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Original article

Systematization of the prospective analysis of the Ecuadorian military industrial system

Sistematización del análisis prospectivo sobre el sistema industrial militar ecuatoriano

Sistematização da análise prospectiva do sistema industrial militar equatoriano

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ABSTRACT

This article provides a systematic analysis of the dynamics of the actors associated with the defense industry in Ecuador, as one of the economic branches that has the best chance of boosting economic growth through contributions to the Gross Domestic Product, employment generation and the promotion of national production. The analysis was carried out with a prospective approach, applying the quintuple helix innovation model that allows an integral analysis from the economic, social and environmental components to address a topic of great interest for Ecuador. The research methods applied were historical, systemic, dialectical and modeling, supported by procedures such as analysis-synthesis and integration-abstraction. In particular, a comparative analysis was carried out between Ecuador and other countries in the region, which made it possible to determine common aspects and gaps, especially with Brazil, Latin America's leading country in this area. The development of the research project summarized in the article will allow laying the foundations for decision making in

the sector focused mainly on two variables: investment policies and the management model to be implemented that will allow dynamizing the participation of the different public and private actors in the development of the Ecuadorian defense industry system.

Keywords: industry; defense; stakeholders; prospective strategic; innovation model.

RESUMEN

En el presente artículo, se realiza un análisis sistemático de la temática relacionada con la dinámica de actores asociados con la industria de la defensa en Ecuador, como una de las ramas económicas que mejor posibilidad tiene de impulsar el crecimiento económico a través de los aportes al Producto Interno Bruto, la generación de empleo y la promoción de la producción nacional. El análisis se realizó con un enfoque prospectivo, aplicando el modelo de innovación de quíntuple hélice que permite un análisis integral desde los componentes económico, social y ambiental para abordar una temática de tanto interés para Ecuador. Los métodos de investigación aplicados fueron el histórico, sistémico, dialéctico y modelación, con apoyo de procedimientos como el análisis-síntesis e integración-abstracción. Particularmente se realizó un análisis comparativo entre Ecuador y otros países de la región que permitió determinar aspectos comunes y brechas especialmente con Brasil, país líder de América Latina en la temática. El desarrollo del proyecto de investigación que se sintetiza en el artículo permitirá sentar las bases para la toma de decisiones en el sector enfocado principalmente a dos variables: las políticas de inversión y el modelo de gestión a implementar que permitan dinamizar la participación de los diferentes actores públicos y privados en el desarrollo del sistema de industria de la defensa ecuatoriana.

Palabras clave: industria; defensa; actores; prospectiva estratégica; modelo de innovación.

RESUMO

Este artigo apresenta uma análise sistemática da dinâmica dos atores associados à indústria de defesa no Equador, como um dos ramos econômicos com maior possibilidade de impulsionar o crescimento econômico por meio de sua contribuição ao Produto Interno Bruto, à geração de empregos e à promoção da produção nacional. A análise foi realizada com uma abordagem prospectiva, aplicando o modelo de inovação de hélice quíntupla que permite uma análise integral

dos componentes econômicos, sociais e ambientais para abordar um assunto de grande interesse para o Equador. Os métodos de pesquisa aplicados foram histórico, sistêmico, dialético e de modelagem, apoiados por procedimentos como análise-síntese e integração-abstração. Em particular, foi realizada uma análise comparativa entre o Equador e outros países da região para determinar aspectos e lacunas comuns, especialmente com o Brasil, o país líder da América Latina nessa área. O desenvolvimento do projeto de pesquisa resumido no artigo ajudará a estabelecer as bases para a tomada de decisões no setor, concentrando-se principalmente em duas variáveis: políticas de investimento e o modelo de gestão a ser implementado para impulsionar a participação dos diferentes atores públicos e privados no desenvolvimento do sistema da indústria de defesa equatoriana.

Palavras-chave: indústria; defesa; atores; previsão estratégica; modelo de inovação.

INTRODUCTION

The interest in understanding the complex field of organizational relationships that interact in the management of systems such as, in this case, the defense industry, motivated a group of researchers to develop a research project called "Analysis of stakeholder strategies to boost the defense industry in Ecuador", which had an execution of 36 months in the years 2019 to 2022 at the University of the Armed Forces-ESPE.

In terms of defense economics, it is an important branch that contributes to the economic growth of a nation by meeting the needs of the defense market, which is *per se* a captive market, which main segment is the institution itself, and which can become deregulated to the extent that other markets, such as the civilian and external markets, must be served (Borsic Laborde et al., 2022).

The main concern about the defense economy has been associated with military spending and its administration, in an environment of scarce economic resources and high financial requirements for defense (Scheetz, 2011). Faced with this, the defense industry becomes an alternative that allows generating economic resources through the production and commercialization of products, services and technologies, mostly based on its own R&D capabilities and, thus, promoting economic growth, contributing to the Gross Domestic Product (GDP) and employment generation, as well as enhancing

autonomous strategic capabilities, security and national sovereignty through properly managed innovation processes (Espitia Cubillos et al., 2020).

International experiences, as highlighted in the associated literature, agree that there are three basic factors for the development of the defense economy and industry, both from an endogenous and exogenous point of view:

1. A public policy that marks the will of the national State;
2. Public spending that prioritizes investment in R&D and innovation and, last but not least, less scientifically addressed;
3. A management model for the defense industry system that guarantees the execution of the necessary activities and the use of resources to achieve the desired results.

It was around these three factors that a theoretical-methodological proposal was developed based on:

- Analysis of R&D&I policy and spending in the defense sector.
- Identification of public and private stakeholders associated with the sector and the cooperation between them, which analysis should be made with a strategic and prospective character, i.e., visualization of the future and planning of actions from the present that will make it possible to achieve the proposed objectives.
- The innovation model that serves as a reference to integrate these actors, i.e., how to manage the process of generating scientific results to be introduced into social practice, with an adequate economic, environmental and social impact, among other factors, for which the five-helix approach, which will be discussed later, was considered.

All of the above, with the intention of prospectively modeling a defense industry system, based on principles of sustainability (i.e., a balance between economic growth, social welfare and respect for the natural environment) and competitiveness, associated with the capacity to generate competitive advantages in the international market.

The objective of this paper is to systematize the results in relation to the prospective of the Ecuadorian defense industry system, based on the analysis of the future dynamics of the actors.

MATERIALS AND METHODS

In order to carry out the proposed systematic analysis, several theoretical research methods were applied, such as historical, systemic, dialectical and modeling, with procedures such as analysis-synthesis and integration-abstraction, which allowed synthesizing the results of the research project "Analysis of stakeholder strategies to boost the defense industry in Ecuador".

Updated sources were consulted regarding the development of the sector in Ecuador and other countries in the region, such as Brazil, Argentina, Chile, Colombia and Peru, which made it possible to carry out a comparative analysis, especially in relation to public spending and performance levels in research, development and innovation (R&D&I).

Strategic prospective methodology tools proposed by the French school (Godet) were also applied, such as structural analysis (MICMAC software) and stakeholder/strategy analysis (MACTOR software). Specifically, the modeling method was used to show the application of the quintuple helix approach in the case study.

RESULTS AND DISCUSSION

In relation to public policy and spending, once a comparative analysis was carried out between Ecuador and countries in the region such as Brazil, Colombia, Argentina, Peru and Chile, it is concluded that there are no notable differences in terms of defined policy, institutional system of the defense sector and regulations. This is not the case of the analysis associated with its R&D capabilities represented, for example, in the indicator of patents in force as shown in figure 1 (Brazil has about 8,800, Colombia has almost 8,500 and so do the rest of the countries analyzed, while Ecuador currently has 80 patents in force). It should be noted that this is one of the indicators that best shows the commercialization and production capacity generated by R&D investment.

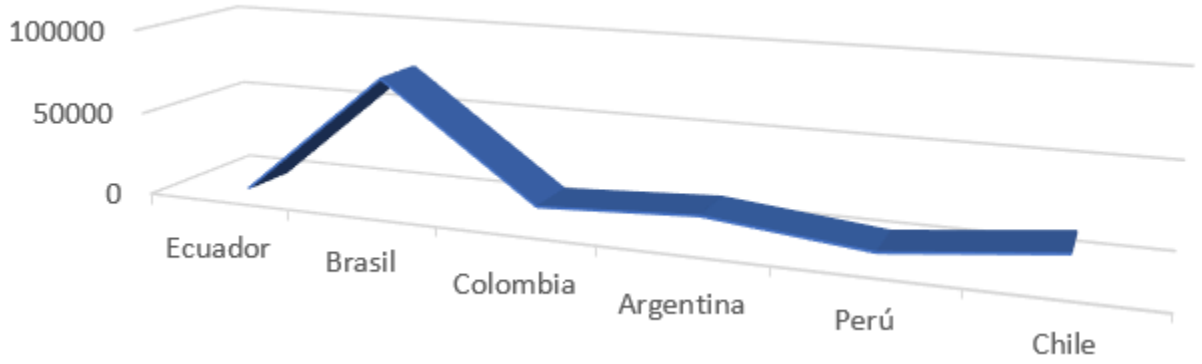

Figure 1. Patents in force in the analyzed countries
Source: Own elaboration based on WIPO data (2021)

The data summarized in the three series (military spending, R&D spending and arms exports) sourced from the World Bank in figure 2 indicate that Brazil is precisely the country with the best performance in all three indicators.

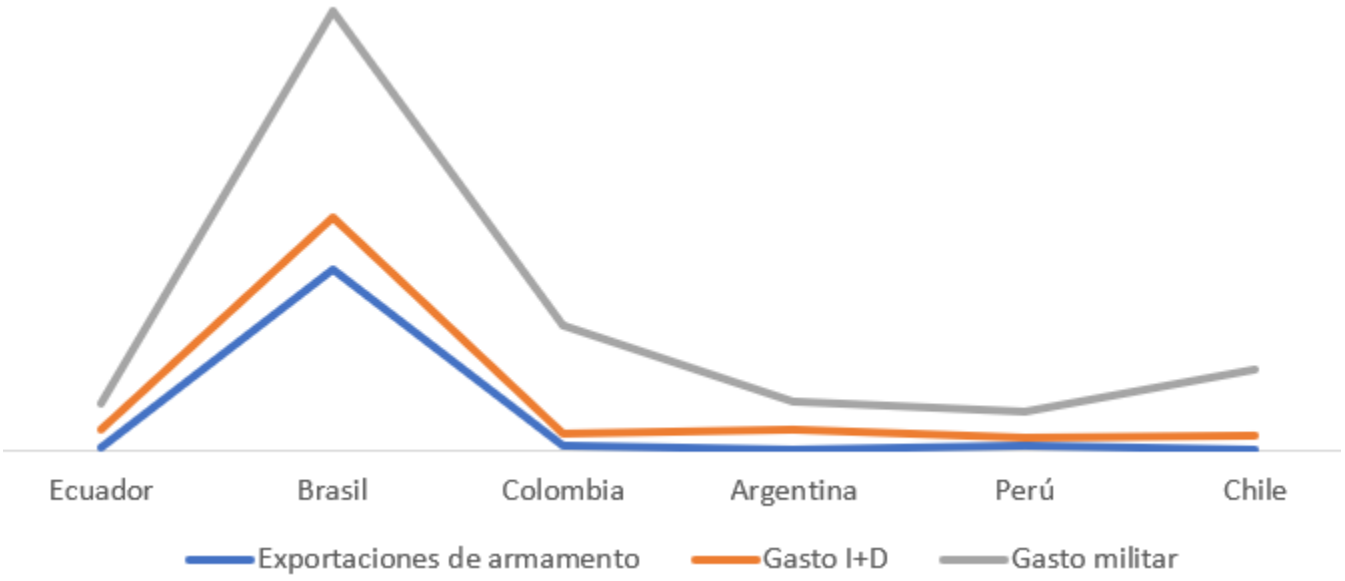

Figure 2. Series of three selected indicators in studied countries
Source: Own elaboration based on World Bank data (2021)

Here it should be noted that in Latin America the issue of the quality of public spending, associated with effectiveness and efficiency in the use of public resources, is still a pending debt in order to increase economic growth, as the Economic Commission for Latin America and the Caribbean warns that the countries of the region are jeopardizing their development goals and the achievement of the 2030 Agenda, if the levels and quality of spending are not raised, promoting investment in R&D and other innovation policies to strengthen competitiveness (Cepal, 2021).

Taking the Brazilian case, and only for reference purposes, it should be recognized that for many years this country has been pointed out as an example in the sector, which is reflected in the fact that:

- The Defense Industrial Base represents almost 5% of GDP (income), surpassing traditional leading sectors such as the oil industry, construction and agriculture.
- It generates close to three million jobs. It closed 2021 with two billion dollars in profits from foreign sales.
- There are 146 registered companies producing aircraft, ships, weapons, cybernetic tools for data protection, radars and secure communication systems, among others.
- It ranks eleventh in the world in patent applications.

In contrast, in Ecuador and according to the latest data published by the National Institute of Statistics and Census (2015), R&D spending figures in the defense sector range between 1.34 % and 2.63 % of the total, with a lower value than the rest of the socioeconomic sectors. This considers, in addition, that the value dedicated in the country to R&D is in itself very low, being approximately 0.5 % of GDP, considering that, for example, in Brazil, it is about 1.5 % (World Bank, 2021).

The analysis carried out for the Latin American region does not fail to be a reality in the country, as highlighted by national authors on the need for the effective use of the budget, which, on average in recent years in the Defense sector, allocates 94% to current spending, especially personnel costs, so that the investment fund is significantly low, to which is added a high dependence on imports for acquisitions, among other structural problems, according to authors such as Granja Sanchez and Manzano Teran (2022).

In Ecuador, it is necessary to improve the quality of defense spending, through a greater budget allocation for research and development, in order to generate technology-based goods and services,

both for domestic use and export, which will allow the country to be less dependent on technology and inputs from other countries (Granja Sánchez & Manzano Terán, 2022).

In the specific case of the Land Force, for example, in 2022, 97% of the budget was allocated to current expenditure, which contrasts with the desired scenario for 2033, designed previously, in which it is proposed to increase investment in R&D&I to have moderately developed technology that will significantly improve operations, as well as with the "Technological Development" line of transformation, which was addressed by the first panelist.

In terms of public policy, there are numerous documents in force in Ecuador, such as the White Book of Defense, development plans and institutional policies, the Organic Code of the Social Economy of Knowledge, Creativity and Innovation (which operates in general for all economic sectors), among others. Similarly, the country has a science and technology policy that is not yet reflected in the sector's production capacity (Jiménez Villarreal et al., 2021).

In addition, few companies associated with production for the defense industry have been identified, including FAME EP, Santa Bárbara EP, Astinave EP, the Aeronautical Industry Directorate and other companies that produce for the security and defense market in isolation.

Based on the analysis carried out, the following questions need to be raised in relation to the perspectives on the subject:

- How can public policy be effectively implemented?
- Is it possible to have robust data for decision making? That is, reliable, updated and sufficient data.
- How to improve the quality of spending, directing it to R&D&I as the basis for the development of the national defense industry?
- Is it feasible to integrate the public and private sector in defense industrial production? What other institutions and organizations should be integrated into the system?

In order to answer these questions, it is necessary to apply a methodology that considers the actors involved, who through their policies, strategies and actions have direct or indirect influence on the functioning of the system and its results. And that, in the defense industry sector, have traditionally been framed in the political context of public administration and industry (Martí Sempere, 2013).

The study of actors, under a prospective approach, is fundamental to propose cooperation relations through public-private partnerships, a tool that has been used very effectively by developing countries, as highlighted by some authors.

Precisely, in order to break the traditional study scheme and broaden the view towards other actors, a more comprehensive innovation model was chosen, such as the quintuple helix model proposed by Carayannis, Barth and Campbell (2012), in which, in addition to the three traditional helixes (government, academia and industry), society and the natural environment are joined to better manage the social and environmental impact of innovation processes. Figure 3 shows the adaptation of this innovation model to the Ecuadorian defense industry sector.

Figure 3. Quintuple helix model and comparison with the three-helix model
Source: Own elaboration

It should be noted that the triple helix model is one of the most widely used in the design of innovation systems, including in the sector under study, as shown in the work of Tamayo and Tamayo (2020),

who state that actors should be integrated, especially technology transfer centers, research institutes, universities, among others.

The application of a prospective methodology focused on the analysis of actors includes the study of variables, with the participation of nine high-level national and foreign experts, whose criteria were processed qualitatively and quantitatively, with the application of MICMAC and MACTOR software.

In this case, 13 variables associated with the quintuple helix approach were studied, from which the following key variables were defined:

- Economy
- Technology
- Defense market
- Consumer needs
- Quality, productivity and competitiveness
- Innovation
- Liaison with the private sector

As can be seen, the variables selected as key have a mostly economic and market focus, explained by the existence of a solid policy and by the manifest need to stimulate the allocation of resources for industrial development, which allows the sector to grow based on quality, productivity and competitiveness indicators, based on the analysis of the market and its consumers, for which social, economic and doctrinal factors must be evaluated, according to Cebollero Martínez (2019).

The stakeholder study covered seven stakeholders associated with these variables and 19 strategic objectives, identifying that the stakeholders with the greatest convergence, i.e., whose future projects should have greater interaction, would be the Ministry of National Defense, the Joint Command of the Armed Forces and the Forces that comprise it.

In addition, the analysis of the correspondence between stakeholders and objectives identified the formation of three groups or clusters identified as follows:

- G1 "Security and defense system": includes the Ministry of National Defense, COMACO and the three Armed Forces.

- G2 "Governmental and civilian system": encompasses government and private business sector
- G3 "Production and academic system": includes universities, research centers and public companies in the defense sector.

The main conclusions of the research project are as follows:

- The advances that have already been made in public policy in the country lay the foundations for the dynamization of the rest of the related variables and actors.
- Decision-making by security and defense agencies could prioritize actions related to economic variables (especially spending), which will have an impact on the performance of the future system.
- There is potential for the integration of actors representing government, academia, industry (public and private enterprise), society and the environment, through collaboration/cooperation mechanisms, such as the proposed strategic groups that bring together actors with common objectives and joint actions, under the leadership of the security and defense agencies.

The analysis shows that the management of the defense industry system in the country is a complex but feasible goal, for which the key aspects on which to act have been identified (investment policies and management model), which dynamization requires the active participation of actors representing the governmental, business, academic and social spheres, with the leadership of the security and defense agencies.

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Conflict of interest

Authors declare that they have no conflicts of interest.

Authors' contribution

Angie Fernández Lorenzo directed the research project, designed the structure of the article and participated in the selection of the topics to be systematized.

Humberto Aníbal Parra Cárdenas and Darwin Manolo Paredes Calderón updated the data, reviewed the topics to be systematized and participated in writing the article.

All authors approved the version finally submitted to the journal.