

# THE ELEMENTS OF ANALYSIS OF THE CULTURE OF INNOVATION IN THE DEFENSE SECTOR AND ITS THREE-DIMENSIONAL MODEL

**Los elementos de análisis de la cultura de innovación en el sector de Defensa y su modelo tridimensional<sup>1</sup>**

**Os elementos de análise da cultura de inovação no setor de Defesa e seu modelo tridimensional<sup>2</sup>**

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## ABSTRACT

Since the end of the Cold War and the events of September 11th, new threats have emerged, impacting the perception of collective security and imposing modifications in the way of the military power of several nations. This phenomenon has been causing a boiling in the military sciences, with reflex in the social, political and economic field, provoking a process known as Transformation of the Defense, which is only viable with the disruption of traditional management models and with the introduction of a new organizational culture that promotes an environment appropriate to the process of innovations in the sector. The current model of the System of Defense Sector Innovations, as pointed out by the investigation, is fragmented and disjointed, producing, at best, incremental innovations and, rarely, those ones related to rupture. The research, with a structuralist epistemological character, aimed to unveil the underlying structure that gives supports the existing innovation culture in the sector in a hidden way. Additionally, the concepts of innovations of the Defense sector (technological and doctrinal), were presented of system of innovations and, also the three-dimensional model of analysis, containing elements of the innovation culture of the sector: interests of the agents (*illusio*), valuation factors of innovation (*valorem*); support factors (*capitis*), alliances (*alliances*) and its benefits (*Beneficium*).

**Keywords:** Culture of Innovation. Transformation of Defense. Industrial Defense Base. Organizational culture.

## RESUMO

Desde el final de la Guerra Fría y de los acontecimientos de once de septiembre, surgieron nuevas amenazas, impactando la percepción de seguridad colectiva e imponiendo modificaciones en el modo de actuación del Poder Militar de diversas naciones. Este fenómeno ha causado una ebullición en las ciencias militares, con reflejo en el campo social, político y económico, provocando un proceso conocido como Transformación de la Defensa, que solo es viable con la ruptura de modelos tradicionales de gestión y con la introducción de una nueva cultura organizacional que promueva un ambiente adecuado al proceso de innovaciones en el sector. El actual modelo del Sistema de Innovaciones del Sector de Defensa, como apuntó la investigación, es fragmentado y desarticulado, produciendo, cuando mucho, innovaciones incrementales y, raramente las innovaciones de ruptura. La investigación, de carácter epistemológico estructuralista, tuvo por objetivo desvelar la estructura subyacente, que de forma oculta, da soporte a la cultura de innovación existente en el sector. Adicionalmente, se presentaron los conceptos de innovaciones del sector de Defensa (tecnológicas y doctrinarias), de sistema de innovaciones y, también el modelo tridimensional de análisis, conteniendo los elementos de la cultura de innovación del sector: intereses de los agentes (*illusio*), factores valorativos de la innovación (*valorem*); factores de soporte (*capitis*), alianzas (*alliances*) y sus beneficios (*Beneficium*).

**Palavras-chaves:** Cultura de Innovación. Transformación de la Defensa. Base Industrial de Defensa. Cultura Organizacional.

## RESUMEN

Desde o fim da Guerra Fria e dos acontecimentos do onze de setembro, novas ameaças surgiram, impactando a percepção de segurança coletiva e impondo modificações no modo de atuação do Poder Militar de diversas nações. Este fenômeno vem causando uma ebulição nas ciências militares, com reflexo no campo social, político e econômico, provocando um processo conhecido como Transformação da Defesa, que só é viável com a ruptura de modelos tradicionais de gestão e com a introdução de uma nova cultura organizacional que promova um ambiente adequado ao processo de inovações no setor. O atual modelo do Sistema de Inovações do Setor de Defesa, conforme apontou a investigação, é fragmentado e desarticulado, produzindo, quando muito, inovações incrementais e, raramente as de ruptura. A pesquisa, de caráter epistemológico estruturalista, teve por objetivo desvelar a estrutura subjacente, que, de forma oculta, dá suporte à cultura de inovação existente no setor. Adicionalmente, foram apresentados os conceitos de inovações do setor de Defesa (tecnológicas e doutrinárias), de sistema de inovações e, também o modelo tridimensional de análise, contendo os elementos da cultura de inovação do setor: interesses dos agentes (*illusio*), fatores valorativos da inovação (*valorem*); fatores de suporte (*capitis*), alianças (*alliances*) e seus benefícios (*Beneficium*).

**Palavras-chaves:** Cultura de Inovação. Transformação da Defesa. Base Industrial de Defesa. Cultura Organizacional.

<sup>1</sup> Artículo disponible en español: <<http://portal.eceme.eb.mil.br/meiramattos/>>

<sup>2</sup> Artigo disponível em português: <<http://portal.eceme.eb.mil.br/meiramattos/>>

## 1. INTRODUCTION

Safety is a feeling of assurance that is necessary and indispensable to a society and to each of its members, against threats of any nature. It is a necessity, an aspiration and an inalienable right of the human being, embodied in the fundamental objectives expressed in Federal Constitution / 88.

What happens is that since the end of the Cold War and the events of the eleven of September, the world has been suffering from the so-called "new threats", a concept that, according to Chiarelli and Michaelis (2005), emerged or gained new contours with the launch of the US National Security Strategy in 2002. For the authors, the main threats framed in this concept are a) Increasing unemployment and, consequently, social marginality; b) Uncontrolled migration; c) Drug trafficking;

d) Terrorism in all its forms; e) organized crime; f) cross-border crimes; g) Violations of human rights; h) Degradation of the environment; and (i) Miscellaneous Discrimination.

Such threats, combined with financial and cyber-attacks, network-based battles, with strategic targets, the temporary suspension or the temporary or total suspension of the internet network or its functionalities, influence the preparation and employment of a nation for this omni dimensional war (FRANCO-AZEVEDO; MARTINS-MOTA, 2012).

To safeguard the conditions that provide a sense of security, it is necessary to adopt a set of measures, attitudes, and actions, developed by the Defense function, which cannot be understood as an exclusive assignment of the Armed Forces. The Defense function must be exercised by all Expressions of National Power, with emphasis on military expression (BRASIL, 2008).

Thus, this research starts from the premise that, in order to increase this sense of security, it is necessary to prepare and equip military power to deal with so-called new threats. For this, it is essential to develop a solid Industrial Defense Base (IDB), which also generates economic-social and scientific-technological reflexes, contributing to the development of the country and to the expansion of the nation's dissuasive power (AMBROS, 2017, page: 136; BRASIL, 2007b; SANDLER; HARTLEY, 1995, page185).

It is understood that this preparation of the Military Expression of Power and the strengthening of the BID (Industrial Defense Base) are directly proportional to the sector's innovation capacity. It so happens that the Defense Sector Innovation System (SIS-Def) is fragmented and disjointed, producing, at most, insufficient incremental innovations to expand the dissuasive power of the Armed Forces and of the country (CUNHA; AMARANTE, 2011). One of the

possible indicators of this situation is the reduced number of patent applications required by the military congress. The Brazilian Armed Forces requested little more than 100 patents (Brazilian Navy 29, Brazilian Army 23 and Brazilian Air Force 80). In contrast, in the USA, the Navy (US Navy) registered more than 18,926 patents, the Army (US Army), around 16.600 and the Air Force (US Air Force), 5.072 (DALL'AGNOL, 2015, page52; UNITED STATES PATENTS AND TRADEMARK OFFICE, 2013).

In the 2016 Global Innovation Index, prepared by *World Intellectual Property Organization*, Singapore is in sixth place, alongside Switzerland, the United Kingdom, and the United States. Malta, Spain, and Portugal appear next to China (25<sup>a</sup> position). Brazil occupies the 69<sup>a</sup> position, close to countries like Lebanon, Panama, and Peru (DUTTA; LANVIN; WUNSCH-VINCENT, 2016).

According to Radar (2016) in 2013, expenditures on research and development of Brazil in relation to PIB (Gross Domestic Product) were equivalent to 1,24%. Regarding this percentage, only 0.71% referred to public expenditures, which has not changed significantly since the 1980s, when the contribution of the Federal Government varied between 0.64 and 0.84%. If compared to the expenditures patterns of the Organization for Economic Cooperation and Development (OCDE), Brazil invests a little with research and development (P & D), (USA, Germany, and France employ above 2%, Japan and South Korea above 3%; China invests around 1,5% of the PIB - Gross Domestic Product). Singapore, with a small PIB (Gross Domestic Product), invests around 3%, which shows the sector's priority (RADAR, 2016).

From these settings, it can be inferred that even countries that do not have a PIB (Gross Domestic Product) as expressive as that of Brazil (PIB - Gross Domestic Product: U \$ 1.8 trillion) can be innovative, as in the case of Singapore (PIB - Gross Domestic Product: U \$ 300 billion), which demonstrates the existence of non-economic factors influencing negatively the development of innovations in the country.

Analyzing the rapidity of the technological evolution of the last decades and the process of "Transformation of Defense" occurred in several nations, it was observed that such a process did not succeed without an environment that could promote continuous innovations (UNITED STATES OF AMERICA, 2004; MURRAY, 1997; MURRAY, KNOX, 2001). It is believed that this process depends, therefore, on an innovative culture of SIS-Def (Defense System) agents.

Thus, the objective of this work was to unveil and understand the underlying structure, which, in a hidden way, supports the existing innovation culture in the sector, indicating the elements that make it up.

For this, the article was structured in five

sections, relying on this introduction: the theoretical reference focused on the concepts of innovation, transformation of the Defense and organizational culture; then the methodological procedures were presented, where it was tried to explain about the design of the work, which has a qualitative approach and a structuralist epistemological character; the analysis of the results, where the underlying structure was presented and explained; and, finally, the main conclusions of the research were presented.

## 2. THEORETICAL REFERENCE

### 2.1 THE DEFENSE SECTOR IN THE CONTEXT OF THE PROCESS OF TRANSFORMATION

According to the National Defense Policy (PND) (17) and the National Defense Strategy (END) (24), the Defense Sector is made up of the Ministry of Defense and is composed of the Brazilian Navy, by the Brazilian Army, and by the Brazilian Air Force. He is responsible for the preparation and use of the military expression of the National Power (BRASIL, 2016b, 2016c).

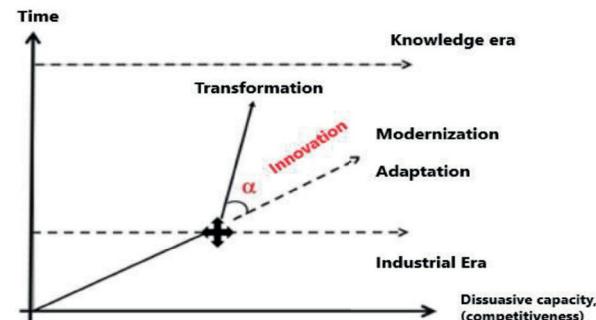
In times of peace, the Defense Sector acts in a way that contributes to the diplomacy actions undertaken by the country, on the other hand, in case of war or armed conflict, it is the sector of the Brazilian State that applies force in its fullness. The Federal Constitution defines the Armed Forces as permanent and regular national institutions, organized on the basis of hierarchy and discipline, under the supreme authority of the President of the Republic, which are intended for the defense of the homeland, the guarantee of constitutional powers and, on the initiative of any of these, of law and order.

To fulfill its constitutional destination, attributed by Article 142 of the Federal Constitution / 88, the Armed Forces must devise their organizational and operational structures around capabilities, in line with the structuring of the country's defense, according to the characteristics of each singular Force. (BRASIL, 1988, 2016b, 2016c). It is also possible to say that, with the enactment of Complementary Law number: 97, by the Complementary Law, number: 136, of August 25, 2010, such allocation began to count on a new approach, a little more focused on fighting new threats (BRASIL, 1988, 1999).

With this, new constraints, brought about by this interpretation, began to influence in the way of organizing, preparing and employing the military power. It was started, therefore, the so-called "Defense Transformation", which can be defined as a set of reforms to increase the effectiveness of military forces. It acts as a military revolution in operational art and science (LAMB et al., 2005, page 1), being a process that depends essentially on the capacity of innovation of the sector.

For Covarrubias (2005), the transformation is, at the same time, a process of technological and non-technological innovation, that is, it is also necessary to innovate in the ways of organizing, preparing the employment of the Military Power. According to Garstka (2005), it is a process with four dimensions: people (including personnel, leadership, education, and training); the processes (the doctrine); the organization; and technology (equipment).

Transformation is a long-term process dependent on the **degree of innovation** ( $\alpha$ ) which, in addition to raising military power to a new level of technology, leading it from the industrial age to the era of knowledge, will promote changes in the organizational culture of the Forces (Graphic 1).



Picture 1 – Fragmented and disjointed Innovation System

Source: Cunha and Amarante (2011)

As you can see in the graphic above, it is not just about retrofits, adaptations or modernizations. The speed with which this transformation will occur depends, essentially, of the innovative attitude in the defense environment.

### 2.2 INNOVATION SYSTEM IN THE DEFENSE SECTOR

This innovative attitude ( $\alpha$ ) of which the previous section, considered essential to the process of transformation, depends on the creativity and the development of new organizational, procedural,

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operational and technological concepts. (O'ROURKE, 2006, page 34).

As a result, from the analytical point of view, this research will focus on aspects of the theory of innovation systems, because it allows the study of the fundamental aspects for the development of an organizational culture that facilitates the innovative process.

The term innovation was developed by Schumpeter (1934, 1957), who argued that new technologies would replace the old ones, in a process he calls "creative destruction" when new technologies appear as waves and disappear by the action of new waves. With the evolution of the concept over the last century, the Schumpeterian distinction between invention, innovation, and diffusion of three clearly defined acts started to disappear, in favor of a conception of technological change as a continuous process (ROSENBERG, 1976).

This evolution has brought other aspects to innovation, which started to be seen as a complex process, requiring the interaction of various agents, such as universities, research institutes, development agencies and the government, to your success. This idea is corroborated by the evolutionary and neo-Schumpeterian approaches of Freeman (1989) and of Nelson and Winter (1982), which see innovation as a process dependent on the trajectory, through which knowledge and technology are developed from the interaction between several actors and factors, which accumulate knowledge during the course (FIGUEIREDO, 2005). These interactions are essential to the object in our research.

With the studies of Kline and Rosenberg (1986), the emphasis shifted from the philosophy of the simple act of linear model innovation to the social process, where innovation emerges in an interactive and multidisciplinary environment. As a consequence, the term innovation was gradually replaced by innovation processes or innovation activities. This view is corroborated by Fagerberg (2004) who states that innovation is a systemic phenomenon, the **fruit of the interaction between the different actors** of the productive process and the organizations. For the author, innovating involves "combining various types of knowledge, skills, competencies, and resources" (FAGERBERG, 2005).

The Oslo Handbook (ORGANIZATION FOR COOPERATION AND ECONOMIC DEVELOPMENT – OCDE, 2005), supported by the neo-Schumpeterian approach to innovation and focusing on the Innovation System, defines innovation as the "implementation of a product (product or service) new or significantly improved, or a process, or a new marketing method, or a new organizational method in business practices, in the organization of the place of work or in external relations" (OCDE - Organization for Cooperation

and economic development, 2005, page 55). The great change from the 1st, publication in 1987, to the 3rd edition (2005) was that the term technological innovation was replaced by innovation, losing the adjective.

With this evolution, the PINTEC manual (BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS – IBGE, 2009, page 18), also failed to use the term "technological" in definitions of product and process innovation, because according to Oslo Handbook this word "evokes the possibility that many companies in the services sector interpret 'technological' as 'plant user' and high-tech equipments", and so does not apply to many of your product and process innovations" (OCDE - Organization for Cooperation and economic development, 2005, page 24).

In 2016, the Innovation Law, based on the neo-Schumpeterian approach, defined innovation as:

A novelty or improvement in the productive and social environment that results in new products, services or processes or that includes the aggregation of new functionalities or characteristics of the product, service or process that may result in improvements and the effective gain in quality or performance (BRASIL, 2016a<sup>3</sup>).

All this evolution had already been perceived in the world military segment. In the US Army, for example, the term technology is inseparable from doctrine or organizational changes. Rosen (1991) defines military innovation as "a change in the way of fighting or the introduction of a new means of military employment".

This work will not only focus on military innovations. The focus is the innovations in the Defense sector. Thus, based on the modern theories on innovation by Kline and Rosenberg (1986), of Nelson and Winter (1982) and Fagerberg (2005), while observing the military context, the author sought to elaborate a concept that approached more closely the practices of the Defense. And then came a definition that meets the industry's yearnings and which also takes into account the propositions of the Oslo handbooks (OCDE, 2005) and from Bogotá (NETWORK OF INDICATORS OF SCIENCE AND TECHNOLOGY – RICYT, 2001).

<sup>3</sup> In the linear, technical change was understood as a sequence of stages, in which new knowledge from scientific research would lead to processes of invention which would be followed by activities of applied research and technological development resulting at the end of process, in the introduction of marketable products and processes.

Thus, in the Defense sector, innovation was defined as:

The implementation of a Defense product (product or service), or a process, or a marketing method, or organizational method, new or significantly improved, which are capable of altering considerably the way of organizing, preparing and employing the Military Power. In this sector, innovations can be divided into technological and non-technological. (AZEVEDO, 2013).

This definition was coined by the Research Group: Guerra do Futuro, Innovation and Defense Industry, of the Brazilian Army Command and General Staff School (GFIID/ECEME).

For the Brazilian Army Command and General Staff School (GFIID / ECEME), the innovations in the Defense sector can be divided into technological and non-technological. The technological ones (*inovatec*) are represented by material or tangible innovations (products, services and manufacturing processes) developed for priority use, in the military segment, but being able to extrapolate to the civilian environment (duality). The non-technological ones (*inovadout*), represented not only by doctrinal innovations, which create skills for the employment of tangible innovations, but also those that are intangible, related to the Art of War: doctrinal, organizational, strategic and tactical principles.

In other words, technological innovations are those that introduce some Military Employment Material (MEM) or Defense Product (PRODE), improve the production processes of these artifacts or enable the provision of any operational service of interest to the Defense. But the innovations in the art of war (non-technological) or doctrinal are those that generate changes in the way of organizing, preparing and employing forces for operations (war and non-war). In times of peace, they can encompass innovations in the way of administering military organizations (OMs) and how they work.

It is important to highlight non-technological innovation can influence, promoting or demanding, technological innovations and vice versa.

The innovation process in the defense sector can be understood as a set of activities and interactions, consolidated in a process involving the creation, development, the use, and diffusion of technological and non-technological innovations.

The GFIID Brazilian Army Command), based on the Oslo handbook (OCDE - Organization for Cooperation and Economic Development, 2005), summarizes this set of activities in the following

steps: prospection (preparation of scenarios, studies of alternatives, feasibility study and strategic alignment); evaluation of the demands (Armed Forces, Industries and Society); selection and decision of innovation (allocation of resources for investment, prioritization of investments and other activities). Other stages include implementation (the acquisition of knowledge in external sources, training of human resources, organizational modernization, modernization of equipment, continuous R & D (research and development) activities, monitoring and project management, cost control, launch, diffusion and sustainability of innovation); and knowledge management (review and learning capture).

Tidd, Bessant and Pavitt (2008) used a lot, three of these categories: demand, selection and implementation. The first is to prospect signals from the internal and external environment about potential changes, obtaining and processing information, from the environment in which they are immersed.

The second one deals with project selection, where it is essential that technology and market opportunities chosen are aligned with the overall strategy of the institution/company and the implementation consists of accomplishing the ideas, already approved, combining different forms of knowledge, efforts, and skills, whether they are internal or external (PAVITT, 2005; TIDD; BESSANT; PAVITT, 2008).

The study of theories of Innovation Systems allows the understanding of the facts, of the activities, processes, and interactions among the agents of the Defense sector. The expression Innovation System emerged in the 1980s and spread through the works of Freeman (1987), Nelson (1987, 1988), Nelson and Winter (1982), and Lundvall (1992). Lundvall, one of the first to deal with the subject of the way it is known nowadays, highlighted the importance of **strong interactions** among the actors of the innovations.

Freeman (1995) defined the National Innovation System as a "set of public and private institutions, whose activities and interactions contribute to the creation, advancement, and diffusion of technological innovations in a country".

Edquist (2001, page 13), Malerba (2002, 2004) and Silvestre (2006) state that an innovation system can be delimited in space or by sector (or both) depending on the object of study. This type of classification, where a system is not defined by geographical delimitation, becomes useful for the comprehension of the peculiarities of the Defense Innovation System. Based on these authors, the SIS-Def (Defense System) was defined as:

A group of public and private agents who, supported by factors of economic, social, political, military and

organizational order, perform activities and interactions, contributing to the creation, development, production, commercialization and the diffusion of innovations (technological and non-technological) in Defense (GFIID - Brazilian Army Command, /ECEME - General Staff School, 2013).

In this system, there is interaction between agents of the public and private spheres, such as: the governmental agencies, especially those belonging to the Military Power, characterized by the Armed Forces and Auxiliary Forces; the Industrial Defense Base (BID); the research institutes and colleges; the development agencies; and the laws and regulations that involve the system.



**Picture 1 – Fragmented and disjointed Innovation System**

**Source:** Cunha and Amarante (2011)

As pointed out by Cunha and Amarante (2011) SIS-Def (Defense System) is fragmented and disjointed because it has a low interaction not only between the agents of innovation of the sector but also internally in each of the blocks of actors (Picture 1).

### 2.3 THE APPARENT MODEL OF THE INNOVATIONS SYSTEM THAT IS IN EFFECT IN THE DEFENSE SECTOR (SIS-DEF)

After defining the System of Innovation in the Defense Sector, we tried to present, in this section, the composition of it, in order to compose the mass of elements of the observational field, as indicated by the research protocol of a structuralist nature.

This involves the explanation regarding the structure and functioning of the apparent model (visible). It was observed that, in the Ministry of Defense (MD) and in the Armed Forces (FA), there are subsystems of technological innovations (*inovatec*) different for each of the institutions, which are disjointed from the systems of non-technological innovations (*inovadout*).

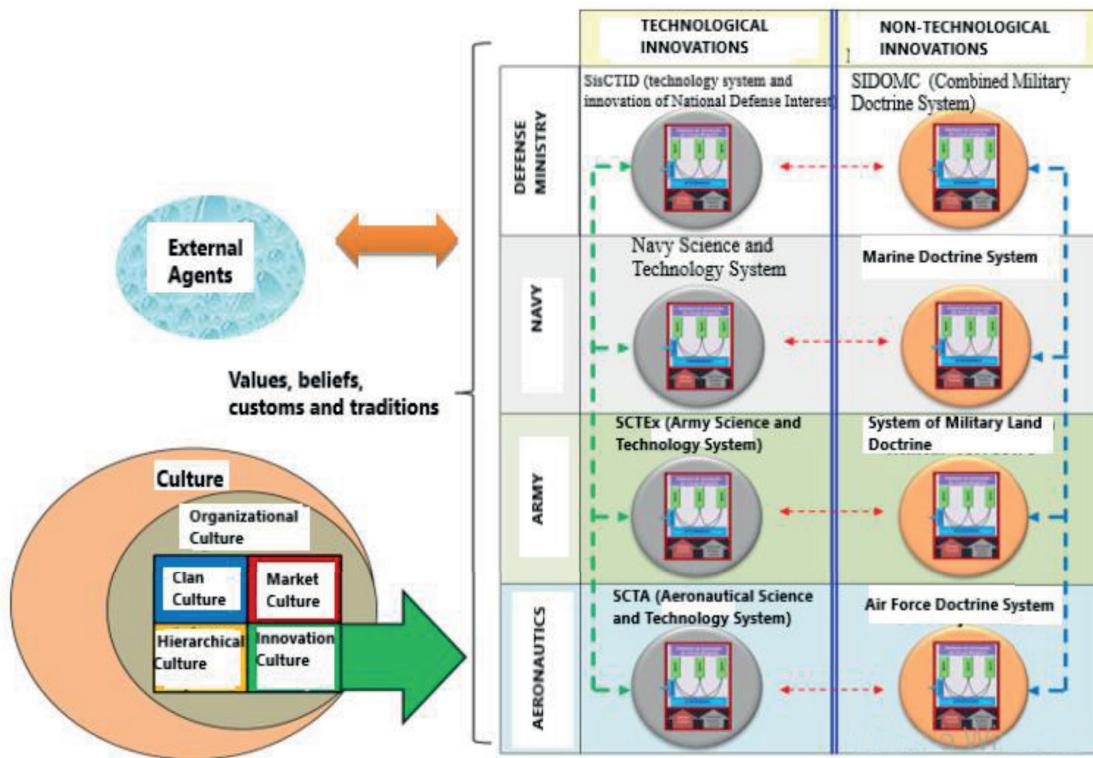
The sectoral subsystems of technological innovation of each of the Single Forces (Navy Science and Technology System - SCTM), the Army Science and Technology System (SCTEx) and the Aeronautical Science and Technology System (SCTA) should be integrated with the subsystems that control the advance and the diffusion of doctrinal (non-technological) innovations, represented by the SIDOMT (Terrestrial Military Doctrine System), by SIDMAE (Aeronautical Military Doctrine System) and by the Navy Doctrine System (BRASIL, 2005, 2009, 2010, 2013, 2015).

In relation to the latter, the situation is even less appropriate, because there is no formal and systematized model of evolution of naval military doctrine. The Navy Basic Doctrine Manual (EMA-305) prescribes a current doctrine, but does not point to a system of doctrinal innovation. The actions of the evolution of the doctrine are carried out in an informal way (BRASIL, 2014b).

At the strategic level (MD), which should ultimately manage the entire innovation process in Defense, exists the System of Science, Technology, and Innovations of Interest of the Defense (SisCTID), which deals only with technological innovations. In the same ministerial body, there is the Combined Military Doctrine System (SIDOMC), which deals with doctrinal (non-technological) innovations. The interconnection between the two systems is practically non-existent.

It is worth mentioning that, since 2004, there are no new initiatives to improve these systems. The last policy adopted by the body was Regulatory Ordinance number: 1317, of November 4, 2004, which approved the guidelines of SisCTID (technology system and innovation of National Defense Interest) (BRASIL, 2003a, 2003b, 2008). Finally, there is no system that integrates the management of innovations within the scope of Defense in its broad spectrum. As there is also no interconnection between the systems of technological and doctrinal innovations within the MD (Defense Ministry).

Picture 2 shows a schematic representation of the current model (apparent model).



**Picture 2:** Schematic representation of the SIS-Def (Defense System).

Source: Prepared by the author

In it, three types of relationships are observed. The red arrows represent the interactions between the science and technology systems of each agent (left column) and their respective systems of doctrine (right column). The reading of the documentation that deals with each of these systems allows to infer that there is a tenuous interface between them, which is accomplished through the dispatch of documents, requirements and reports, which, in general, are elaborated on the ministerial level (Defense Ministry - MD) or the General Staff of the Forces, which indicate the capabilities to be acquired and the technical specifications of defense products.

The green arrows, in turn, represent the interactions that should exist between the science and technology systems of the Forces and those of the Ministry of Defense.

However, in the existing documentation, there is a connection even less dynamic than the internal relations (red arrows) and so it says that the system is fragmented.

In turn, the blue ones represent the interactions between the Force doctrine systems and those interactions with the Defense Ministry - MD. These ones are more intense. There are many publications and joint exercises.

Finally, the orange arrow indicates the relationship between SIS-Def (Defense System) and other systems and agents of innovations that are external to the Defense. When this flow of interactions is low, it is said that the system is disjointed.

In the external environment to the Defense, the interactions practiced between SIS-Def (Defense System) and other systems of innovation are based on upsets and non-systemic and non-formal initiatives.

## 2.4 ORGANIZATIONAL CULTURE AND CULTURE OF INNOVATION: IMPLICATIONS WITH THE DEFENSE SECTOR

### 2.4.1 CULTURE AND ITS INTERFACE WITH MILITARY DOCTRINE

And studies regarding organizational culture and innovation are of fundamental importance to compose the mass of field elements. The term culture itself is polysemous and its meaning in the context of the organizational studies is different from the discipline that gave rise to it: anthropology and

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ethnology. According to Cherques (2008), the term designates different domains:

- i) surveys regarding the source, nature, and limits of non-economic values in organizations;
- ii) set of conduits, conditions and ways of proceeding in the environment where the organization is or will be installed; iii) the word of the idealization referred to individual and collective conduct of the organization members.

For Hall (1984), "culture is not innate but learned and shared," because when an individual is inserted into a group, he acquires the capacity of adaptation to the reality of that group. Culture is a collective and not an individual characteristic (HOFSTEDE, 1998).

Schein (2004, page 17) defines culture as a "pattern of basic assumptions (attitudes, values, beliefs, norms, and customs) which are shared by a particular group to solve the problems inherent in their daily lives." These assumptions must have worked well enough to be considered valid and therefore, to be retransmitted, as being the correct way of perceiving, thinking and feeling about such problems.

According to Pires and Macêdo (2006, page 91), the "culture expresses the values and beliefs that members of a group share" and such values manifest themselves through symbols, such as myths, rituals, histories and a specialized language, orienting the individuals of a given culture in the way of thinking, acting and making decisions. This concept is very similar to what, in the military sciences, is called **military doctrine**: "set of values, principles, concepts, norms, methods and processes whose purpose is to establish the bases for the organization, preparation and employment of the Armed Forces" (BRASIL, 2008).

In this sense, during the research were identified several authors who conducted work on organizational culture, based on the concept of culture.

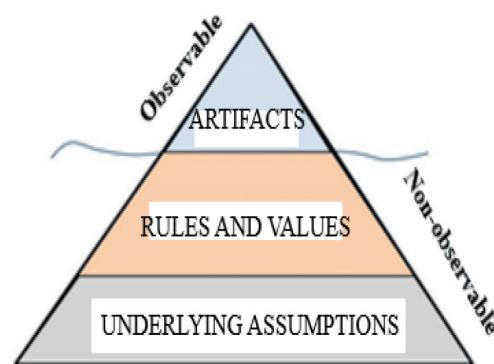
Fleury and Fischer (1989, page 117), for example, have developed a research that links culture and organization. For them, "the organizational culture is conceived as a set of values and basic assumptions expressed in symbolic elements, that in their capacity to order, assign meanings and construct the organizational identity, both acts as an element of communication and consensus, as hidden and implement the relations of domination." On these construction possibilities, Freitas (1991) and Pettigrew (2007) argue that, although not an easy task, cultural changes can be managed by the inclusion of aspects such as:

the commitment of the heroes; the recognition of a real threat in the outside world, to make transition rituals the pivotal element of change; to train new values and behavioral patterns; to keep in mind that change is promoted by the *insiders*, even if receiving outside help; construct tangible symbols of the new direction and insist that the safety of people (employment) is ensured in the transition process (FREITAS, 1991, page 117).

Corroborating this discussion, Srour (1998) argues that culture is transmitted, assimilated and shared, resulting from a socially conditioned learning in the organization, since the social agents acquire collective codes or internalize them.

It can be said, then, that the organizational culture is moldable and can undergo changes, provided they are planned in a way that involves all members and creates a commitment to the organization's new posture.

In order to understand the underlying assumptions of an organization in order to evaluate and eventually, changing the culture led this researcher to seek the best models to understand the organizational culture of the Defense sector. The most common and appropriate conceptions for the evaluation and diagnosis of military culture, in particular, are those offered by Edgar Schein and Kim Cameron and Robert Quinn.



**Picture 3:** Levels of Organizational Culture (2004).  
**Source:** Adapted from Schein (2004).

The model of Schein (2004) presents three levels of culture: 1) artifacts, 2) norms and values, and 3) underlying assumptions (Picture 3).

Schein postulates that the assumptions of an organization's culture can be observed through artifacts (uniform, symbols, and appearance (physical manifestations), ceremonies, military graduations, rituals, rewards and punishments (behavioral manifestations), and stories, legends, myths and jargon (verbal manifestations).

Norms and values make up the second level and, unlike artifacts, cannot typically be observed. Values are more conscious than basic assumptions, but they are not usually in the foreground of the minds of members of the organization and manifest in daily life or in interviews.

Standards are closely associated with values and are the unwritten rules that allow members of a particular culture to know what is expected of each in the face of a wide variety of situations.

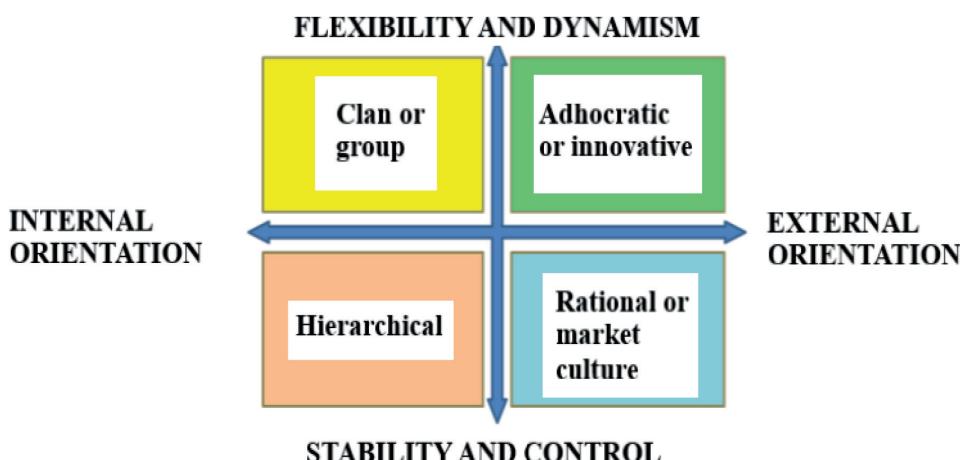
At the deepest level of the organization, Schein (2004) considers the beliefs and assumptions as important factors. Assumptions exist beyond consciousness and are invisible and hardly identified elements in the interactions among the agents of a sector. Assumptions have the ability to influence what the members of a culture perceive and how they think and act. It is in this belief that this research is based. It is necessary to understand the Culture of Innovation of the sector, to unveil the basic assumptions and with this, to be able to suggest public policies capable of modifying existing structures (CURVELLO, 2012).

On the other hand, the model originally conceived by Quinn and Kimberly (1984), later re-edited by Cameron and Quinn (2011) and Cameron et al. (2007), intends to establish cultural profiles of organizations as a way to classify and to understand the characteristics of the culture of the organizations, proposing the use of instruments for the diagnosis, interpretation and implementation of change processes. The authors understand that there are

organizations with profiles more prone to innovation than others. For them, while there are elements that contribute to fragmentation and disarticulation, there are others who give the necessary amalgam for cohesion, which can lead the organization towards success in relation to innovations. It is understood that the culture of innovation it is also manageable and therefore changeable.

The model above was elaborated from empirical research, by means of a survey regarding the way about how people in organizations think, what their values and assumptions are, and the ways they process information. Based on 39 indicators of organizational effectiveness, the statistical analysis allowed us to identify two large bipolar dimensions and four clusters. The first bipolar dimension differentiated effectiveness criteria that emphasized flexibility and dynamism on the one hand, against stability, order, and control of another. This means that some companies are effective because they change and innovate, while others because they are traditional, predictable and mechanistic – which, although it seems contradictory, is possible, depending on the sectors in which they act. The second bipolar dimension varies from criteria that emphasize the internal orientation, where organizational effectiveness is given as a function of the integration of people, as opposed to external orientation, of differentiation, based on competition with other organizations. The interaction of the four dimensions gave rise to four quadrants or four types of culture: *group or clan; innovative or adhocratic; hierarchical; rational or market culture* (Picture 4).

The denominations of each quadrant were not randomly assigned, but rather resulted from the academic literature that explains how, over time, different organizational values are associated with different forms or types of organizations.



Picture 4: Quinn and Kimberly's Organizational Culture Typology (1984).

Source: Adapted from Cameron and Quinn (2011).

The typology of the *Clan or the group culture* is a type of organizational culture that has high flexibility and internal focus. In this type of culture, it is assumed that the best way to obtain results is through work teams. For this reason, customers are seen as partners. The organization is concerned with the development of a human working environment, and the task of leadership is the facilitation of participation, commitment, and loyalty. Valuation and rewards are based on team performance rather than individual performance.

*Hierarchical culture* also has an internal focus, but is more concerned in the long term and with aspects such as stability, predictability, and efficiency. Usually, it demonstrates the values and norms associated with bureaucracy. The work environment is formal and structured, with several hierarchical levels, procedures, rules, tasks, and functions are generally relatively stable and integrated. Leadership has the role of coordination, monitoring, and organization. Employees accept the formally established authorities, rules and regulations imposed. Motivation factors are security and order. In this type of culture, leaders tend to be conservative and cautious, especially to problems of a technical nature. In general, the military is circumscribed in this quadrant.

The type of *Market or Rational culture* seeks to achieve better organizational results through competitiveness and productivity, which are achieved through an emphasis on external positioning and control. This culture reflects that the higher the performance and results, the higher the pay. According to this profile, the external environment is not seen as benign, but hostile and with demanding consumers. The leadership is focused on the achievement of goals, which translate into profits.

*Innovative or Adhocracy* is a type of culture where there are flexibility and external focus, dynamism, entrepreneurship, and creativity, focused on the production of innovative products and services. Pioneering is valued while leadership is visionary and risk-oriented. Organizations with this profile are permeated by change assumptions; accept the risk and are willing to break paradigms; they like to predict the future and care about getting resources, support and external image.

Therefore, based on the works of Quinn and Kimberly (1984) and Cameron and Quinn (2011), it is understood that culture of innovation is the organizational culture that facilitates the development of innovation and innovation processes, it contains specific aspects and is different from others because it has a focus on certain values, beliefs and behavior patterns.

### 3. METHOD OF RESEARCH

This research started from the premise that the innovation system of the Defense sector is fragmented and disjointed, which induces a reduced number of patent applications in the Defense sector. Initially, it was sought, in an exploratory way, to identify the main reasons that said the system is so and not otherwise. Because of this and the fact that countries with PIB (Gross Domestic Product) lower than Brazil present high innovation rates, the focus was more on cultural and axiological aspects than on political-economic ones.

It was adopted a research of descriptive and explanatory character, as far as the ends, and, regarding the means, it was a documentary, bibliographical and field research, according to taxonomy presented by Vergara (2007).

Descriptive, because it sought to study how innovation management is given and what elements of organizational culture influence the innovation process. It is important to highlight that it did not focus only on the identification of such elements, but rather on the understanding of the relationship between them, as proposed by Cherques (2008). For this, we opted for the inclusion of observations, records, analyzes, classifications, and interpretations, according to Gil (2002).

The research was explanatory, because in addition to exploring and describing, explanations were sought for the elements of the apparent structure and their relationships. The explanation is one of the fundamental points of science since its purpose is to explain phenomena and not just to describe them (GIL, 2002).

The research is qualitative, since "the production of knowledge is considered to be an interactive process, where the relations between participants and researchers and between researchers are constitutive attributes of this process" (MADUREIRA; BRANCO, 2001, pages 65-67).

Aiming to assign greater validity and reliability, the triangulation strategy was used, which, according to Patton (2002), contributes to the composition of a more faithful picture of the phenomena through convergence. Denzin and Lincoln (2000, page 5) argue that, in social sciences, triangulation:

It is not a validation tool or strategy, it is an alternative to validate. The combination of different methodological perspectives, diverse empirical materials and the participation of several researchers in a single study must be seen as a strategy to add rigor, breadth, complexity, richness, and depth to any research.

This research had a structuralist character, whose method proposes the definition of an underlying structure, starting from a set of relations between concretely observed elements. This underlying structure for Lévi-Strauss (1970) is: i) a logical mathematical scheme, constituted as a model of transformations of elements, such that any modification of one element implies in the modification of all the others; ii) a totality that has a meaning, that is, it has: (a) a meaning; (b) a direction; and (c) a purpose; iii) a logical organization, conceived as a property of the real, which forms a bridge between the theoretical model and the empirical reality (CHERQUES, 2006, 2008).

Following the proposed by Cherques (2008), the delimitation of the Observational Field (Defense sector) was carried out, which was described in section 2.1 of this paper. Then, the chosen Analytical Viewpoint (system of innovations) was presented, in order to clarify how it would be created the *Corpus of Elements*.

The bibliographic collection of the literature was carried out in a database made available in the Portal of CAPES Journals, such as *Web of Science*, *Scopus*, *SCIELO*, *PortCom*, Google Scholar and others. The other data were collected in field research,

plus research on documents, laws and publications, articles, theses and dissertations prepared by researchers from the Armed Forces, universities, and industries.

In all, 60 (sixty) SIS-Def (Defense System) members were interviewed. The selection was based on relevance, representativeness, and accessibility in four groups of agents: Government, Armed Forces, BID (Industrial Defense Base) and IES (Colleges). For each of them, the number of respondents was defined by the saturation criterion, which designates the moment in which the addition of data and information in a survey does not alter the understanding of the studied phenomena (CHERQUES, 2008, 2009; CRESWELL, 1999, 2007, 2009; GUEST et al., 2006).

The interviews lasted between 20 minutes and 2 hours and 30 minutes and were recorded, with the consent of the participants. They were selectively transcribed with *Atlas IT Software*, version 5.0, to perform data analysis.

In addition to Military Organizations, eighteen BID (Industrial Defense Base) companies participated in the survey and nine IES (Colleges) who study on the subject of Defense, making about 46 hours of interviews. The tables below present the companies and IESs (colleges) that participated in the research.

**Table 1 - Participating companies and associations and projects studied**

Agent	Institution / Company	Projects (Innovation)
BID	EMBRAER	Cargo Aircraft KC-390
	IACIT	GNSS (Global Navigation Satellite System)
	VISIONA	Satellites
	H2LIFE	Water treatment
	CONDOR	Nonlethal weapons
	ATEM & REMER	Patent Consulting
	IMBEL	Portable radio transceiver TPP-1400
	Ormitido	Marine Projects
	HELIBRAS Helicópteros do Brasil	Helicopter EC- 725 (HX-BR)
	FIAT-IVECO	Armored Car on Guarani Wheels
	SAVIS	SISFRON Project
	ENGEPRON	Grajaú Patrol Ship
	ARES Aeroespacial e Defesa	A robot that neutralizes explosive devices
	Companhia Brasileira de Cartuchos – CBC	Ammunitions
	ORBISAT	Aerial and ground surveillance radars
	AVIBRAS	Unmanned vehicles (air, sea and land)
	BCA Ballistic	Ballistic Vests
	EUROBRAS	Sustainable shelters and containers
	ATECH	Sagittarius - airspace control

Source: Elaborated by the author

Table 2 – Participating Higher Education Institutions

Agent	Institution	Partnership with the Armed Forces
Colleges	Getúlio Vargas Foundation	Army and Navy
	University of São Paulo – USP/CTMSP	Navy
	Federal Fluminense University	Army and Navy
	University of the Air Force	Aeronautics
	General Staff and Army Joint Staff	Army
	Naval War School	Navy
	General Staff and Joint Staff of the Air Force	Aeronautics
	Military Engineering Institute	Army
	Military Institute of Aeronautics	Aeronautics

Source: Elaborated by the author

Following the protocol of McCracken (1988), the instrument of data collection was constituted by a characterization of the profile of the interviewee; followed by an open and non-directed question (*grand tour*), with the purpose of giving the interviewee an opportunity to discuss the chosen topic (SIS-Def). It was also performed 12 pre-planned questions (*planned prompt*), which remained available, in cases in which the interviewee ceased to discuss part of the subject.

The contents covered by the pre-planned questions were: organizational culture; barriers to the innovation process and its facilitators; interactions, partnerships, and alliances; sharing of resources and the possibility of gains with the interactions; main interests of the agents; and infrastructure for innovation.

The collected data were analyzed by methods of documentary analysis, bibliographical and mainly of content analysis (AC), a method that has been used extensively in research in the social sciences (BARDIN, 2011; MINAYO, 2000).

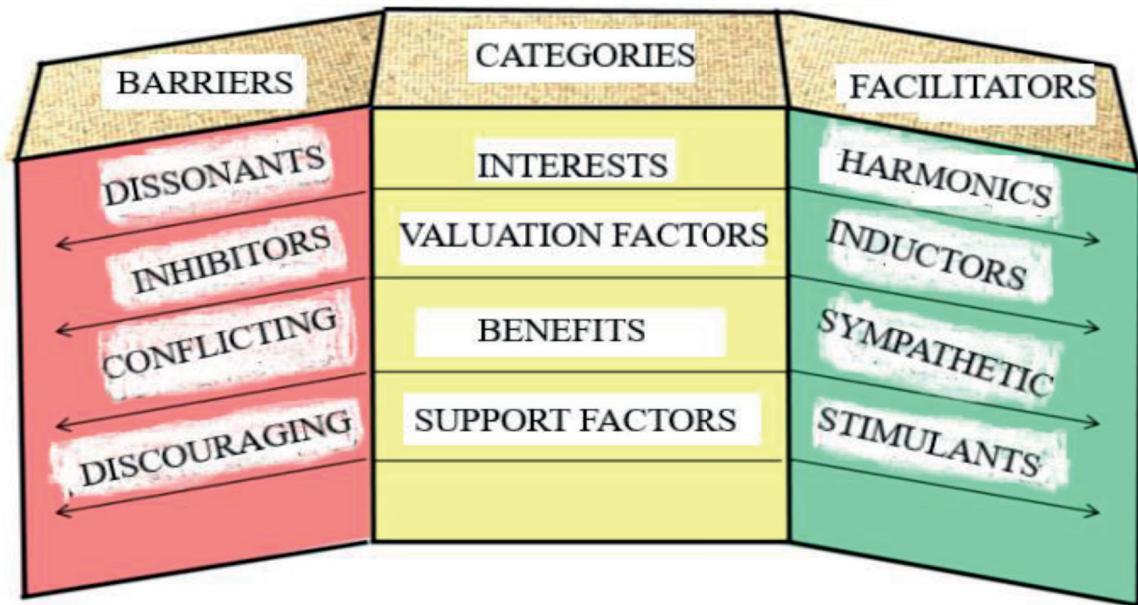
In the content analysis (AC), the systematization of the data includes the necessary rigor to the research, and at the same time, a flexibility of rules that allows apprehending in the discourses, the values, beliefs, opinions and feelings of the participants, that were indispensable to the in-depth understanding of the organizational culture and innovation processes.

#### 4. ANALYSIS OF RESULTS

The bibliographic analysis of the collected material made it possible to identify a mass of elements, which was presented in the theoretical reference, along with the apparent SIS-Def (Defense System) model, described in section 2.3. With these data, the procedures of variational and transformational analysis were performed, described in the structuralist method, where it was possible to vary the elements in positioning in the structure, to replace them and eliminate those that were not essential to the model, opening the way for the unveiling of the structure underlying to be unveiled.

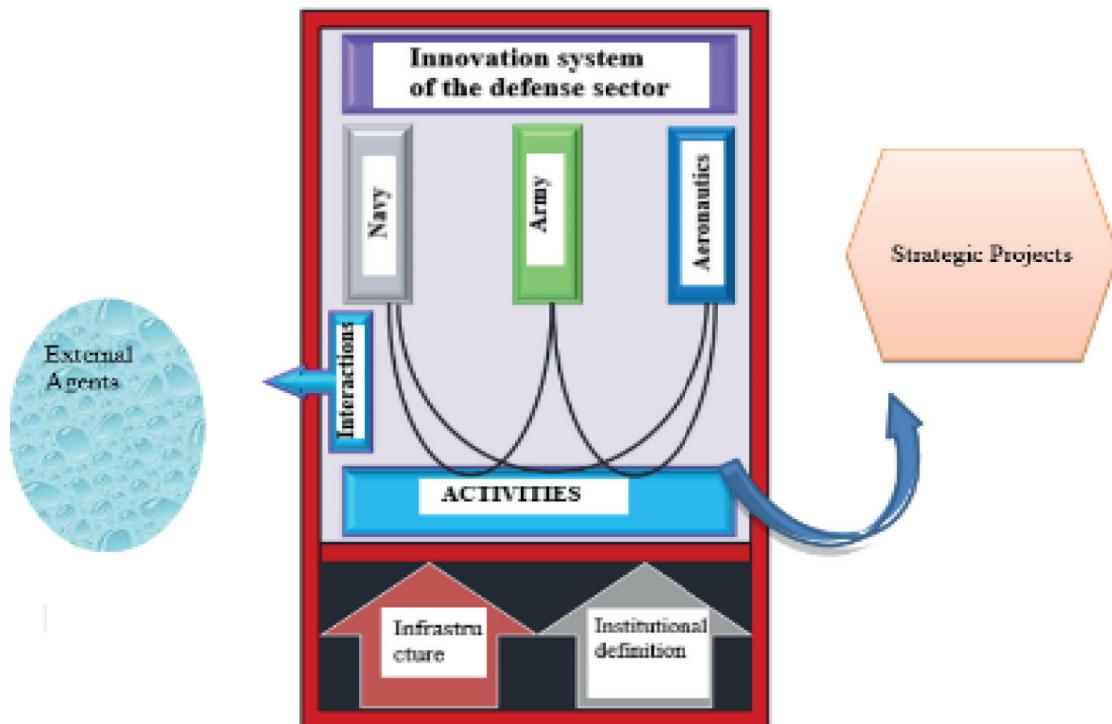
As a result of this first analysis, categories emerged and, at first, they were consolidated in five (5) groups: agents, innovation processes, infrastructure to develop strategic projects, facilitating aspects of the innovation process, and barriers to innovation.

However, throughout the research, as the interviews occurred, we felt the need to subdivide each of these categories into binary subcategories. Thus, as observed in the picture below, it can be said that the data collected were grouped in 8 (eight) binary categories: interests of the agents (dissonant and harmonic); value factors or values (inducers and inhibitors); support factors (stimulants and discouraging); and benefits of alliances (solidarity and conflict). The latter ended up undergoing new variations, as will be seen below.



Picture 5: Synthesis of the category scheme

Source: Elaborated by the author



Picture 6: Analysis Scheme of SIS-Def (Defense System) - Source: Elaborated by the author, based on Freeman (1995)

## THE ELEMENTS OF ANALYSIS OF THE CULTURE OF INNOVATION IN THE DEFENSE SECTOR AND ITS THREE-DIMENSIONAL MODEL

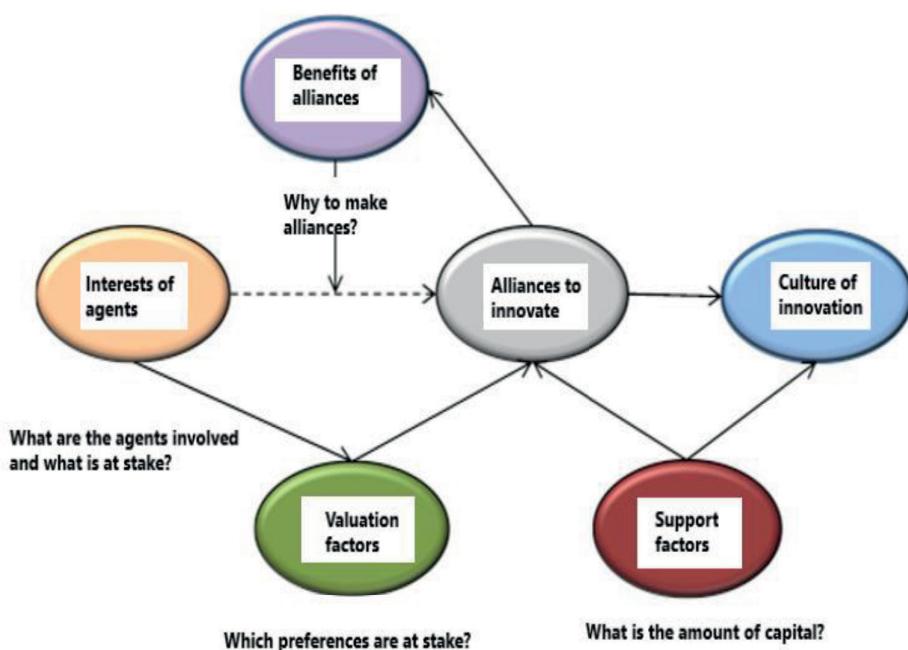
In parallel to the field surveys, the data were analyzed according to the following scheme, based on the concepts of Freeman (1995), Malerba (1999, 2005) and Edquist (2001, 2005) (Picture 6).

In the picture 6, it is possible to visualize the following elements: agents internal to SIS-Def (Navy, Army and Aeronautics); external agents (BID - Industrial Defense Base, IES - Colleges and others); the activities (demand, selection and implementation, etc.); the interactions; strategic projects; the C & T (science and technology) infrastructure; and institutional definition. In relation to these last two aspects, Lundvall (1992) argues that they support activities and interactions.

Following the structuralist protocol, proposed by Cherques (2006, 2008), to arrive at the underlying structure, we also proceeded to the determination of elemental syntagmatic and paradigmatic relations. According to the above author, *syntagma* is a chain of relationships between elements. Each element of a phrase is understood in relation to another element.

In turn, a paradigm is a set of interchangeable elements in the same position of the structure to which it belongs.

The construction of the model was based on the concrete reality, observed by a single Point of View (innovation system), from which the mass of elements was raised, and also the elements integrating the apparent model (Picture 2). As recommended by the protocol, this choice obeyed one rule: being able to clarify which *habitus* present in the process of interaction between the main agents of innovation in the Defense sector. From this point of the research, there was the separation of the concrete empirical. According to the method, an underlying model is not something that really exists, but a logical schema of what is possible to exist, that exists in mind, that exists as a concept or that exists ideally. After following these steps, several models were elaborated, which were tested throughout the research. The model of the picture below was what had homology with reality.



Picture 7 – List of elements that constitute the culture of Innovation

Source: Elaborated by the author

In the model, it is observed that the innovation fundamentally depends on the interactions (*Alliances for innovating*) among the agents of an innovation system. Thus, the greater the intensity of alliances (interactions) established, a greater maturity the system will obtain and, as a consequence, a better performance it will have. In turn, the *Alliances to Innovate* are influenced by the *Interests of the Agents* and by capital (*Innovation Support Factors*) available and offered by the agents that are interacting.

The *Interests of the Agents*, in turn, are influenced by the values (*Valuation Factors*) that are present in the organizational culture of each agent, acting as inducers or inhibitors of *Alliances*. The more *Innovation Benefits* are visualized, the more Interests will be awakened to the accomplishment of *Alliances*.

Analyzing the strategic projects studied in this research and the interviewees' speech, it was observed that innovation does not occur simply by establishing interactions. *Alliances* alone do not leverage

innovations. There is a need for *Innovation Support Factors* (FSI) to be present in the synchronous cut. The better positioned the agents are in these factors, the more motivation there will be to seek cooperation, that is, agents with debilitated FSI (Innovation Support Factors) do not stimulate the formation of *Alliances*.

It is important to note that *Interests* also influences or has the potential to influence the formation of *Alliances*, but that does not mean they are focused directly on partnerships. The focus of the *Interests* is in the innovation and thus can be achieved without the need for partnerships (alliances). While the interests of agents can be achieved without the need for partnerships, the benefits are derived from them.

Cherques (2008) argues that for a structure to exist, what counts is the existence of *Elements* which are related to each other, according to the laws of inclusion. Each *Element* of the structure is dependent on the others and is determined by their relation to them. The amendment, addition or deletion of an *Element*, implies accommodation and readjustment in the position of the others. In order to define them,

"we must rely on our intuition, on the feeling that, under the visible, immediately justifiable set, there are structures that are not manifested." (CHERQUES, 2008) Each element of the underlying structure will then be conceptualized.

*Field research has indicated that the "Interests of the Agents or Illusion"* are the motivations of every order mobilized when the agent intends to innovate. The question that is asked to understand the term is "*What are the Agents' Interests when they are seeking to innovate in the Defense sector? What is at stake?*".

The preconceived connotation of the word "interest" is disregarded here. Individual, organizational, sectoral (group) and governmental interests were identified.

When evaluating the interviews in light of the strategic projects of the Defense sector, it was noticed that the interests were grouped into two categories: **harmonious interests**, and **dissonant interests**, when the interests of the agents collide. A list containing some interests raised in the survey is found in Tables 4 and 5 below.

**Table 3 – Interests that are common to all agents and levels**

<b>MAIN INTERESTS THAT ARE COMMON TO ALL AGENTS AND LEVELS</b>	
<ol style="list-style-type: none"> <li>1) To expand the country's dissuasive power through a strong Defense industry and well-equipped Armed Forces.</li> <li>2) Strengthening of the Ministry of Defense (MD) so that it acts as a leader in the innovative processes of Defense.</li> <li>3) Strengthening of the BID (national and foreign industries).</li> <li>4) To develop a culture of innovation.</li> <li>5) To promote joint courses of Defense in the universities or in the company.</li> <li>6) To strengthen national defense thinking and broaden the debate on the issue.</li> <li>7) To increase the realization of events and C &amp; T (science and technology) activity.</li> <li>8) To move forward on the issue of knowledge protection and intellectual property.</li> <li>9) To develop common projects among the main actors of the innovation system.</li> <li>10) For the development of projects in partnership with other nations.</li> <li>11) To foment the formation of jobs in the Defense sector.</li> <li>12) To contribute to the opening of new Defense markets (exports).</li> <li>13) To encourage the production of materials with dual technology (civil-military).</li> <li>14) Technology transfer (mechanisms, debates, and incentives).</li> <li>15) Standardization of materials for the Armed Forces.</li> <li>16) Long-term ordering policy.</li> <li>17) Tangible and intangible rewards (royalties, a scholarship to the researcher, promotions, etc.).</li> <li>18) Reduction of the decision-making cycle.</li> <li>19) The flexibility of deadlines for P, D &amp; I (flexibility x control).</li> <li>20) To increase the level of employee/employee / military satisfaction.</li> <li>21) To increase in material assets (materials and equipment).</li> <li>22) To offer better products and services to customers.</li> <li>23) Expansion of the amount of research related to defense in universities.</li> <li>24) To contribute to the development and expansion of the</li> <li>25) Development of the country's educational, military and industrial sector.</li> <li>26) Strengthening the image of the institution (Armed Forces, Universities).</li> </ol>	

Source: Elaborated by the author

THE ELEMENTS OF ANALYSIS OF THE CULTURE OF INNOVATION IN THE DEFENSE SECTOR AND ITS THREE-DIMENSIONAL MODEL

Table 4 – Specific agent's interests, separated by levels

MAIN SPECIFIC INTERESTS OF AGENTS BY LEVELS				
Individual interests	Military Interests	Business Interests (BID)	Colleges (IES)	Government Interests
Improvement of working conditions in the organization.	To develop technological intelligence system for Defense.	Development of competitive advantage.	Improvement of the training of military engineers for the Armed Forces and for the Country.	To promote the country's development, democracy, and social peace.
To work on PRODE (defense product) project and development.	Expansion of the operational capacity of the Armed Forces.	Increased support for the national industry.	Greater approximation of the civil academic environment with the military.	To expand the country's perception of security and sovereignty.
Professional recognition.	Modernization and strengthening of military power.	Search for immediate return and profit.	Sponsorship of chairs by companies.	To maintain the integrity of the national patrimony.
Participation in the innovation decision-making process.	Control of the C & T (science and technology) department by the operational segment (end x half).	Reduction of levels of customer urgency in product development (deadlines).	To train students from different fields of knowledge for defense industries.	To accelerate economic growth (PIB - Gross Domestic Product) and maintain the balance of the country's trade balance.

MAIN SPECIFIC INTERESTS OF AGENTS BY LEVELS (continued)				
Individual interests	Military interests	Business Interests (BID)	Colleges (IES)	Government Interests
Satisfaction in contributing to the organization's aggrandizement.	Development of high-performance military products.	To create a stronger call for Defense by knowledge sectors.	To contribute to the Armed Forces through research and innovation.	Economics, military and scientific-technological development.
Professional growth (search for better opportunities).	Maintenance of linked strategic companies (companies: IMBEL and ENGEPROM).	Increased support for innovative companies.	To contribute to society through the training of qualified professionals.	Projection of military power as a dissuasive factor.

Source: Elaborated by the author

The element "**Alliances to Innovate**" represents the establishment of interactions between each of the main agents of innovation in the Defense sector, and may occur at the inter-organizational level, intraorganizational level or even between individuals. In the Defense segment, such interactions can occur in a number of ways. The most common are: partnership, cooperation, collaboration, agreements, compensation agreements (Offset; industrial compensation), informal methods and others.

But in relation to the "**Alliances Benefits**", they are the concrete results of establishing the alliances or are views of possible outcomes. That is, they come from or necessarily result from interactions. For example, when alliances are established, they generate the benefit of sharing risks and resources. The question you ask here is "*Why to establish alliances when the goal is to innovate?*". The tables below present a list of the main *Benefits of Innovation*.

**Table 5 – Common benefits seen by agents**

<b>MAIN COMMON BENEFITS VISIBLE BY AGENTS</b>
<p>1) Absorption of managerial capacity in other institutions.</p> <p>2) Training of human resources with other institutions.</p> <p>3) To absorb or use qualified labor from other agents.</p> <p>4) To take advantage of technologies external to the organization for the development of innovations.</p> <p>5) To increase the mutual knowledge among the main agents of the sector with respect to the innovations in the sector.</p> <p>6) To enable the exchange of knowledge and experience.</p> <p>7) To share the efforts and fruits of innovative research.</p> <p>8) To share laboratories and other resources.</p> <p>9) To share costs and risks, without increasing personnel or significant organizational changes.</p> <p>10) To get joint funding for surveys.</p> <p>11) Training of human resources for the Defense sector through cooperation.</p> <p>12) To bring the Defense, Government (FA - Armed Forces) and IES (colleges) industries closer together, strengthening the interactions between the main agents of the innovation system.</p> <p>13) To contribute to the strengthening of the defense industry through cooperation.</p> <p>14) To contribute to the strengthening of higher education, particularly in defense matters.</p> <p>15) To stay as an innovative company / institution.</p> <p>16) To access to public resources only available through cooperation.</p> <p>17) To cooperate with the development of new technologies for the Defense sector, contributing to increase the dissuasive power of the Country.</p>

Source: Elaborated by the author

**Table 6 – Specific benefits seen by agents**

<b>MAJOR SPECIFIC BENEFITS VISIBLE BY AGENTS</b>				
<b>Individual interests</b>	<b>Military interests</b>	<b>Business Interests</b>	<b>Colleges</b>	<b>Government Interests</b>
An increase of self-esteem by contributing to the development of innovation.	To get new knowledge about the production process.	Prioritization of area of common interest in P & D (research and development).	Financing of researches with industry resources.	Defragmentation of the national and sectoral innovation system.
Personal satisfaction with innovation development for organization.	To search for college experts.	Possibility of joint financing in an area of common interest.	To enable the renewal of laboratories and infrastructure.	Development of strategic sector in C, T & I (Science, Technology & Innovation), with overflows to other sectors.
To know different methods and techniques for practicing the profession.	To receive and transfer technology.	To expand knowledge about the demands of FAs (Armed Forces).	Financing of researches with government resources.	To develop productive sectors of high performance in science, technology and innovation.
Opportunity to expand tacit knowledge.	Development with the highest index of nationalization possible.	Access to highly qualified and specialized human resources	Maintaining the training of researchers in Defense matters.	To develop dual technologies with government resources.
The professional recognition of the involvement with innovative processes of the institution (personal image).	Defragmentation of the innovation sector system (SSI).	Access to new knowledge or qualified researches	Training of human resources with other institutions.	Increase in the trade surplus due to the export of high value-added products resulting from defense innovations.

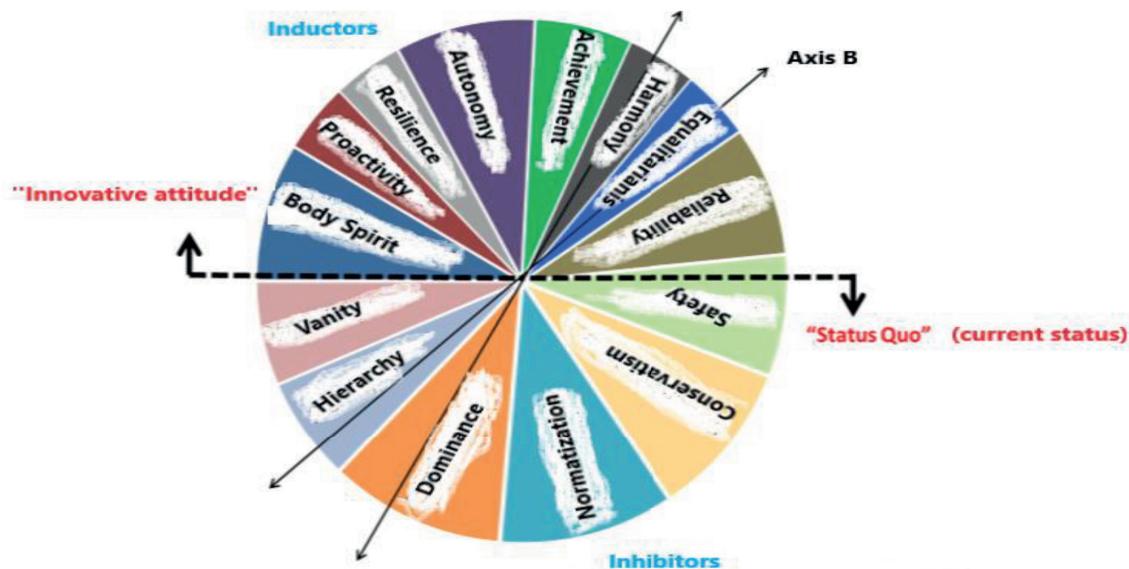
Source: Elaborated by the author

## THE ELEMENTS OF ANALYSIS OF THE CULTURE OF INNOVATION IN THE DEFENSE SECTOR AND ITS THREE-DIMENSIONAL MODEL

In turn, the "**Valuation Factors for Innovation (FVI)**" guide the preferences of the agents, be they social or individual, in their interests in interacting and cooperating. They can be classified as **inductive values and inhibitory values**. The questions here are: *what are the preferences of the actors when you want to innovate? Based on what values are decisions made to innovate?*

Based on the methodology adopted by Oliveira and Tamayo (2004), Tamayo, Mendez, and Paz (2000), Tamayo and Schwartz (1993) a list of values was

elaborated, that were grouped in order to compose fifteen **Valuation Factors for Innovating (FVI)** in the Defense sector. In Picture 8, there is a dashed line that subdivides the factor groups into two parts. The **Values** located above that line are those that induce agents to an innovative attitude and, at the bottom, those who tend to keep the Agents in *Status Quo (current status)*. The study of these values was very useful for the achievement of this research. The significance of each evaluation factor of this was identified in existing publications in FA (Armed Forces) (BRASIL, 1980, 2014b, 2014c, 2016d, 2016e).



**Picture 8 – Structure of the Valuation Factors for Innovation.**

**Source:** Elaborated by the Author based in Oliveira e Tamayo (2004).

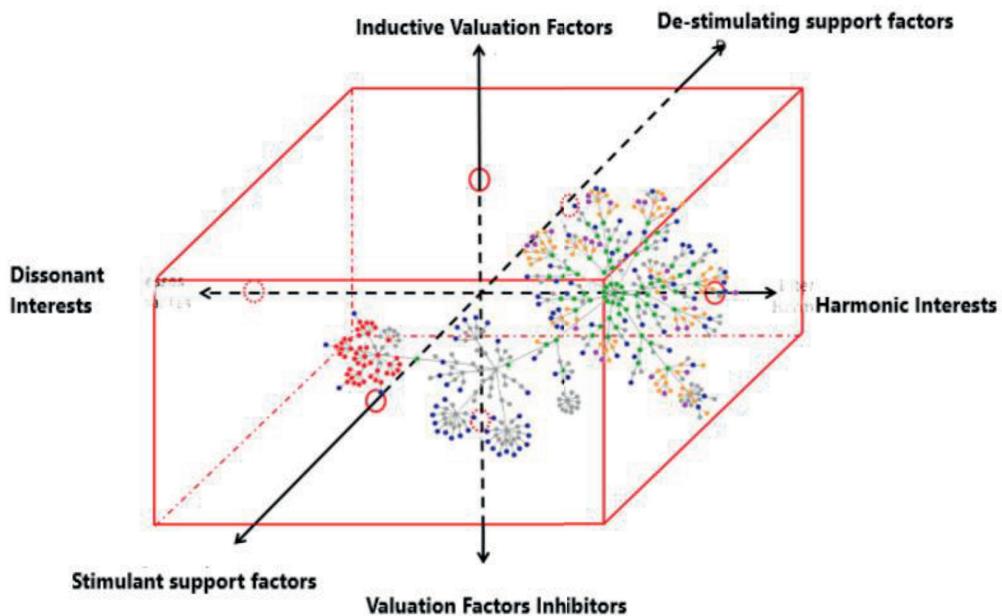
In the end, the "**Innovation Support Factors**" are constituted by physical, human and organizational aspects that allow creativity, learning, and teamwork in the innovation system of the Defense sector. It seeks to understand "*What is the value of capital at stake?*". According to the research, these support factors are influenced by the **Production Structures (What I have)** and **Institutional Definition (what I want)**.

As data for this category were collected, it was observed that they could be grouped into the categories proposed by Lundvall (1992) and Tidd, Bessant, and Pavitt (2008, page 486). Thus, the data consolidated in the following support factors are *Physical infrastructure for innovating; High management commitment; Organizational structure; Key individuals; Continuous individual development; Extensive communication; Teamwork; Learning with the environment and people management*. Each of them can contribute to the innovative process (**Stimulating Factor**), or inhibit the same

(**Discouraging Factor**).

The three-dimensional representation of the five elements of the innovation culture (Picture 9), too, can help to understand the relationship between them and thus facilitate the analysis and management of the system. The three axes of the three-dimensional model are: the axis of Interests (*Harmonic and Dissonant*); the **Valuation Factor** model (**Inducers and Inhibitors**); and the model of the **Support Factors** (**Stimulants and Disinhibitors**).

Understanding the importance of interactions (alliances) for the innovation process, the model establishes alliances and their benefits in the focus of the innovation culture. The other elements act on the structure in the function of these interactions. For this reason, in the picture, the **Benefits** are grouped as graphs. Each of the graph nodes represents a **Benefit**. Its positioning varies according to the intensity with which each of the other factors (FSI, FVI, and interests) attracts it.



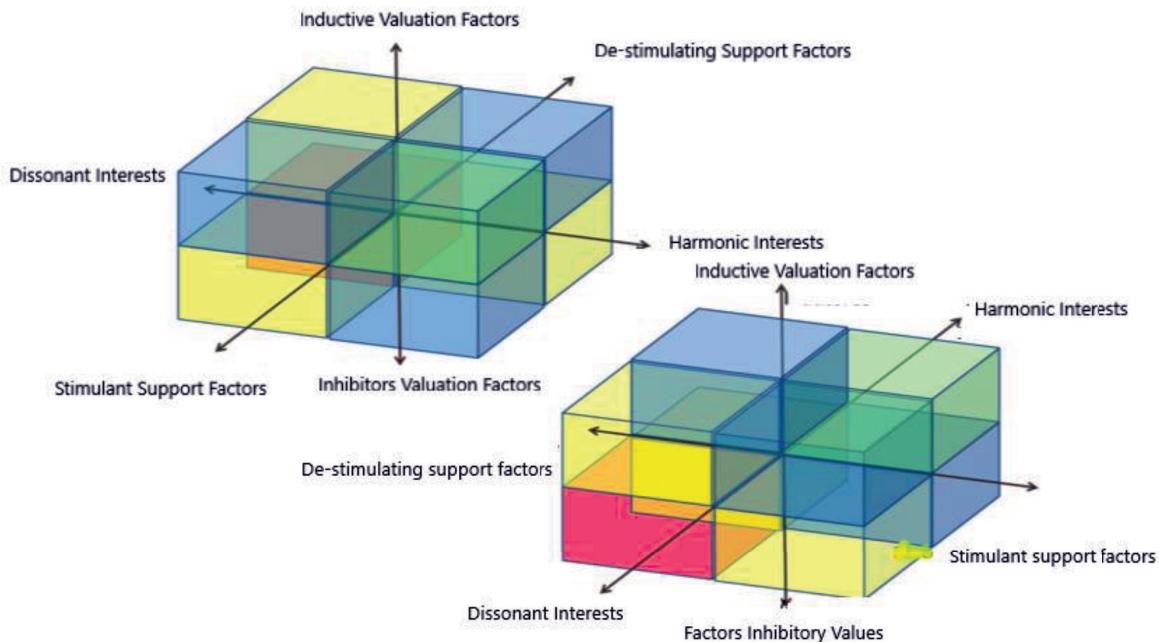
**Picture 9 – Three-dimensional representation of innovation culture (innovation tetrahedron)**

Source: Franco-Azevedo (2013)

It is important to emphasize that the three-dimensional model was elaborated during field research. When analyzing the strategic projects of the Defense in the light of the unveiled elements, it was realized that the interactions and innovations were more intense or frequent, according to a set of elements that were present in that synchronous cut.

The analysis tetrahedron can be subdivided into 8 (eight) quadrants and 6 (six) faces, as can be observed in Picture 10 (Tetrahedron of Innovation).

It is possible to verify that each of the 06 (six) faces of the cube has four parts, whose color varies according to the intensity of the factors in the axes (green, yellow, blue and red). The better positioned in *Harmonic Interests*, *FSI (Innovation Support Factors)* *Stimulants*, and *FVI (Valuation Factors for Innovation) Inductors*, for example, the greater the intensity of the interactions to innovate (green quadrant). The more positioned at the opposite ends, the worse the alliance flow (red quadrant).

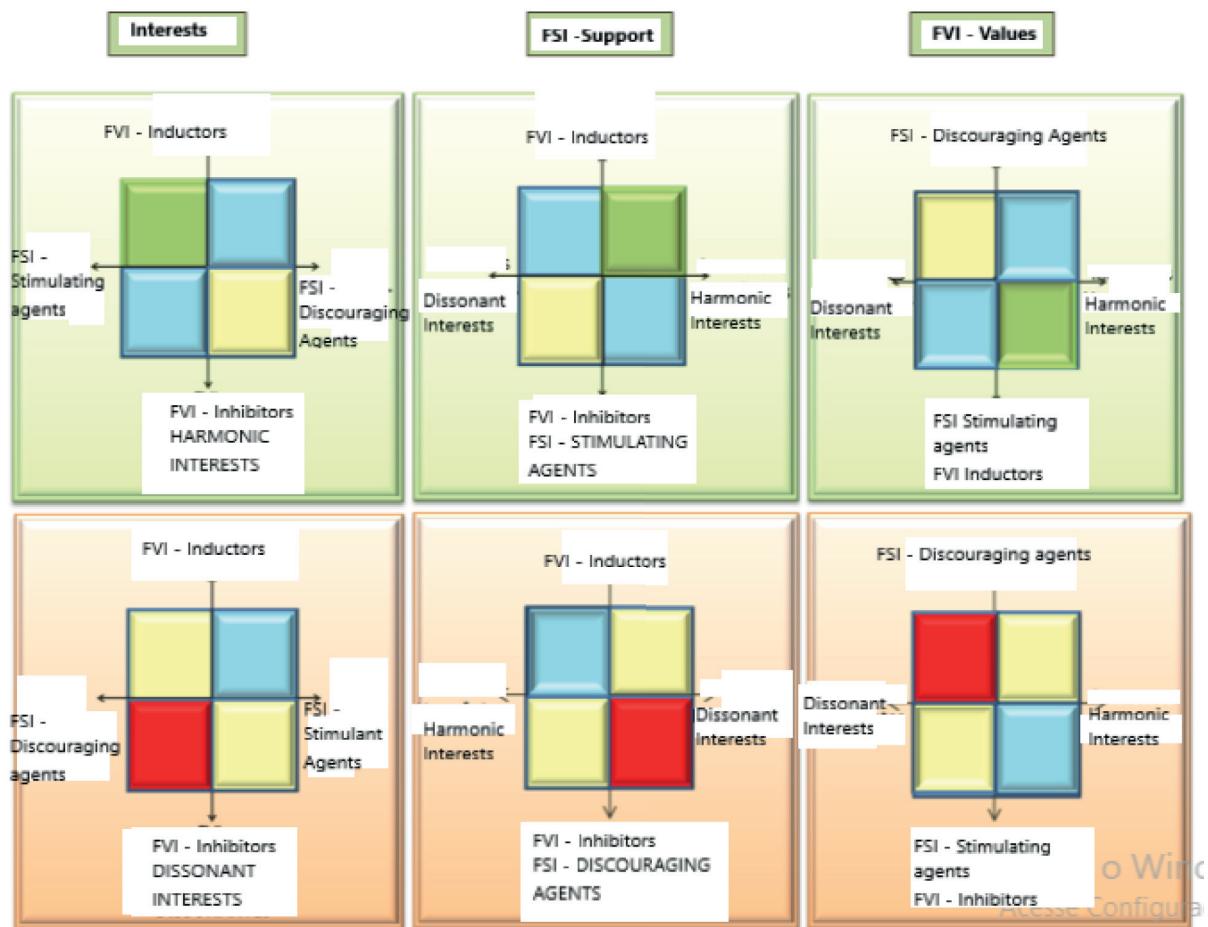


**Picture 10 – Two faces of the Tetrahedron of Innovation**

Source: Elaborated by the author

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The picture below reflects the six unfolded cube faces. The top greenish faces are the so-called clear faces of the cube and the undersides are dark faces. In the clear, opportunities for interactions and innovations are more evident, as there is a greater concentration of favorable elements.



**Picture 11:** Six unfolded cube faces

**Source:** Elaborated by the author

The table below summarizes the expected behavior in each situation or quadrant and Picture 11 helps to understand the positioning of the benefits in each quadrant.

**Table 1 – Expected Behavior for Alliances and Innovations**

QUADRANT	BENEFITS (Visualization)	ALLIANCES	INNOVATIONS
Green	Clearly viewed	Potentialized	Maximized
Blue	Visualized	Recommended	Facilitated
Yellow	Weakly viewed	Possible	Hindered
Red	Difficulty viewed	Disapproved	Occasional or Forced

**Source:** Elaborated by the author.

In the green quadrant, for example, the benefits are clearly visualized, thus alliances are maximized and, as a consequence, maximized innovations.

## 5. FINAL CONSIDERATIONS

The objective of this work was to unveil the underlying structure, which, in a hidden way, supports the existing innovation culture in the sector, which can be translated into an opportunity to increase the flow of interactions in the innovation management system of the Defense sector (SIS-Def).

The results indicate that the culture of innovation in the Defense sector can be analyzed by means of 5 (five) elements: the interests of the agents (*illusio*); the value factors of innovation (*valorem*); the factors of support (*capitis*); alliances to innovate; and benefits seen with alliances (*Beneficium*).

It is not a simple task to manage a complex system, whose results depend heavily on the flow of interactions. Research has shown that there needs to be an organizational culture that inspires confidence, the spirit of body and ability to work together, accepting and understanding the different interests of each of the agents (*Illusio*). Mutual knowledge and the area *habitus* facilitate negotiations and help each actor understand and accept what is at stake.

The potential benefits that alliances will bring (risk sharing, infrastructure utilization, etc.) are essential, but not sufficient to ensure greater interaction between agents. The clearer the benefits are visualized (*Beneficium*) of the cooperation, the easier to establish partnerships for innovation (*Alliances*).

The interests come from the preferences at stake. The Valuation Factors of Innovation (*valorem*) present in the organizational culture influencing the behavior of the actors. As it has been contacted, there are values that induce and inhibit the innovative attitude in the Defense sector. One way of managing the innovation culture in this sector is to develop a set of factors that facilitate innovation and minimize the effect of those that induce the maintenance of the *Status Quo* (*current status*).

It is important to emphasize that the factors that support innovation (FSI - Innovation Support Factors) are essential to broadening the flow of interactions, which will be intensified when agents are well positioned in these factors (*Capitis*).

The research also presented as results the concepts of Innovation and Innovation Systems in the Defense sector. In this path, the main finding is that technological innovations (*inovatec*) depend on non-technological or doctrinal innovations (*inovadout*) and vice versa.

Additionally, the three-dimensional model of analysis was presented, which may be useful to understand how the elements of the structure relate.

In the end, the underlying structure unveiled, containing the elements identified in this research (*Illusio*, *Valorem*, *Beneficium*, *Alliances* e *Capitis*), opens the way to the understanding of how to manage the organizational culture present in the Military Expression of Power, and with that, contribute to the ongoing transformation process in Defense, which depends fundamentally on an innovative attitude of the agents.

The expansion of the interactions will provide an opportunity to defragment and re-articulate the SIS-Def, which will benefit the Defense Industrial Base, whose strengthening will also expand the country's dissuasive power.

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