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SPECIAL CONTRIBUTION

Government management based on science and innovation: advances and challenges

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ABSTRACT

This contribution discusses the creation of a government management system based on science and innovation (the "SGGCI"). It explains the essential ideas on which it is based and provides details of the progress and difficulties encountered in its implementation. Ideas are aired about the role of universities and the science and technology community in terms of a path to sustainable and inclusive development, in a context adverse to these purposes. The important role played by national science and technology in confronting the COVID-19 pandemic is highlighted, closely linked to governmental management, all of which have made it possible to offer a social, scientific, political and public health response capable of facing the challenge posed by the pandemic. The reasons for considering science and innovation as fundamental pillars of government management in Cuba in all areas are discussed. It is reiterated how the pandemic has highlighted the importance of a scientific, scientific-technological style, marked by prompt responses, synergies and close cooperation. All this has led to emphasizing the importance of the science-government link. The management system created favors a systematic dialogue between scientists and the government.

Gestión de Gobierno basada en ciencia e innovación: avances y desafíos

Palabras clave

Cuba; Gobierno; ciencia; innovación; universidades

RESUMEN

En esta contribución se aborda la creación del sistema de gestión de Gobierno basado en ciencia e innovación (SGGCI), se explican las ideas esenciales en las cuales descansa y se ofrecen algunas informaciones acerca de los progresos y las dificultades que encontramos en su implementación. Se comparten ideas acerca del rol de las universidades y de la comunidad científica y tecnológica en función de un camino al desarrollo sostenible e inclusivo, en un contexto adverso a esos propósitos. Se destaca el relevante papel que han desempeñado la ciencia y la tecnología nacionales en el enfrentamiento a la pandemia de la COVID-19, estrechamente vinculadas con la gestión gubernamental, todo lo cual permitió ofrecer una respuesta social, científica, política y sanitaria capaz de enfrentar el desafío que la pandemia nos planteó. Se comentan las razones para considerar que ciencia e innovación son pilares fundamentales de la gestión gubernamental en Cuba en todos los ámbitos. Se reitera que la

pandemia puso en evidencia la importancia de un estilo científico, científico tecnológico, marcado por la celeridad en las respuestas, las sinergias y la fuerte colaboración. Todo ello condujo a enfatizar la importancia del vínculo ciencia-Gobierno. El sistema de gestión creado favorece el diálogo sistemático entre los científicos y el Gobierno.

INTRODUCTION

Cuba is firmly committed to sustainable, inclusive development and accordingly mobilizes its resources in the forms of knowledge, science, technology and innovation. The country has made sustained efforts to promote education, especially higher education, and possesses significant scientific and technological resources. However, our knowledge is still some way from fully becoming the transforming social force needed to drive implementation of the National Plan for Economic and Social Development up to 2030. There remains usable knowledge that is not being used. The answer is to progress towards a socialism that is increasing supported by knowledge.

To this end, over the last two years, a system of government management (the "SGGCI") based on science an innovation has been introduced. At all levels, in interacting with the other social actors, government must ensure that science and innovation fulfil the social roles that the country needs.

Cuba is beating the pandemic. The challenge that COVID-19 posed to the country called for strengthening of our technological autonomy, especially in the sphere of public health, and, more concretely, in the creation of our own vaccines. The need is to extend this capacity for innovation to every sector of society.

The international scenario is distinctly unfavorable to the countries of the South. The North-South knowledge gap is widening. In the first stage of the pandemic, the hope was that the global nature of the phenomenon would generate less egoistic policies of greater benefit for the world as a whole. However, the present reality is that the world governed by the blind rules of the market exhibits no greater solidarity, or compassion, or humility or is any less austere, while the gaps between the haves and the have-nots continue to grow.

It is still the case that a substantial proportion of the world population has no access to the anti COVID-19 vaccines. Scientific, technological and production capacities abound, but the essential humanism is lacking.

For Cuba, the task of development is particularly onerous. The trade and financial blockade imposed on our country by Washington, the 60th anniversary of whose existence as official policy has just occurred, was criminally intensified during the previous US administration regardless of the effects of the pandemic, has remained intact under the present administration, and has been compounded by attempts at destabilization and blatant political interference in the domestic affairs of the Cuban nation.

Progress has involved transformations in the economy and in society. In the economic sphere, conditions have been created for bolstering the socialist state enterprise, for raising agricultural production, for diversifying the economic actors with the setting up of micro, small and medium-sized businesses, regulation of the non-agricultural cooperatives and extending self-employment.

In the social sphere, efforts are intensive. In particular, work at neighborhood level has been reactivated, as have efforts to the benefit of people and communities in situations of vulnerability.

All such initiatives, of a humanistic character, require the application of knowledge and innovation.

This contribution rehearses the basic ideas associated with science-and-innovation based government and its aims, set out in a previous contribution.[1] Certain evident advances, and the challenges we face, are discussed. In particular, we highlight the contribution of higher education to the national effort.

THE ROLE OF THE SYSTEM OF GOVERNMENT BASED ON SCIENCE AND INNOVATION

As explained above, with evident impact on all economic and social activity, a system of government management (the SGGCI) based on science and innovation, has been created. When one speaks of governmental participation in the promotion and application of science, technology and innovation, it is essential to remember that Cuba boasts an extremely rich tradition of political thinking and action, dating back to the origins of Cuban nationality, with eminent figures such as Félix Varela, José de la Luz y Caballero, José Martí and exceptional scientists - Carlos Juan Finlay, Álvaro Reynoso, Tomás Romay, among many others - who worked to convert knowled-

ge, science, education into drivers of development and social transformation. At the forefront of this tradition is the historical leader of the Cuban Revolution, Commander-In-Chief Fidel Castro, who can be considered the founder of national revolutionary science and instigator of the advances in education, public health, science and other fields that the country has enjoyed during the last six decades. It is on these solid foundations that our present efforts are based.

The desire to expand the role of knowledge in the country's development process is related to experience gained by the author during several decades as a political manager. First, during the years at the helm of two Cuban provinces, later as minister of higher education (2009-12) and then as first deputy president (2012-18). One repeatedly wondered what were the best ways of boosting the role of science, technology and innovation within the Cuban development model.

Under these premises, in 2018 the idea was formulated that the pillars of government management should include the activities of science and innovation, combined with social communication and computerization. In other words, the need was identified to convert knowledge and science, to ever greater degrees, into transforming social forces, which would contribute to finding innovative solutions to the plethora of economic, social, political, cultural and other challenges that rise up like water from a spring from the development model being introduced.

The Vision of the Nation on which the National Plan for Economic and Social Development ("PNDES 2030") [2] is based provides a framework of norms within which to steer our efforts in science, technology and innovation. According to the Vision, it is not a matter of having more science and more scientists, with more publications and patents. Rather, it is that these resources should be deployed to drive prosperous, sustainable, equitable development and underwrite the independence and sovereignty for which we Cubans have fought for two centuries. And all this calls for a lot of knowledge, a lot of human capacity in science and technology, strong links between the knowledge sector and that of the production of goods and services, good public policies that support the existing capacities and promote the building of new ones.

These are the overriding reasons for regarding science and innovation as basic pillars of government management, in all spheres, throughout the state agencies, in all the businesses and at every level - from the community to the presidency of the Republic.

Against this background and on these bases, the article "Why do we need a system of government management based on science and innovation?" [1] set out the conceptual bases, content and aims of such a system (the SGGCI), closely linked to the PNDES 2030 plan. It can now be said that the system is not only being implemented with encouraging results, but that it is being constantly enhanced.

What follows is an outline review of the basic ideas behind this system of management, together with details of some of the advances and setbacks experienced in its implementation

What is the SGGCI and what is it for?

It is a system of government working that aims at strengthening the role of science and innovation in the search for creative solutions to problems arising in the course of the country's economic and social development, both in the production of goods and services and in the spheres of public administration, scientific, technical and innovative (STI) activities, education, culture and others.

What function does SGGCI perform?

Among other aspects it enables the setting of priorities and the distribution of resources; it promotes the integration of expert knowledge in the decision-making process; it supports the formulation, monitoring and review of public policies; it promotes interaction and removes barriers; it extends the scope of innovation to every sector and segment of society; it generates motivation and incentives among the actors; it reinforces institutionality; it promotes the values and approaches peculiar to innovation among the population and managers.

What are the elements of SGGCI?

There are basically two. The first is represented by its conceptual bases; the second consists in its components and the primary actions associated with these.

The SGGCI provides responses to two kinds of basic questions:

I. On what conceptual bases should government management based on science and innovation be strengthened? This refers to the essential aspects that should underlie government action on a day-to-day basis. A solid conceptual basis is key to success in the work of management in this field.

II. What are the main components of the SGGCI, understood as the principal spheres which government policy should prioritize and what are the main actions that comprise these?

To answer the first question, the conceptual bases on which government management based on science and innovation should be strengthened are as follows:

1. Progress in science and innovation driven by the values contained in the Vision of the Nation and aimed meeting the

aims of PNDES 2030. All government action based on science and innovation should reflect this approach.

2. Knowledge, research and learning are key elements in the encouragement of innovation. All managers should accept that meeting the aims of the activities in their charge benefits from exchange with experts - scientific, professional, from within and outside the organization they manage.

3. It is necessary to ensure that the dialogue between experts, scientists, professionals, decision-makers and other actors is interactive and systematic.

4. The formulation, monitoring and review of the policies, strategies and plans pursued by the organizations must invariably be submitted to the judgment of experts able to perform objective evaluations of these. It is useful to receive dissimilar perspectives on the same question.

5. Government management based on science and innovation should, according to the approach of the innovation systems: a) favor identification of the actors that count in each case and influence the innovation process, b) promote interaction between them, c) ensure the availability of institutional bases (ground rules) that underwrite inter-institution cooperation, creativity, scope for producing new ideas and innovating, without creating snags.

6. Innovation is a distributed social phenomenon which can and should be expressed in all sectors of society, not just that of STI: the business, public administration, education and social and political organizations sectors, among others. In this way, benefit is obtained from the availability in every sphere of prepared people able to involve themselves in the learning processes that innovation demands. Consequently, the emphasis on innovation leads to prioritization of training and the retention of human potential, in the most diverse fields of knowledge, and to the continuous education of the public at large. We must boost the student population, step up technical and professional training, and encourage social appropriation of knowledge by the population as a whole.

7. Developing independent technological capacity, in every possible sphere, should be an aim shared by all the actors in the STI system. Producing in Cuba everything we practically and reasonably can, replacing imports and generating exports, require technological and innovation capacity

8. The formation and advancement of managerial personnel in public administration should include knowledge of innovation policy and management, in parallel with upgrading training in innovation management among middle managers in the business sector.

The second question can be answered by reference to Figure 1 below, which reflects the main components of the SGGCI.

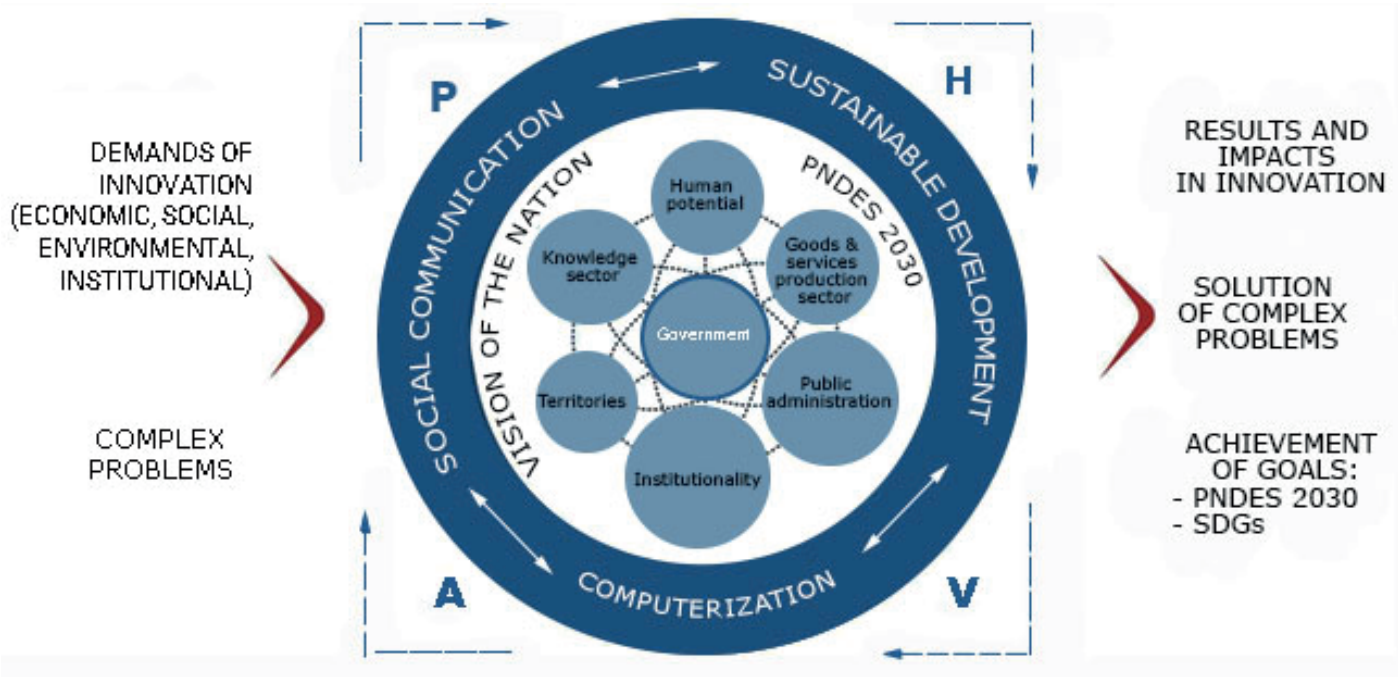

Fig. 1. Graphical representation of the SGGCI government management system based on science and innovation.

The dialogue between the conceptual elements and the main experiments/initiatives based on science and innovation arising from government management to date enable identification of the basic components of the SGGCI and the repertoire of measures to be taken. These are as follows:

1. The government is tasked with promoting, carrying out, driving, steering and regulating the interactions between all the components of the SGGCI. National and international dynamics - the experience of dealing with the COVID-19 pandemic speaks volumes in this respect - clearly indicate that government has a basic role to play. More so in the case of Cuba, whose development model, defined as socialist, assigns a fundamental role to state ownership. Operation of the SGGCI cannot be left to a ministry or any other individual state agency; the system needs to be run from the top levels of government, from the nation to the localities.

2. Human potential. Cuba's economic and social development, PNDES 2030 and the proposals contained in the Vision of the Nation all imply as a prerequisite the strengthening of the nation's human potential. Constant preparation is fundamental, of scientists, professionals, workers, small farmers, managers in the various sectors and the population as a whole. All of which requires upgrading of the education system, from primary level to the professional training, postgraduate (including doctoral) levels and beyond.

3. The sector of production of goods and services is a key component. It is essential to expand its capacities for innovation to upgrade its performance, meet the needs of the population, raise the sector's productivity and competitiveness. Transformation of the Cuban business sector must clear the path to innovation.

4. Approaches alternative to the SGGCI generally associate innovation solely with businesses. Here, public administration is seen as an essential component, and requires the assimilation of innovation. It is, for example, a key issue in the development of public policies.

5. Under the approach applied in the innovation systems adopted [3], the SGGCI identifies institutionality as a key component, understood as the "rules of the game" (standards, regulations and laws) which should help to fortify the actors and their links, the flows of knowledge and technology. Having adequate "rules of the game" is critical to the functioning of the SGGCI and especially to the strengthening of its connections.

6. The territorial dimension is fundamental.[4] Compared with the preferentially sector-based approach - vertical, rooted in the offer of research results whose beneficiaries are generally taken to be, primarily, the technology-based firms - local territorial development is adopted as a privileged component of the SGGCI. Local development calls for knowledge and innovation management processes with inter-sector, trans-discipline visibility that favor production, diffusion and application of knowledge, adapted to the local needs of the areas concerned. It is essential to mobilize the territorial creativity associated with "situated knowledge", i.e. knowledge adapted to the peculiarities of the context in which it is applied.

7. The knowledge sector is of great importance in the SGGCI. In this case, the term is used in its widest possible sense, although universities, borough centers offering degree courses and the science, technology and innovation concerns predominate; their research, development and innovation (I+D+i) projects and training programs must increasingly include innovation.

Advances and challenges

The design of this system was in progress when the COVID-19 pandemic arrived in Cuba, which armed us with the first reason for asserting the value of science and innovation in responding to the severest challenges.

According to UNESCO's 2021 report, at world level the pandemic "has energized knowledge production systems". This has been very much the case in Cuba, as discussed below.

The first cases of COVID-19 in Cuba were recorded on 11 March 2020, but the country had already responded to the pandemic much earlier. Through its representatives in China, BioCubaFarma obtained early details of the Wuhan outbreak. This valuable information coupled with the WHO reports and recommendations, triggered an intense process of scientific debate and a wave of project proposals for research and development in response to the pandemic.

The Council of Ministers approved a first Plan for Prevention & Control of the New Coronavirus, immediately followed by the launch of a wide-ranging process of training in matters of biosecurity. A national protocol for managing the disease was defined. In February 2020, a Science Group and an Observatory for Combating COVID-19 had been set up. The former is run by the Innovation Committee. Since then, there has been a proliferation of research projects and innovation initiatives, many involving the universities.

It was clear that the response demanded a huge effort of inter-sector, inter-institution and interdisciplinary cooperation. It was necessary to mobilize all the capacities created, upgrade them as far as possible, and take maximum advantage of the values that guide the conduct of our professionals, scientists, healthcare personnel and the population as a whole.

The effort was coordinated from the presidency of the Republic, which facilitated coordination of government management with the scientific and technological efforts and mobilization of expert knowledge, favoring rapid searching for answers, elimination of potential obstacles and difficulties and an active campaign of social communication.

It must not be forgotten that all these efforts were made in a very difficult economic context, aggravated by intensification of the economic, financial and commercial blockade and constant political harassment by the world's principal economic and military power. Under these conditions, Cuba had much greater difficulty than other countries in obtaining certain resources (including medicines, equipment and vaccines) essential to combating the pandemic. It was in this way, as in many occasions in the past, that difficulties were turned into an opportunity.

This unusual situation prompted a strategy aimed at exploiting existing capacities: skilled human potential, a robust medico-pharmaceutical biotechnology industry, a developed public health system and a higher education system capable of supporting the effort in every corner of the country.

These capacities, combined with social cohesion, the population's trust in the public administration and other values were the bedrock that enabled us to initiate the creation of new capacities, including the greatest possible technological autonomy (in vaccines, pulmonary ventilators, medicines, public health protocols and other areas) and respond adequately to the exceptional challenge posed by the pandemic.[5]

Such was the background to a turning point: May 19, 2020, when our science and technology community was called upon to engage in the search for our own vaccines. With minimum resources, the science and technology community put forward five vaccine candidates, of which three have been approved; consequently, as of 19 April 2022, 89.7% of the Cuban population has been vaccinated with a complete three-dose schedule. Achieving this has, of course, demanded an extraordinary response by the public health system and the public at large.

Technological autonomy has been achieved in several areas. One that has seen considerable progress is that of pulmonary ventilators. The blockade is affecting the suppliers of these to Cuba, which are relucted to supply spare parts or sell more apparatuses.

The technological advances mentioned have been achieved with very limited economic resources. This shows that developing countries can obtain substantial technological results, dedicated to serving the people rather than filling the coffers of the big transnationals.

Based on what has been learned from the pandemic, the public health system has been gradually upgraded, combined with strengthening of the pharmaceutical industry, which must be increasingly prepared to respond to the health system's needs and guarantee reasonable degrees of technological autonomy. All of which is work in progress.

But the fight against COVID-19 has had a much greater legacy. It has enabled the accumulation of important know-how in the areas of inter-sector, inter-institution and interdisciplinary coordination aimed at solving complex problems and has shown that such coordination can pave the way to meeting the goals of PNDES 2030.

The next complex problem addressed by government management was food sovereignty, a key aspect of national development. We have been working on this, systematically, since the first semester of 2020.

The following is a summary of the main fronts on which progress is being made. One of these is referred to internationally as *science for policy* or *government science advice* on policies. It is concerned with supporting the entire decision-making process with expert knowledge, in every area.

Science advice has a long history. Many of the Revolution's plans benefited from expert guidance. In this context, the last decade has provided significant examples.

2011 saw the start of a cycle of change in public administration with the economic and social policy guidelines of the Party and the Revolution, approved at the 6th Congress of the Cuban Communist Party and the National Assembly of the People's Power. In the years following promulgation of the guidelines, a large number of public policies have been generated and key documents have been approved.

This process included creating a role for science advice[6], while highly important measures - such as the Constitution of the Republic approved in 2019 through a mechanism of popular consultation with the support of 86.85% of those who voted - have proved decisive. This was unquestionably a process that motivated collective intelligence.

In 2020, an "Economic-social strategy for driving the economy and responding to the crisis caused by COVID-19" was approved, enabling acceleration of the transformations under the above-mentioned guidelines, which were confirmed at the 8th Party Congress in April 2021.

As mentioned earlier, the pandemic has highlighted the importance of a scientific - or rather, scientific-technological - approach marked by rapid responses, synergy and close cooperation. All of which underscores the importance of the science-government link.[7] This has happened in other parts of the world, while in Cuba, close and at the same time respectful and harmonious relations have been achieved and deserve special mention.

The management system created has enabled systematic dialogue between scientists and the government. The advances on this front have led to the conviction that this way of working that connects science and government should be extended to address other complex problems. That of food sovereignty has already been mentioned, and is being worked on in research centers, universities, firms and local authorities at all levels.

Science advice is a factor also in macro programs, on the basis of which the country is organizing progress towards meeting the goals of PNDES 2030. The programs concerned, representing the combined efforts of ministries, universities, research centers and social organizations, are as follows:

- Government, institutionality and macroeconomics
- Production transformation and international insertion
- Infrastructure
- Science, technology & innovation
- Natural resources & environment
- Human development, equity & social justice.

Each of these has its groups of experts who maintain an active dialogue with the decision- makers.

Science advice is being gradually introduced in organizations and businesses by means of Technical Advisory Councils. Greater participation by independent experts in the drawing up and monitoring of policies is apparent.

Implementation of national policies at territorial level also requires the mobilization of expert knowledge in the areas concerned.

Transparency in the working of government is being enhanced, in order to strengthen communication with the citizen and encourage activism and popular control. To the same end, exchanges are under way with the most diverse sectors of society.

There are currently temporary working groups in the most diverse areas, political and social included, addressing (e.g.) policy on and advancement of managerial personnel; conceptual debates on the building of socialism; problems of society and culture.

A key focus of such work is that of strengthening the links between the knowledge, industrial and public administration sectors. Innovations include science & technology parks, university-society interface organizations, foundations and other innovation-stimulating instruments. These ends are also served by consolidation and diversification in the business sector - state-run, cooperative and private - and especially by the synergies between these.

An important role is played by the setting up of science, technology and innovation systems within all the ministries and firms, which reinforces the Cuban STI system.

The desire to strengthen the links between the knowledge sector, industry and public administration led to the creation in May 2020 of the National Council for Innovation, attached directly to the country's presidency.

In parallel, social innovation strategies are being developed, associated with growing popular participation in the running of public affairs, in combating inequalities and promoting the greatest possible degree of social justice. These ends are served by a wide-ranging system of exchanges with the most diverse social sectors (mentioned earlier), enabling the enhancement of government policies.

A special focus is on territorial development and the devolution of responsibilities, resources and decisions. One important innovation is the significant role of local development in the development model, accompanied by efforts towards greater institutionalization within national dynamics.

All these factors favor a proactive approach by the boroughs, people's councils, communities and their residents, opening up new possibilities through implementation of the content of the Vision of the Nation, mentioned earlier.

The Policy for Furthering Territorial Development is applied through various rules of supporting legislation, notably Decree 33/2021, *Strategic management of territorial development*.

These processes call for an expansion of human capacities, of knowledge, science, technology and innovation at local level. Capacities of individuals, but also within institutions and public policies.

The ubiquity and richness of human potential mean that higher education is closely involved in these processes. It is key to the creation of capacities, the training of the actors, including governments, and the application of knowledge at the level of borough management and the introduction of local policies. The borough centers offering university training are often highly active in knowledge and innovation management at local level, with tangible results.

Local development is high on the agenda of the Cuban state and government. This is apparent, for example, in the system of territory visits by the Council of Ministers and the emphasis it places on the role of the universities in their interactions with ministries, firms and governments.

These regular visits by the Council of Ministers to the territories can also be considered an interesting social innovation. They facilitate dialogue between the national, provincial and borough levels, including contact by the first-level managers with the local problems, and the links between the knowled-

ge sector - primarily the universities - the central government agencies and firms, both key to local development.

There is an appreciable increase in the recognition of the role of knowledge, science, technology and innovation in local development. The higher education system and those of science, technology and innovation are increasing their focus on the territories.

CLOSING REMARKS

Despite the progress described, we are still a long way from achieving the goals we have set ourselves. Connecting knowledge with solving problems of development is a huge task, especially if the efforts required take place in the midst of a brutal economic, commercial and financial blockade and with decidedly limited resources.

The SGGCI still calls for a good deal of learning on the part of the scientists, experts, entrepreneurs, research centers, universities and public administration. Learning takes place in step with progress, but the path of knowledge is unquestionably the best path. And in that respect, the universities are key.

Last year, an exceptionally challenging one - given the deadly combined impact of two parallel pandemics: COVID-19 and the stepped up US blockade plus a soft coup attempt and a communications war - was the acid test of the SGGCI.

Once again, the Revolution has emerged from a severe test with flying colors. None of the threats were removed, but the available forces were deployed more effectively.

The lessons of this difficult stage highlight the importance of direct working in the neighborhoods, of reinforcing the boroughs, of social participation, of intensive communication with the people, of creative resistance.

The biggest problems are about to be solved, while other, new ones that are not yet even visible, are about to emerge. But one conviction holds good: science and innovation are helping to find the best answers.

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