SEj
Vol. 2, N° 2, 2018

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ISSN 2523-9503

Journal of Sciences and Engineering

A publication of
CINCADER
Centre of Research and Training for Regional Development
Online at www.journals.cincader.org

Management of sustainable innovation for national development

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Resumen

A lo largo de la historia el desarrollo de los países se ha generado principalmente por el impulso en dos ejes complementarios: Ciencia y Tecnología, y, Comercio. En la actualidad venimos experimentando un desarrollo científico y tecnológico de escala exponencial y la Economía en todos sus frentes se ve impulsada por la aplicación intensiva de la tecnología. De acuerdo a estas consideraciones, la presente investigación trata de exponer el desarrollo de la Gestión de la Innovación como mecanismo transversal para impulsar las diferentes áreas socioeconómicas y especialmente las soportadas por la ingeniería. Para ello, se hará uso de la Vigilancia Tecnológica a fin de identificar los avances delo principales centros de investigación relacionados a la innovación en el mundo. Seguidamente se hará una evaluación de los principales modelos de Gestión de la Innovación y metodologías relacionadas que exponen algunos de los Observatorios de Innovación existentes en el mundo para finalmente hacer una propuesta de Gestión de la Innovación aplicable a la realidad del Perú, de modo tal, que pueda ser tomada en consideración por los grupos de interés (Gobierno, Academia, Empresas y Sociedad Civil) comprometidos con la Gestión de la Innovación en el país.

Palabras clave: Gestión de la Innovación, Prospectiva, Desarrollo Sostenible, Vigilancia Tecnológica

Abstract

Throughout history the development of the countries has been generated mainly by the impulse in two complementary axes: Science and Technology, and Trade. At present we are experiencing an exponential scientific and technological development and the Economy in all its fronts is driven by the intensive application of technology. According to these considerations, this research tries to expose the development of Innovation Management as a transversal mechanism to promote the different socioeconomic areas and especially those supported by engineering. To this end, use will be made of Technology Watch in order to identify the advances of the main research centres related to innovation in the world. Next, there will be an evaluation of the main models of Innovation Management and related methodologies that expose some of the existing Innovation Observatories in the world to finally make a proposal for Innovation Management applicable to the reality of Peru, so that it can be taken into consideration by stakeholders (Government, Academy, Business and Civil Society) committed to Innovation Management in the country.

Keywords: Innovation Management, Foresight, Sustainable Development, Technology Watch

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1. Introduction

Considering that the Sustainable Development of a country goes hand in hand with the level of Research in its different thematic and social axes, it is necessary to propose an Innovation Management model according to the problematic situation of the country.

The Global Innovation Index 2017, indicates that Peru occupies one of the lowest positions in Latin America in terms of innovation which does not go hand in hand with its supposed macroeconomic performance where the World Bank considers it an upper-middle income country and is well below Chile.

Table 1. Innovation Ranking in Latinamerican countries

País	Ranking
Chile	46
Costa rica	53
Mexico	58
Panama	63
Colombia	65
Uruguay	67
Brasil	69
Peru	70
Argentina	76

Fuente: Global Innovation Index 2017

Manuel Sosa (2017), after evaluating the publication of the Global Innovation Index 2017, indicates that in the two main dimensions that have been evaluated there has been no progress or a backward movement.
In terms of capacity to innovate, we have improved, but we have not achieved greater innovations due to a lack of human capital with greater technological capacities and greater sensitivity, and because education does not match the needs of the market. With respect to innovative performance, despite the existence of incentives, there has been a setback, due to the fact that the effort has been dispersed and because commercial factors or the needs of consumers have not been taken into account.

2. Materials and Methods

Some concepts related to the topic of research are defined below, followed by an exploration of some innovation systems and finally a model for sustainable innovation management is proposed. Here are some concepts that need to be understood in the framework of the research.

National Development

National Development is a process by which citizens begin to rebuild the value of a nation in such a way that it allows them to improve their opportunities to lead more productive lives and live well in a more complex environment. (Ashford, 1967),
On the other hand, Dana Lewis Ambrose (2013), mentioning Leslie Larson in a 2011 publication, defines national development as the ability of a country or countries to improve the social welfare status of their population.
We could therefore say that National Development is a process by which the population of a country as a whole builds a state of value for their nation in order to achieve an improvement in their social welfare.

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ISSN 2523-9503

Technological Prospective

Guisao Et All (2013), they define it as: "[...] a collective exercise of analysis and communication between experts that,... makes it possible to identify the probable components of future scenarios, their technological projections, the social and economic effects, the obstacles and the variables in favor [...]".

On the other hand, Medina and Ortegón (2006), referring to the OECD, indicate that Prospectiva Tecnológica "[...] is a set of systematic attempts to look at the long-term future of science, technology, economy and society, in order to identify those generic emerging technologies that are likely to generate the greatest economic and/or social benefits".

Consequently, Technology Foresight must be considered as the methodological tool that allows us to model future scenarios, not only technological ones, thus contributing to the sustainability of the generation of the different types of innovation with the interaction of the multiple actors that drive National Development (fourfold development helix).

Innovation

For Tidd and Bessant (2014), it is the process of creating value from ideas and to achieve success in innovation at a personal or organizational level it is necessary to have the capacity to manage these resources. They also indicate a classification of the innovation according to its evolution in the axis of component level or system level.

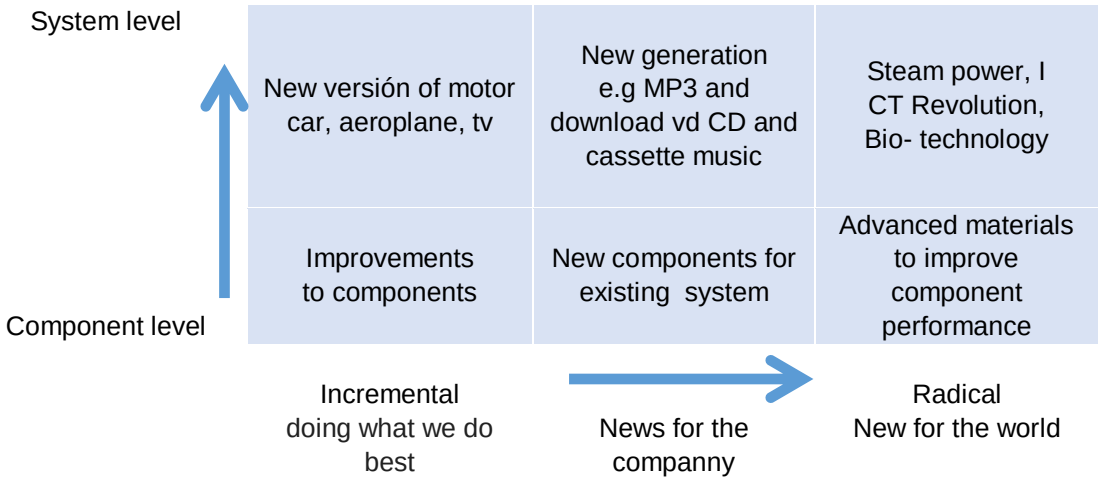

Figure 1. Types of Innovation
Source: Taken from Strategic Innovation Management

Goffin and Mitchel (2017), mentioning the work of Joseph Schumpeter considers 5 components of innovation:

1. "The introduction of a good, which is new to consumers, or one of higher quality than was available in the past.
2. Methods of production, which are new to a particular branch of industry. These are not necessarily based on new scientific discoveries and may, for example, already have been used in other industrial sectors.
3. The opening of new markets.
4. The use of a new source of supply.
5. New forms of competition, leading to the restructuring of an industry".

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And it describes which would be the phases of innovation. See figure 2.

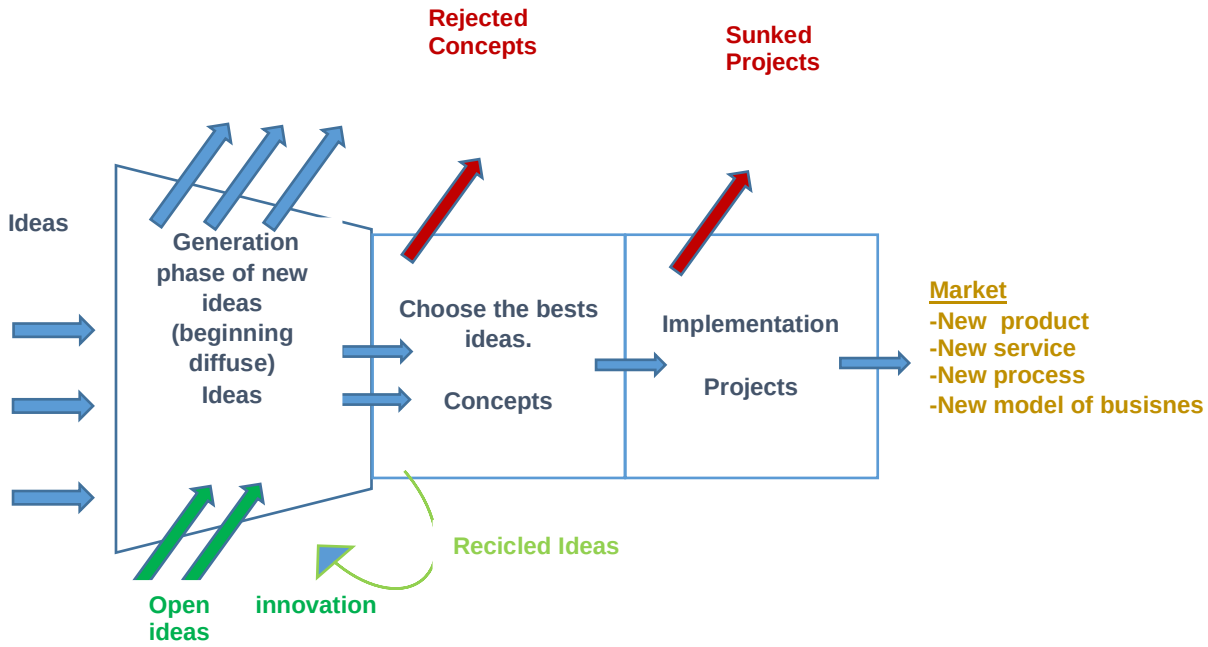

Figure 2. Phases of Innovation
Source: Taken from Innovation Management: Effective Strategy and Implementation

Innovation management

For Tidd and Bessant (2014), innovation management requires certain patterns of behavior, which are defined by the way in which processes are managed to search for possible opportunities for research, the process of selecting the opportunity to address and then the implementation or propagation of the same.

ESAN in its book Innovation Management Models for Local Governments concludes that this concept is distinguished by the generation of public value and the contribution to local development. In addition to identifying 6 essential components: motivation, actors, resources, alliances, citizenship and cultural change. It also identifies 3 pillars: Knowledge management, factors that promote innovation and adaptability to the environment and cultural context (Morales et al, 2014).

For Cuevas et all (2014), in an increasingly global environment, to face the challenges of a dynamic and even unstable market, innovation and knowledge management represent factors that strongly impact the competitiveness of organizations. Researchers have reaffirmed that innovation is a determinant in business performance and especially in SMEs.

Goffin and Mitchel (2017) consider the following to be relevant for innovation management:
I.- The phases of Innovation
II.- The involvement of the functional areas of the organization with Innovation.
III.- The vision of the top management is aware of the management of innovations.
IV - Research on trends in innovation management.
V.- The need for a framework for innovation management.

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Finally, we can find a quite concrete definition made by the government of Navarre, Spain in its Guide to Innovation Management (2008): "is the organisation and management of both human and economic resources, with the aim of increasing the creation of new knowledge, the generation of technical ideas that will lead to the creation of new products and services.
to obtain new or improve existing products, processes and services, and the transfer of those same ideas to the production, distribution and use phases".

Innovation Observatory
According to the description found in the web site of OdITE - Observatory of Technological and Educational Innovation "is a laboratory of educational research and innovation, focused on observation, discovery and experimentation with new instruments for the design and implementation of educational activities, as well as for the mobilization of resources and methodologies aimed at improving learning. That is to say, we could interpret that an innovation observatory is a research centre where new instruments are experimented with to promote innovation in its different fields.

3. Results
We will first describe some innovation management systems and then formulate the proposal to the need for innovation management in the country.

Innovation management models

For the government of Navarre, Innovation Management presents 4 blocks:

Table 2. Blocks and components of Innovation Management

Block	Component
Strategic Dimension	Innovation as strategy
Identification of ideas to develop	Creativity and Innovation
	Strategic Surveillance, Benchmarking and Intelligence competitive
Project development	Project Management
Exploitation of results	Financing Innovation
	Ensuring Innovation
	Exploitation of Innovation
	Knowledge management

Source: Practical guide to innovation management in 8 steps (2008)

According to Waissbluth M Et All (2014), trying to describe the Chilean model of the public sector indicates that today there are complex systems that by nature are open where the best way to make innovation is co-creation and describes it as the process "[...] where new ideas are designed together with people, and not for them [...]" in which a problem is faced from different perspectives, in an interactive way and with the greater participation of the actors involved and their consequent ways of thinking. They also mention some examples of the application of this system, these are: MINDLAB, a public-private organisation in Denmark, NESTA in the United Kingdom, co-innovation in Singapore, the Public Policy Lab in the United States.

Some methods that promote this type of systems are:

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ISSN 2523-9503

- Innovation Labs, creates a space to catalyse collaboration between different units.
- Design Thinking, defines 4 moments (understanding the nature of the problem, devising a solution, building the best solution and implementing and evaluating the solution) and tries to answer the questions what is needed, how is it needed? And for whom is it needed?

- Local collaboration, the problems of neighbouring localities are similar.
- Open and guided tours, methods are comparatively more effective in achieving greater exchange of knowledge.

Rocha and Lora (2016) describe the social innovation park model-Colombia. This is a model that seeks the development and transformation of communities through the development of solutions to their different problems and for which the different actors involved must articulate within a social knowledge management framework.

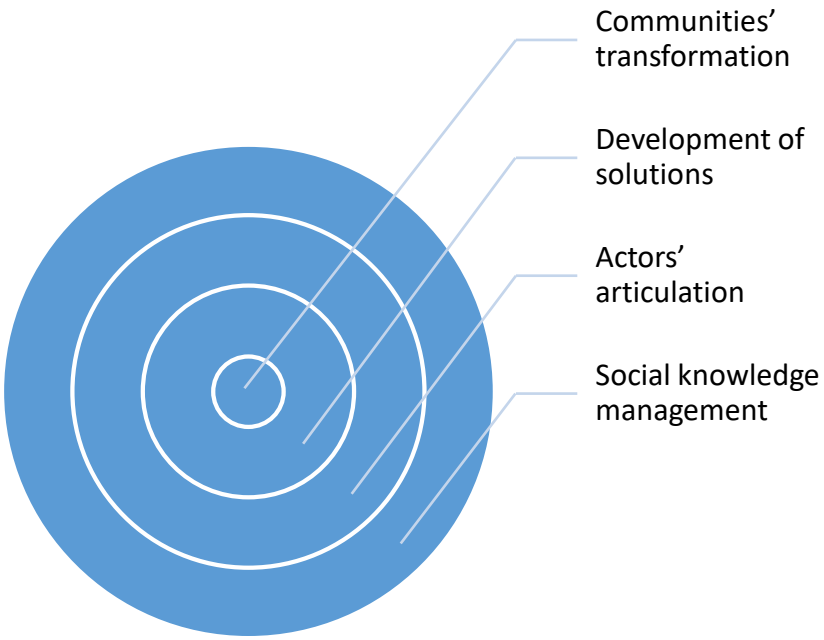

Figure 3: Simplified PCIS management model
Source: the model of the social innovation science park-Colombia 2016.

They also describe the participation of each one of the actors grouped in 4 groups the same that in prospective we call the quadruple helix of development.

Table 3. quadruple helix of development

Knowledge Management Processes	Exchange Zone	Quadruple Helix Agents
Knowledge creation	Post-Graduated Training Shared value	Universities Company
Application of knowledge	Public policy and implementation	State

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Social appropriation of the	Beneficiary communities	Society

Source: the model of the social innovation science park-Colombia 2016

In 2013 the European Commission launches the 7th framework programme for research and innovation with a 2020 horizon. In this scenario the VTT Technical Research Centre of Finland manages the fifth challenge called social challenge on climate action and develops the CASI-F Common Framework for the Assessment and Management of Sustainable Innovation.
CASI-F proposes the management of sustainable innovation in five (5) steps for seven (7) types of innovation:
1. Exploration and relevance of innovation: identify relevant innovations, policies and aspirations for the research focus.
2. Multicriteria analysis and evaluation: select or prioritize the innovations, policies and aspirations nominated using a set of criteria relevant to the social challenge mentioned above.
3. Analysis and evaluation of critical problems: analyze innovations, policies and selected aspirations to identify and prioritize critical problems, such as barriers, future carrier variables, opportunities and threats;

Multilevel advisory management: generate and prioritize actions of different actors at multiple levels to manage critical variables.
5. Management of action plans: development of roadmaps for the most important and urgent actions associated with critical variables.

The 7 types of innovation dealt with by CASI-F are:

1. Product Innovations
2. Innovations in services
3. Social innovations
4. Organizational Innovations
5. Innovations in governance
6. System innovations
7. Marketing Innovations

Popper et all (2017), go a little further and define for the case of the European Community 150 meta tasks classified in ten (10) groups of activities of 15 meta tasks each group. The complete table can be read in the respective article.
1. Impulse
2. Forecast
3. Resources
4. Mobilization Or Exchange
5. Suitability
6. Attitude
7. Catalysis
8. Promotion
9. Transformation
10. Sustainability

Morales et all (2014) through an ESAN publication try to describe a tacit model of Innovation Management applied by some local governments of Lima Peru. This model is based on three (3) pillars: Knowledge Management, Factors that promote Innovation and Adaptability to the environment and Cultural context, at the same time, consists of six (6) components: Motivation,

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Actors, Resources, Alliances, Citizenship and Cultural Change; and describes an innovation management process composed of 7 steps:

1. Idea Generation
2. Selected proposal
3. Proposal developed
4. Adoption
5. Commissioning
6. Sustainability
7. Measurement and evaluation

The following is a proposal for a sustainable innovation management model to boost national development.

Proposal for Prospective Laboratories for Sustainable Innovation

Sokolov et all (2018), tell us that in most developed countries or in frank development processes such as United Kingdom, Germany, Japan, Korea, etc. The priorities of science, technology and innovation systems are based on the results of prospective studies of the most important areas of science and technology development. These priorities are divided into 4 interrelated groups: functional priorities, priorities of socio-economic objectives, actors and thematic priorities.

On the other hand, both the CASI-F and the Colombian model speak to us of the need to involve the different actors and in their different levels of action, these actors are presented in four (4) groups what in Prospective we call the quadruple helix of development. Along the same lines, from the Chilean model of public innovation we can rescue the proposal of co-creation through the implementation of Design Thinking, and innovation laboratorios.

From the foregoing, it is clear that any innovation management model must consider the development of prospective research in order to define innovation priorities and implement a process that considers the work of innovation observatories.

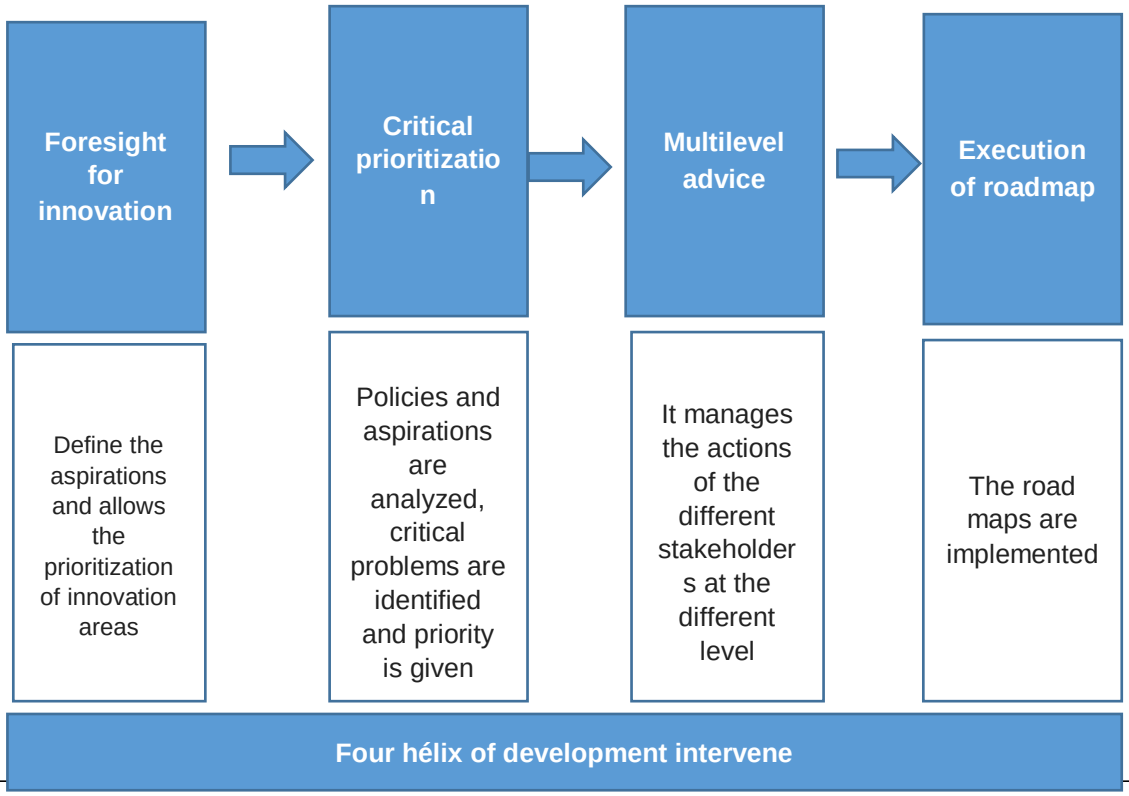

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Figure 4: Proposed model for innovation management.

4. Discussion and Conclusions

- Peru invests very little in research compared to the countries of the region, at the same time it has a deficit of researchers because it only has 200 researchers per million inhabitants, the average in Latin America is 1300 and Brazil 2500 per million inhabitants.
- Peru is a country whose development in innovation (rank 70) does not keep pace with its macroeconomic development, being far below in the ranking of innovation 2017 in relation to the Latin American countries where Chile (rank 46) occupies by far the first place.
- In the world there are different proposals for Innovation Management, being one of the most complete the model exposed by Casi-F for the European Community.
- Any proposal for Innovation Management must contemplate the application of Prospective to determine social expectations and the prioritization of sectors to be researched.
- Innovation Management must include the different actors in their respective levels of decision making or participation (the fourfold helix of development: social, academic, political, business) and must contemplate a process of co-creation.

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