2002, covering an area of 100 hectares. It was realized and launched in 2021, built in accordance with international standards. This pole serves as a vital Pole for hosting information and communication technology (ICT) companies. Located on the heights of the new city of Sidi Abdellah, it offers a serene and beautiful environment, enhanced by green spaces and stunning views of the Zeralda coastline to the north, the Mitidja plains, and the Chr  a mountain range to the south. It features advanced infrastructure and a high-quality environment, enabling it to meet the demands of highly efficient companies at competitive costs.

Higher Schools:

The pole hosts several prestigious schools, including:

- The National Higher School of Cybersecurity,
- The National Higher School of Autonomous Systems,
- The National Higher School of Nanoscience and Nanotechnology,
- The National Higher School of Artificial Intelligence,
- The National Higher School of Mathematics.

This national technological Pole is designed to accommodate 20,000 university students in scientific and technical fields.

Incubators:

The incubator spans an area of 9,800 square meters and is dedicated to supporting project holders from the idea stage to the creation of startups. This is achieved through a comprehensive support program that provides workspaces, training, events, and product development. A consultative committee selects projects, and the National Agency for the Promotion and Development of Technological Parks (ANPT) offers free services to assist project leaders and startups throughout the process of developing their products and businesses. This process, averaging four years, follows five main phases:

- **Pre-incubation:** Lasting three months, focusing on awareness, orientation, and initial project support.
- **Incubation:** A nine-month phase providing advice, training, and personalized mentorship.
- **Post-incubation:** Spanning 18 months, aimed at expanding networks and advancing the project.
- **Startup:** Lasting 24 months, dedicated to implementing the project and introducing the product to the market.
- **Acceleration:** Designed to speed up the project's growth through intensive programs.

Multipurpose Spaces:

The technological pole includes a futuristic building comprising two towers (a business center and a corporate hotel) connected by a large lobby. The total rentable area exceeds 19,739 square

menters, catering to both startups and larger companies operating in the ICT sector. This pole stands as the ideal accommodation structure in Algeria, thanks to its technological advantages and a distinctive environment that fosters exchanges and collaboration in entrepreneurship.

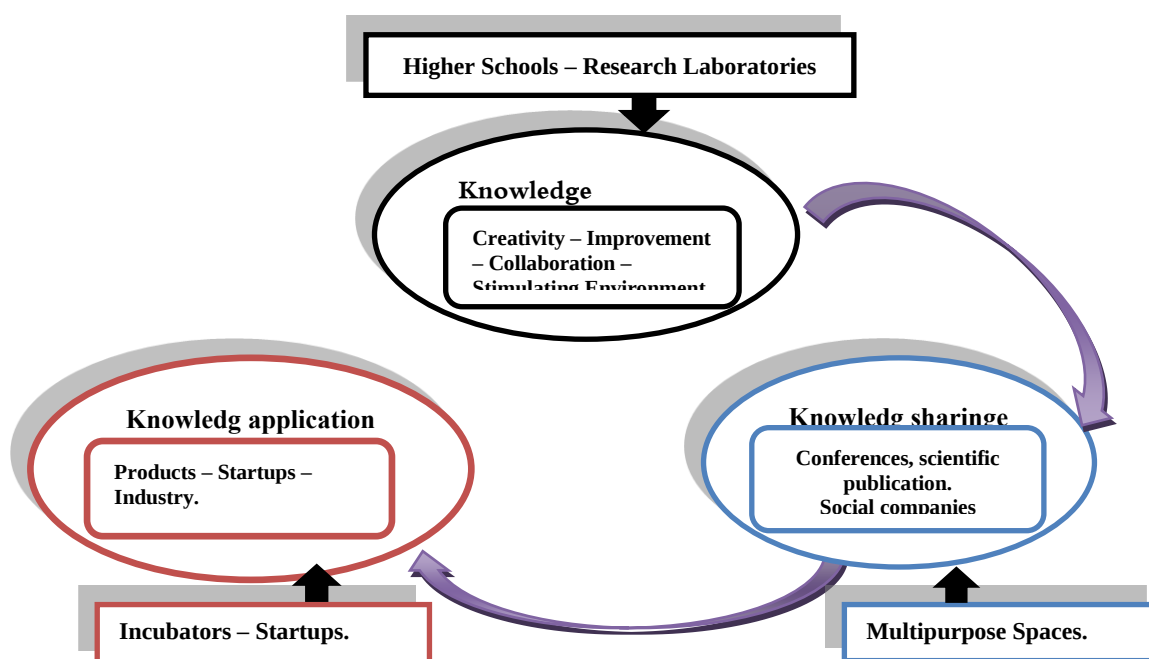
Centers of Excellence:

The pole also features two training and excellence centers, established through partnerships between the ANPT and companies such as Huawei and ZTE.

7.3 Knowledge production in the Sidi Abdellah Technological Pole, Algeria

The Sidi Abdellah Technology Pole is an environment that nurtures creativity and innovation, and is considered an ideal model in Algeria for knowledge production and its application, as shown in the figure below, and is according to the following three stages:

Figure (1): Knowledge production in the Sidi Abdellah Technological Pole, Algeria



The source: Prepared by researchers

- **The first stage: generating knowledge:**

Since the university is the main institution that contributes to the production and continuous development of knowledge, thanks to the diversity of specializations, methods and scientific opinions, the higher schools created in the Sidi Abdellah Technological Pole are a fundamental pillar in the process of generating knowledge and developing innovation in Algeria. Each of these schools plays a specific role in this framework, thanks to the high specializations it offers and the advanced research programs it implements. .

- **National Higher School of Cybersecurity:** This school contributes significantly to protecting the country's digital infrastructure from cyber-attacks through research and development in this field, it works to develop new technologies to detect and protect security vulnerabilities. It also

works to qualify national cadres capable of facing the increasing challenges in the field of cybersecurity.

- **National Higher School of Autonomous Systems:** This school is interested in studying and developing autonomous systems, such as drones and robots. The research conducted by this school contributes to the development of new industries in Algeria, such as the aeronautics and robotics industries.

- **National Higher School of Nanoscience and Nanotechnology:** This school focuses on the study of materials at the atomic and molecular level, and the development of new applications for these materials in various fields, such as medicine and energy. The research it conducts contributes to the development of future industries, and to strengthening Algeria's position in the field of advanced technology.

- **National Higher School of Artificial Intelligence** This school is concerned with developing artificial intelligence technologies and their applications in various fields, such as medicine, education and industry. Research related to it contributes to improving production efficiency and providing innovative solutions to complex problems

- **National Higher School of Mathematics:** Mathematics plays a fundamental role in all scientific and technological fields. This school contributes to develop mathematical models necessary to understand natural phenomena and develop technological applications.

The process of generating knowledge at this stage is through:

- **Creativity:** Encouraging researchers and students to think outside the box and develop new ideas in various technological fields.

- **Improvement:** Working to improve existing knowledge and techniques, through conducting in-depth research and studies.

- **Cooperation:** Encouraging cooperation between researchers and institutions from different disciplines, which contributes to generating integrated ideas (signing a framework partnership agreement between the Ministry of Higher Education and Scientific Research (MESRS) and Huawei Algeria Telecommunications Company with the aim of supporting and enhancing training and research in the ICT sector, signing a framework partnership agreement with the National Agency for the Valorization of Research and Technological Development Results (ANVREDET) with the aim of exchanging knowledge and technical and scientific skills between the two parties, as well as studying joint projects that could be the subject of economic evaluation, signing a framework partnership agreement between the Ministry of Higher Education and Scientific Research (MESRS) and the National Company for Research, Production, Transport, Transformation and Marketing of Hydrocarbons Sonatrach, and an agreement between Northwest Normal University, China and the National School of Artificial Intelligence with the aim of developing collaborative educational and research activities. The agreed initiatives include organizing joint academic and methodological activities, exchanging doctoral students, implementing joint research projects, and mutual recognition of academic degrees to enhance cooperation Scientific and improving educational and research outcomes. As well as an agreement between the National School of Artificial Intelligence and the National Electricity and Gas Company (Sonelgaz) to establish and manage a business incubator within the school dedicated to sponsoring and supporting innovative projects).

- **Stimulating environment:** The pole provides an inspiring work environment. Equipped with the latest technologies and devices, which encourages creativity and innovation.

- **The second stage: knowledge sharing:**

At this stage, several mechanisms for knowledge sharing are applied within the pole, through:

- **Seminars and conferences:** Organizing scientific events to exchange experiences and knowledge between researchers and engineers. EDUCTECK Exhibition for Education, Vocational Training, Higher Education and Knowledge Technologies.
- **Scientific publishing:** Encouraging researchers and students to publish their research and studies in peer-reviewed scientific journals.
- **International cooperation:** Building partnerships with international research institutions to exchange knowledge and expertise (cooperation between the National Higher School of Artificial Intelligence with the University of Notre Dame (USA), the Center for the Development of Advanced Technologies (CDTA), and the National School of Mathematics (ENSMath) to create a research center at the Sidi Abdellah University Pole).
- **Social Networking:** Using social media platforms to spread knowledge and interact with the scientific community.

- **The third stage: applying knowledge:**

The most important stage is the stage of applying knowledge, which represents the essence of the work of technological poles at this stage. The process of producing knowledge is not limited to books and articles, but rather it is transformed into tangible products and services that contribute to the development of society as follows:

- **Transforming research into products:** Working on transforming research findings into marketable products and services.
- **Startup Creation:** Support the creation of technology-based startups According to the Global Startup Ecosystem Index 2024, Algiers ranked 502nd globally among the top 600 cities for startup ecosystems. Algiers is one of seven cities from unranked countries that appeared in this global ranking. The city has shown positive momentum in this year's rankings, reflecting notable development and improvement in its startup ecosystem (StartupBlink, 2024, p. 303).
- **Cooperation with the industrial sector:** Building partnerships with industrial companies to implement technological solutions in production

7.4 Future challenges and opportunities to enhance the role of the Sidi Abdellah Technology Pole in developing knowledge and technology:

Despite the efforts made to establish schools in the pole and develop the educational infrastructure, the research environment associated with these institutions has not yet reached the full level of maturity required despite the availability of all available resources. The Sidi Abdellah Technology Pole in Algeria is facing several challenges, the most prominent of which are:

- **Funding scientific research:** after the lack of funding is one of the most prominent challenges that hinder the production of knowledge, as research projects need sustainable financial resources to support advanced research and technological development.
- **Infrastructure:** Despite the efforts made, the pole faces a lack of advanced infrastructure required by research centers and startups to operate efficiently and develop innovative technological products.
- **Providing human resources:** Lack of local expertise specialized in advanced technology fields, which limits the pole's capacity to produce advanced knowledge

– **Limited international cooperation:** The lack of sufficient partnerships with international research centres and universities limits the flow of new knowledge and technology to the pole.

Despite these challenges, the Sidi Abdellah Technology Pole represents the cornerstone for the development of knowledge and technology in Algeria, and opens up broad horizons for growth and development by exploiting the following future opportunities:

– **Benefiting from international agreements :** The pole can benefit from partnerships with major international institutions such as Stanford University and the University of California, Berkeley in Silicon Valley, which is one of the most famous technology centers in the world, to enhance knowledge and technological exchange.

– **Developing the startup ecosystem :** Working to develop and upgrade an incubator environment for startups in the fields of advanced technology, such as artificial intelligence and secondary technology, especially with the presence of specialized graduate schools, which contributes to transforming research into commercial products and enhancing economic growth.

– **Supporting local innovation :** Enhancing support for local innovation by providing more support to innovative researchers and students, and encouraging them to develop technological solutions to local problems, thus contributing to the sustainable development of Algeria.

– **Utilizing natural resources:** Exploiting the country's natural resources such as solar energy and natural gas in advanced research projects, contributing to the development of future clean energy technological solutions.

– **By promoting technological education through specialized higher schools,** the pole helps to become a major center for advanced technology education, contributing to the qualification of future generations of engineers and scientists capable of leading technological development in Algeria and abroad.

– **Encouraging applied research:** Increasing focus on applied research that meets the needs of the local and international market will contribute to transforming knowledge into marketable products and services. thus increasing opportunities for growth and innovation

The challenges faced by the Sidi Abdellah technological pole are considered opportunities for its development and strengthening. By supporting local and international innovation, developing the startup ecosystem, and benefiting from international partnerships, the pole can thrive.

7.5 The importance of knowledge production in the Sidi Abdellah technology pole:

The production of knowledge in this pole is of great importance, as represented by the following points:

– **Enhancing competitiveness:** The research and innovations produced in the technology pole contribute to raising the country's competitiveness. Regionally and internationally, through developing new products and services with added value.

– **Diversifying the economy:** The technology pole contributes to diversifying sources of national income by creating new knowledge-based industries. and technology.

– **Solving local problems:** Much of the research in the tech pole is directed at solving problems facing society, such as water shortages, energy, and food security.

– **Creating job opportunities:** Research and innovation projects contribute to creating new job opportunities for qualified youth, which contributes to reducing the slump.

– **Attracting investments:** The technology pole attracts foreign direct investments, which contributes to the transfer of technology and knowledge to Algeria.

- **Infrastructure development:** Research and development in the technological field requires an advanced infrastructure, which contributes to the development of the country's infrastructure.
- **Strengthening the country's position:** The technology pole contributes to strengthening the country's position as a regional center for innovation and technology.
- **Economic development:** It contributes to diversifying the economy and increasing Algeria's competitiveness.
- **Improving the living conditions of citizens:** It contributes to improving the quality of life of citizens by providing better services.
- **Strengthening Algeria's global position:** Making Algeria a regional center for innovation and technology.

8 Analysis of results:

Our review of knowledge production in the Sidi Abdellah technological pole shows that this pole relies mainly on specialized educational institutions such as higher schools that play a pivotal role in generating knowledge. The focus on schools such as the National Higher School of Cybersecurity, Artificial Intelligence and Nanoscience reflects the efforts made to link knowledge to practical application, which essentially contributes to achieving technological innovation. These schools encourage creativity, improvement and cooperation, which contributes to building a stimulating educational and practical environment. In addition, cooperation and strategic partnerships between the Technopolis and local and international entities such as Huawei, Sonatrach, and international universities. This cooperation not only contributes to the exchange of knowledge, but also to strengthening local capabilities in information technology. These partnerships are a pivotal element in increasing the quality of research and expanding the scope of knowledge production, which goes through three stages: knowledge generation, knowledge sharing, and its application, which is considered an organizational sequence that contributes to transforming theoretical research into practical applications, thus enhancing the knowledge economy by organizing scientific publishing seminars and international cooperation, which are effective tools for disseminating knowledge, taking advantage of available resources, supporting start-ups, and promoting technological education. These elements contribute significantly to enhancing innovation and achieving sustainable development, however, work must be done to overcome challenges related to infrastructure and international cooperation to ensure continued success.

Finally, this study showed that the Sidi Abdellah technological pole has broad impacts on the national economy, including diversifying sources of income, enhancing competitiveness, and creating job opportunities. Attracting foreign investment and developing infrastructure are important points in strengthening Algeria's position as a regional center for innovation.

9 Conclusion:

This study concluded that the Sidi Abdellah technological pole represents a cornerstone in supporting the transition towards a knowledge economy in Algeria by promoting scientific research and technological innovation. This pole contributes to developing advanced solutions to local and international challenges, thus placing Algeria on the global technology map. Specialized higher schools play a pivotal role in generating, disseminating and applying knowledge, supported by local and international strategic partnerships, which opens up broad horizons for the development of technological industries and enhancing competitiveness nationalism

The great importance of this pole lies in its vital role in facing local challenges such as diversifying the economy, creating opportunities, work and achieve sustainable development. With increasing investments in this sector, it becomes necessary to enhance cooperation between the various stakeholders to ensure continued success and achieve the country's strategic goals.

The continuation of this success depends on an ongoing commitment to development, knowledge production and support for the innovation environment, to enhance Algeria's position in the field of technology regionally and globally.

The Sidi Abdellah Technology pole is a pioneering model in supporting innovation and knowledge production in Algeria. It provides an integrated environment that combines scientific research and the practical application of modern technology through specialized higher schools and partnerships with local and international institutions. Advanced research is enabled and transformed into practical solutions that contribute to developing industries and creating new opportunities for start-ups.

In addition to the above, the following recommendations can be put forward:

- **Enhancing cross-sectoral collaboration** by further strengthening partnerships between universities and businesses and
- **Establishing joint research and development centers:** Developing effective mechanisms for transferring technology from universities and research centers to companies.
- **Supporting entrepreneurship and innovation:** by providing sufficient funding for start-ups and support services, while working to organize competitions and hackathons to encourage innovation and develop new ideas.
- **Infrastructure development:** Developing wired and wireless communications networks to meet the needs of the technology sector, providing shared workspaces, and updating laboratories and equipment with the latest technologies to meet the needs of advanced research.
- **Increase international cooperation:** by building international partnerships and participating in international conferences and exhibitions. And attracting foreign investments to finance research and development projects.
- **Focus on priority areas:** Identify priority areas for research and development based on national needs.

With the cooperation of all stakeholders, the Technology pole can play a vital role in driving economic and social development in Algeria and transforming it into a regional center of innovation and excellence.

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