

Vestnik MIRBIS. 2022; 3(31)': 35–40.

Вестник МИРБИС. 2022. № 3(31)'. С. 35–40.

Original article

DOI: 10.25634/MIRBIS.2022.3.3

Improving the model of integration between science and production in technological clusters in Cuba in the digital economy

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Abstract. The purpose of this article is to improve the mechanisms of integration between science and production into clusters and technoparks in Cuba in the digital economy, as well as in the development of innovative technology in order to insert the country into the world economy. The article describes the main features of the policy of development of science, technology and innovation from 1959 to the present in Cuba. The study goes through several stages, including the 90s. A common factor at all stages after the triumph of the revolution is technological transfer and economic independence in a globalized economy. The article goes on to talk about the creation of the first scientific poles in the country and linking these poles with higher education centers. The paper presents a model of integration of the science sector with industrial sectors based on the triple helix model.

Key words: technoparks, clusters, aviation, technological innovations, digitalization, digital economy.

For citation: Castello P. D. Improving the model of integration between science and production in technological clusters in Cuba in the digital economy. DOI: 10.25634/MIRBIS.2022.3.3. *Vestnik MIRBIS*. 2022; 3: 35–40.

JEL: O33

Научная статья
УДК 332 :146.2

Совершенствование модели интеграции науки и производства в технологических кластерах Кубы в условиях цифровой экономики

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Аннотация. Цель данной статьи заключается в обзоре механизмов интеграции науки и производства в кластерах и технопарках на Кубе в условиях цифровой экономики, а также развития инновационных технологий с целью встраивания страны в мировую экономику. В статье описаны основные направления политики на Кубе в области науки, технологий и инноваций с 1959 года по настоящее время. Исследование проводилось в несколько этапов, включая 90-е годы и современный период. Общим фактором на всех этапах развития Кубы после победы революции является передача технологий и экономическая независимость в глобализированной экономике. Также в статье рассказывается о создании в стране первых научных полюсов и связи этих полюсов с высшими учебными заведениями. В статье представлена модель интеграции сектора науки с отраслями промышленности на основе модели тройной спирали..

Ключевые слова: технопарки, кластеры, авиация, технологические инновации, цифровизация, цифровая экономика.

Для цитирования: Castello P. D. Improving the model of integration between science and production in technological clusters in Cuba in the digital economy. DOI: 10.25634/MIRBIS.2022.3.3z. *Vestnik MIRBIS*. 2022; 3: 35–40.

JEL: O33

1. Introduction

The intentions of the scientific, technical and technological innovation policy are to integrate the country into the global economy with greater economic diversification, greater food sustainability and environmental sustainability, and, in addition

to independence, economic and technological integration in a globalized economy and increasingly digitized economy.

The main feature of the process of science, technology and innovation from 1959 to 1990 in Cuba was the transfer of technologies obtained under preferential economic relations and established scientific ones.

Since the late 1990s, during the "special period" after the collapse of the socialist bloc and the Soviet Union, the Cuban government has been forced to replace imports and consistently change its economic model.

At this stage, the National System of Scientific and Technological Innovations (SCIT) appears as a part of Ministry of Science, Technology and Environment of Cuba (CITMA) due to the need to coordinate the entire production process at the scientific poles, working on the basis of efficiency and competitiveness, which will lead to an economy and profitable entry into the international market, closer exchange with society, the formation of cooperation networks, the comprehensive strengthening of the National Forum of Science and Technology to meet the the needs of the national economy for innovation in these years.

Progress is being made in some areas, such as the biotech industry, tourism and nickel production, but not in other sectors and institutions.

Technological innovation and the creation of new scientists integrating scientific, technological and production concepts were crucial that were developed at this stage. Although models of this type of center already existed at the international level, Cuba has adopted and modified these concepts to adapt them to its economic and social system. In the 90s, special attention was paid to the creation of Polish scientists in the field of biotechnology, and later associated with universities and other industrial centers. An example was the creation of the University of Computer Science, which improved the model of the scientific pole, turning it into a research center connecting science, technology, education and production.

Poles of scientific production

Scientific production poles was born as a result of the inevitable and necessary application of the philosophy of developing projects of scientific and technological innovations, always with a social vocation.

Since the 1980s, a direct link between research and production, with a self – financed economic cycle, has been built at the Cuban scientific poles [Hernández 2020].

The essence of her work is positively marked by coordination and integration, and although their beginning is associated with a solution that is short-term until the first half of the 1990s, today it is a hallmark of science in Cuba.

Scientific production poles are a form of organization designed to link science and the production of goods and services. United geographically or thematically by a group of organizations and institutions that connect his or her professional capabilities, finances, and infrastructure. This implies, in aggregate, the integration of the scientific community into the business system and productivity [Díaz 2021].

In Cuba, with a sense of innovation and adaptation to its peculiarities, they were introduced to the experience of scientific work from organizational forms that are more advanced in international practice, programs, projects and scientific poles.

The scientific pole is a mechanism for integrating science, technology and innovation activities, which should work systematically in coordination with the territorial Government.

Depending on the priorities identified for the development of regions, with the aim of contributing – without resorting to bureaucratic formulas-to provide specific answers to the most important problems of the economy and society related to the activities of science, technology and innovation. Create streamlined and efficient integration and interface mechanisms to facilitate the transformation of knowledge into new and / or improved products and services that have a real impact on the economy and society. Increase the efficiency of production chains and cost at the end of the research cycle, using the scientific potential of the territory and making optimal use of the material resources available to them.

Cuba has been prioritized:

- Food production.
- Science in the field of biotechnology and production of medicines and vaccines
- Rational use of natural resources (water, soil, forests).
- Activities to counteract climate change (adaptation).
- Development of energy, in particular renewable energy sources.
- Application of science in the strategy of physical planning of coastal areas.
- Activities in support of tourism development.
- Social research in the field of population, health, pedagogy and production.
- Basic and natural sciences

In Cuba, the State is the body of governance and

institutional innovation at the poles, although there are other institutions at the national and regional levels that advocate inclusivity.

Technopark in Cuba

Cuba launched its technology parks in 2020, at the height of the Covid-19 pandemic.

A science and technology park is an organization run by specialized professionals whose main goal is to increase the well-being of its community by promoting a culture of innovation and competitiveness of enterprises and institutions that generate knowledge, installed in the park or associated with it, stimulate and manage the flow of knowledge and technology between universities, research institutes, companies and markets; it encourages the creation and growth of innovative companies through incubation and centrifuge facilities, and provides other value-added services, as well as high-quality facilities and equipment¹.

The concept of a "technology park" dates back to the 1950s, the Stanford Research Park created by Stanford University in the United States, where companies such as Hewlett Packard and General Electric settled.

These institutions are characterized by the following aspects.

Maintaining official relations and interaction with universities, research centers, and other higher education institutions.

Encourage the creation and growth of high-tech companies and other high-value-added organizations belonging to the tertiary sector, usually residing in the park itself.

Have a stable management body that encourages technology transfer and encourages innovation among enterprises and organizations that use the park.

With this type, institutions seek to encourage innovation and the creation of products or services that generate high added value. Usually, a technology park is created next to a technical university to facilitate the influx of students and young professionals into technology companies. It should also be noted that the technology park is located in a location with easy access².

1 Parques científicos-tecnológicos en Cuba, el camino a la innovación, 2021. Available at: <http://www.citmatel.cu/noticias/parques-cientificos-tecnologicos-en-cuba-el-camino-la-innovacion> (accessed: 15.06.2022)

2 Parque Científico-Tecnológico de La Habana: Entorno de innovación para el desarrollo de las TIC. Available at: <http://www.cubadebate.cu/>

Subjects of scientific and technical support for research in Cuba:

- 143 research centers
- 26 scientific and technical service centers
- 60 units of development and innovation
- 4 high-tech centers
- 2 scientific and technical parks

National development programs include:

- food production and their agro-industry
- basic and natural sciences
- nanoscience and nanotechnology
- neuroscience and neurotechnology
- social sciences and humanities
- local development
- climate change adaptation and mitigation
- telecommunications and computerization of society
- comprehensive and sustainable energy development
- sugar cane agro-industry
- biotechnology, pharmaceuticals and medical technologies
- development of logistics and supply chain
- aging, longevity and health of the population
- automatic, robotic and artificial intelligence.

Park Havana, based on the University of Information Sciences (UCI) campus, has a total of 5 projects in the incubator across the entire portfolio of 53 opportunities it currently owns.

Other characteristics of the Havana Science and Technology Park are 53 business opportunities, of which:

24 identified, 5 in negotiations, 2 in project, 4 in evaluation and 18 approved. Of the partners, 38 are domestic, 4 are foreign, and 11 are non-governmental³.

Among the projects of the Havana Science and Technology Park are:

AlaSoluciones project: allows the development of unmanned vehicles with monitoring and control systems, so-called drones.

Smabit Project Smabit: Smart Home: This project is exported jointly with the German company Smabit.

EMSI Farma project: for the development and implementation of automation methods for the

<http://www.citmatel.cu/noticias/parque-cientifico-tecnologico-de-la-habana-creacion-crecimiento-y-competitividad/> (accessed: 20.06.2022)

3 Cuba: Parques Científico-Tecnológicos, desarrollo e innovación. Available at: <http://www.citmatel.cu/noticias/cuba-parques-cientificos-tecnologicos-desarrollo-e-innovacion> (accessed: 18.06.2022)

biotechnological and pharmaceutical industries. The development of the main software of the "cuban high-performance" fan was carried out jointly with COMBIOMED [Mederos 2021].

In addition, it has also created a technology park for China, which includes other economic development and manufacturing projects.

Creating an innovation ecosystem from the Havana Science and Technology Park, which contributes with solutions to government management, based on the integration of the business sector, academia and the rest of the economic actors, is one of the main goals of the institution for this 2022¹.

Model of integration between science and production at the scientific poles in the digital economy

The university-pole link is embedded in the very essence of the scientific pole concept and is part of the strategy developed for training personnel. Poles join a diverse set of scientific institutions belonging to various departments of the state. What is common is precisely its scientific nature, or it is institutions that are engaged in the production of new knowledge, the development and application of new technologies, the development of innovative products under strict production and quality control conditions. Work to meet national needs and export to countries where you have to compete with large multinational corporations, which, unlike the reality of underdeveloped countries, are able to allocate significant resources to research, production and marketing.

All this indicates the constant need to assimilate and produce knowledge, making optimal use of every investment, every resource; then exchange with universities is a vital and constant issue.

It also means that a scientific and technical culture is created, strengthened or updated among students and teachers who are connected to the pole and, through them, with other areas of study, through which you can achieve a deeper understanding of the features and benefits of producing high-tech products and specialized services of the pole.

The connection between the scientific institutions of Cuba and universities goes back to the implementation of the concept of Cuban

education, which provides for the integration of work, study and research in different proportions and with special characteristics at each stage of education and throughout life. This was part of the goal of universal education and developing the intelligence of the entire population for the benefit of the individual and society as a whole.

The goal was also to motivate learning through an understanding of their application or to show the integration of theory and practice, while at the same time it was an incentive to deep in the knowledge of teachers and specialists related to the educational process.

Universities, as institutions whose structures are formed as functional responses to various social needs and combined with research centers, play a key role in creating well-being based on innovation as a learning process, introducing new knowledge or combining existing knowledge to develop new skills, raising awareness of the determinants, characteristics and consequences of innovation and technological processes changes.

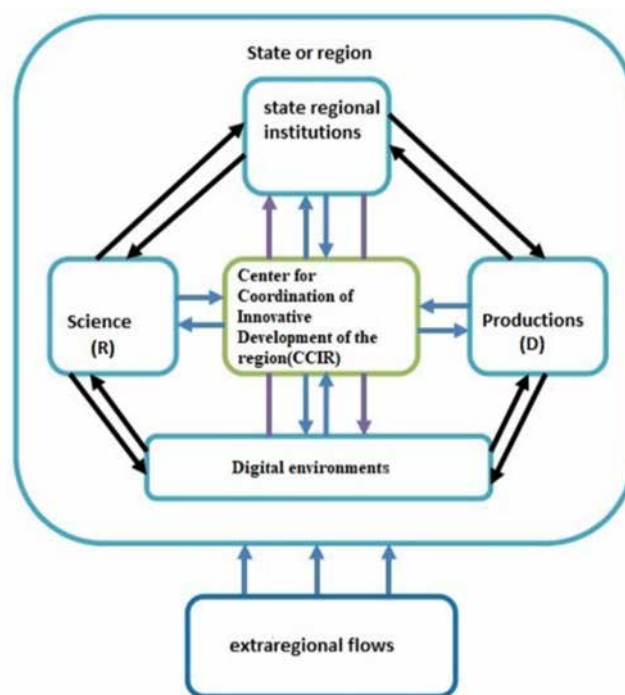


Fig. 1. Ecosystem model of regional innovations
Source [Castello 2021]

Based on the triple helix innovation model, which refers to a set of interactions between academia, industry, and governments to promote economic and social development, and which was theorized by Henry Itzkowitz and Loeth Leidesdorf in the

¹ Las oportunidades de desarrollo crecen con más de 30 proyectos. Available at: <https://www.granma.cu/cuba/2022-02-13/parque-cientifico-tecnologico-de-la-habana-innovacion-para-el-desarrollo-cientifico-del-pais> (accessed: 02.07.2022)

1990s, and further argues that interactions between universities, industry, and governments have led to new intermediary institutions, such as technology transfer offices and parks, scientists have built on the model derived by Yu. I. Seliverstov and M. V. Lyuluchenko applied technology to ecosystems and, in turn, creates a shunt [Castelló 2021] from these models applied to regional ecosystems to integrate science and production in a digital environment. The model is shown in Figure 1.

This model states that universities, research laboratories, and research centers are institutions that can combine their production activities with the model of open innovation in a digital environment, and in accordance with this principle, it is proposed to improve the integration of R & D in Cuba as part of a complete digital transformation.

Conclusions

The close connection of scientific production centers with universities is characteristic not only for Cuba, but it is also a feature and vital necessity of all industrial parks, technological belts and cities of the world of science. This can be seen, for example, in classic Silicon Valley in California, on Highway 128 in Boston, in the United States, in Sofia-Antipolis, and your growing rapprochement with the University of Nice in France and Skolkovo, Moscow, Russia, to name just a few of the examples already given.

The rate of product obsolescence is growing faster, competition is becoming more hidden in the globalized economy of operations and information

snapshot, quality requirements are becoming more stringent, and the need to solve problems that are compounding the world and affecting hundreds of millions of people is increasingly demanding scientific work in depth, more responsible, more coordinated and integrated. Cuba has a huge human potential, an infrastructure created with great effort, and a solidarity that has grown over the past forty years; it feels obligated to the Third World, which is fragmented and undeveloped, to which it is a participant, and at the same time you must learn to survive and compete in a world where the rules of trade and finance apply teaches a battle-hardened First World; you'll need all of your sanity and all of its intelligence, its main source of wealth. The university's strengths and weaknesses play a crucial role.

The need to update economic models and mechanisms is crucial for the development of the country. The methods of integration of science, technology, innovation and production need to be updated to digital environments and with an external innovation flow, and under open innovation models. For this reason, the use of this integrative model is proposed for clusters and technological ecosystems in Cuba. The need to bring this type of models to all economic spheres is vital, and the improve of the model of integration between science and production can set a precedent in the creation of a new clusters and technoparks in Cuba.

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The article was submitted 06/06/2022; approved after reviewing 06/23/2022; accepted for publication 09/20/2022.

Статья поступила в редакцию 06.06.2022; одобрена после рецензирования 23.06.2022; принята к публикации 20.09.2022.